PRE – CONFERENCE VERSION

EXCLUSIVELY FOR ETHIOPIA TRIPLE HELIX CONFERENCE

Not for public and general distribution
Document is subject to final revision before public release

The Entrepreneurial University and the Future of Higher Education in China

Chunyan Zhou and Henry Etzkowitz

Abstract: A theoretical model of triple helix field interaction will be created, to develop a method to differentiate institutional spheres of triple helix and interaction space among three helices. The framework views each helix as a model with a central core and outside field space. It explains that the difference between spin-offs in US and university-run enterprises in China, and where three helices of university-industry-government triple helix interact. Thus, we try to find a cornerstone for quantitative or half-quantitative resolution of the interaction strength. Based on the theoretical model, as well as the comparison of university system, government policies and laws, R&D investment, industrial firms between US and China, this paper explores some future tendencies of entrepreneurial university and higher education in China.

Key Words: triple helix – field interaction, entrepreneurial university, university-run enterprises, higher education in China

Introduction

Chinese universities are in the midst of transition from teaching to research and entrepreneurial modes of academic organization. This academic transformation is influenced university by transition from a Statist society in which government controls academia and industry to a Triple Helix society in which each sphere is relatively independent of the other. This format is hypothesized to provide the optimum conditions for innovation, the lack of capacity of existing industry to absorb technological innovation also affected the early stages of the transition. That government reduced funding for the universities were also encouraged to replace the missing funds by using their resources to start businesses. These business activities, however, remained within the universities rather than being spun off as independent firms. Other government agencies, including the army, also established subsidiary enterprises.

A similar process of creating enterprises from available resources took place in Eastern Europe，when research institutes lost most of their government funding after the demise of the Communist regime. However, in the abrupt transition from a statist to a laissez-faire regime the sponsoring organizations lost most of their resources and were typically not able to provide significant support to grow these enterprises.

In the Chinese context, a few of universities created some of the largest and most successful high tech enterprises in the country. However, rather than spin-offs as independent

entities, they remained part of their originating organizations until quite recently. This created problems for their sponsors since as an independent legal system took hold, dissatisfied consumers or business partners gained the right to sue for redress. Since the enterprises remained the ownership to the universities, it placed them at risk. To redress this anomaly, government has recently taken steps institutionally to separate university firms from their academic source.

This paper attempts to explain an apparently idiosyncratic university-industry relationship by analyzing the interaction among university-industry and government in China. We hypothesize a theoretical framework for the interaction of university-industry-government, as three helices , viz., theoretical model for triple helix – field interaction, to differentiate their institutional spheres ("internal cores") and interaction space ("external field"), and think that the lack of a "field" space around each institutional sphere made the transition of industrial activities for the university to industry difficult, if not impossible. Transfer is dependent upon networks among institutional spheres and organizational mechanisms whose objective is to carry out these translation activities. When the space is missing and formal and informal mechanisms are lacking, when a new activity is undertaken it will tend to remain within its place of origin. The advantage of this model is the ability to create high growth firms by keeping them within the university for a longer gestation period than is commonplace in the US. A field theory of the Triple Helix we develop in the following, is also used to analyze development of an entrepreneurial university during the early stages of transition from a Statist regime

Theoretical Model for Triple Helix – Field Interaction

A triple helix of university-industry-government relations based upon independent, overlapping institutional spheres in which each can interact freely and "take the role of the other" has been identified as form of social organization that is highly conducive to innovation. However, this model lacks precise indicators and measurement techniques. We drew upon science-technology field theory from physics, in order to develop a method to analyze the nature of interaction between science and technology and measure its strength.[1] Now we used it to explain the nature of the institutional spheres (university, industry and government) and the interaction among them.

In physics, the space distribution and change of a physical variable (temperature, force, velocity, etc.) are often involved in physical processes. In order to explore the laws explaining the relationship among these variables, the "field" concept was introduced from mathematics to physics. Thus, if there is a corresponding value at any point to all of the space or part of it, the field of this variable will be confirmed in the space. We further import the field concept from physics to the social sciences in order to advance the understanding of triple helix phenomena. Thus, both a qualitative and quantitative (or half-quantitative) investigation can be conducted.

Three helices describe the dynamic relations among university, industry and government.

However, the introduction of field interaction can help explain where the helices interact and why they form a dynamic triple helix. Triple helix – field interaction, depicts the triple helix as a model with an internal core and external field space (Figure1). We also discuss the issues of transition from a statist triple helix model in which government is the dominant institution. It will be showed how field theory can account for the development of a university-industry -government triple helix as they gain their freedom of action rather than assuming a direct shift from a statist model to an overlapping one (Figure2).

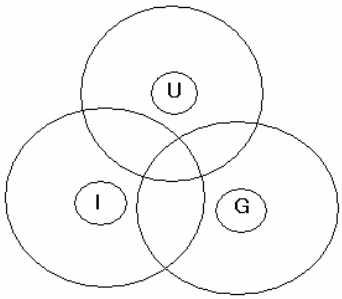

Figure 1 Theoretical Model of Triple Helix-Field Interaction

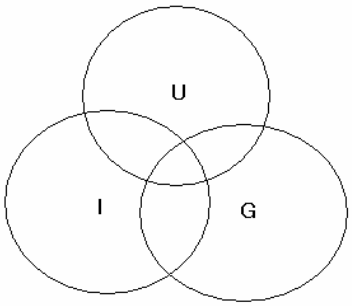

Figure 2 University-industry-government Triple Helix

In fact, three institutional spheres act as independent social institutions. They are essentially different, needing to keep their separation from each other, even as they interact as in US. If one sphere entirely subsumes the others, there will be no space for independent action. Until the spheres attain a clear core identity, if there is some overlapping, it will result in confusion of the relationship among three spheres. For example, in China, some baby firms of university (university-run enterprises) and some government-ownership firms have emerged. University and government both want to directly participate in getting profit from the market through establishing their own firms and producing and marketing goods.

Therefore, an overlapping model and a field one are quite different. The former gives rise to a misunderstanding of the triple helix relationship until university and industry have attained a core identity. Only then can the three spheres embody each other without confusion of roles.

The theme of the triple helix concept is that university-industry-government each keeps relatively their own independence and each sphere has the functions of the other two, that is, in external field space (in function), they can overlap, but not in the core area (institutional sphere). In this way, the difference and relationship can be treated respectively. Therefore, to keep independence embodies internal core area and the interaction function is reflected in the area outside the core, i.e., field space.

Thus, university-run enterprises in China should be in the core area of university, rather than external field space, unlike spin-offs in US. The later comes from the mother university but independent to it institutionally, only interacts with it in the triple helix field space.

As long as a field exists, there is energy around it and the field can act upon its surroundings. In an electric field, for example, the action on charges put in a field space is

represented by the force of an electric field. The endured force per unit charge is defined as the intensity of the electric field, describing the strong or weak degree that the field acts to the charge. In triple helix field, intensity of field can also be introduced, meaning the degree that three helices act to promote innovation activities in the field.

In physics, intensity of field around a charge can be formulized: $E=\frac{kQ}{r^2}$, in which k is a constant; Q represents the amount of the charge, with a unit Coulomb; r represents the distance between a point in the field space and the charge. Thus, the larger Q is, the larger r also is; the larger Q is, the less E is. If we can find the corresponding "Q" or "r" and optimum values of them, then in theory, the optimum intensity for the interactions in question could be determined.

Triple helix field gives rise to intensity of interaction at a point of field space. If E represents it, and Eu, Ei, Eg represent the intensity of university, industry and government receptively, then E = f（Eu，Ei，Eg, C），C in it is the other affection. The relationship among them is showed in Figure3.

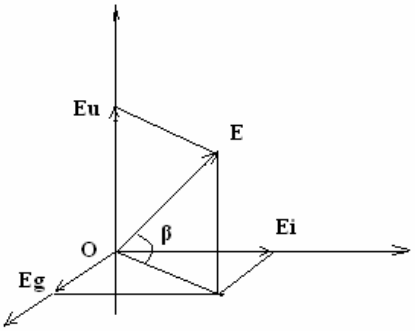

Figure 3 The Intensity of Triple Helix Field

Eu, Ei, Eg decide the result of triple helix model for innovation. If one of them is too strong or weak, an ideal triple helix can not be formed. Therefore, for statist triple helix model, in which government is too strong, it will form a circumstance that other two helices turn around the other one, rather than a healthy triple helix. For laissez faire model, the interactions among three helices are too weak, so there is not enough force to integrate them. It is not an ideal triple helix model, either. Thus, the key to achieve an ideal triple helix of regional innovation is to create relatively independent and balanced three helices through analyzing the lost or weak factors in a region, that is, "gap".

Although the factors to decide the intensity of each helix are complex, the most important includes the R&D capability and financing ability of university; in industry, investment in R&D activity and absorptive capacity; feasibility and effectiveness of government support by policy and laws, or by direct investment. Among the three helices, industry is closest to the market and production practice. In general, it is the main actor or subject in innovation. Sometimes university can be an organizer or subject for innovation. But government shouldn't be involved in it directly.

All of the three helices, in China， have serious deficiencies, especially industry. In this case, university becomes the important actor for high-tech industry through setting up various university-run enterprises. Government, including those at national, province and city levels, participates in economic activities through its sectors. For example, light industry bureau is not only responsible for administration of the sector but also has some affiliated enterprises. As a result, every sphere entered the market, thus making it disordered. How can the government with original role to regulate and supervise the market deal with the firms run by itself? Can universities resolve the tension among teaching, research and creating/running enterprises? What is a university's nature? In other word, is the third mission of university to foster development of industry, or to run some enterprises like industry ?

The problems above arise from the core area. There is no boundary among three core areas at all. The institutional spheres lost independence character here. On the other hand, for this reason, it is very difficult for the spheres to interact in the external field space, for the confusion of actors or status inevitably results in the configurable gaps of its functions. Each helix can not acknowledge its own specific missions and play its role very well. The problem is that the firms which have enterprise characteristics grow in university or government since there is not a clearly defined "spin-off" path.

Entrepreneurial University: Definition and Characteristics

According to the theoretical model of triple helix- field interaction, outside of the helices, there is a triple helix (field) space, with various hybrid organizations, such as science park, spin-off (in US), university-run enterprises (in China), incubator, etc. They come from the interactions between university and industry. Why can university-industry affinity take place? The radical reason is conformance of the objects or reciprocity, that is, both of them aim at innovation, the first business application for science findings or technology inventions. In a knowledge-based economy, knowledge has replaced material, labor and capital, becoming the most important factor of production. Not surprisingly, university, as producer for knowledge, and industry, as user for it, need each other, forming a common goal.

Nevertheless, a relationship to industry is a necessary condition for an entrepreneurial university, but not a sufficient one. An entrepreneurial university is not an only a university with many industrial entrepreneurship activities. It has own meaning and characteristics. In the West, entrepreneurship activities of a university typically include four aspects: (1) entrepreneurship education: to organize teaching through facing to needs of industry, encourage students to form start-ups, tell them how to do it; (2) consultation for industry; (3) technology transfer from university to industry; and (4)spin-offs: firm formation.

In practice, a university has the potential to engage with the development of industry, no matter its level and type. However, different universities have different education goals and missions. Universities in various levels and types meet different societal needs. The teaching university is based on education and engagement with the personnel market; the research university engages production of knowledge, as well as teaching; the entrepreneurial

university has three missions: teaching, research and service for society. In fact, only the entrepreneurial university can participate in the whole society's innovation effort to improve the interaction process of the triple helix. See Figure 4.

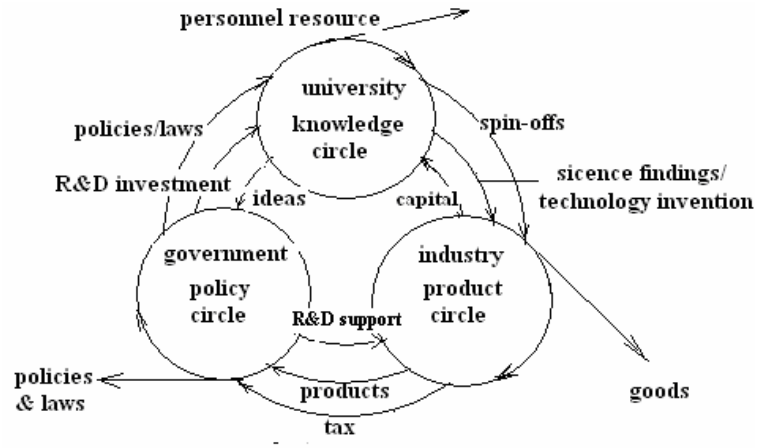

Figure 4 Triple helix -field interaction circles

In our opinion, an entrepreneurial university must have three primary characteristics:

- Entrepreneurship activities are accepted and supported systematically.
- There are interface mechanisms e.g. a technology transfer office, such as Office of Technology License (OTL) and corresponding achievements.
- There are significant numbers of staff members to form firms, which can receive considerable income to support university's research and other activities.

Thus, only the third and fourth among entrepreneurship activities of university above represent the characteristics of entrepreneurial university, not the first two. Of course, an entrepreneurial university still has other entrepreneurship activities in question.

Comparison between University-industry-government Systems in China and America

As a whole，the intensities of university, industry and government field are all very strong. On one hand, it is because innovation and creation spirit in traditional US culture, on the other hand, American has recognized the benefit of technological innovation, since World War II. The idea that basic research is an engine of technological innovation from V. Bush is rooted. The science policy from Bush's report, *Science : Endless Frontier,* has successfully supported basic science research in university, so that there are spillovers of technology invention, resulting in university's direct participation in innovation through firm-formation or consultation and creation of the "entrepreneurial university". At least in Boston and Silicon Valley, we can see that university, industry and government in US, evolving from laissez faire

to a relatively ideal triple helix.

China is different from US in its political system and cultural tradition. Innovation and development of a country rely on economic indicators, not directly on its political system. [?disagree] Can it also form an ideal triple helix? Will it form an entrepreneurial university following the US model? Let's start to consider this issue from the comparison among university-industry-government spheres in China and US.

University System

There are over 3000 universities, in US, including some of the best ones in the world. The top-ranking universities have considerable strength in research. Top-ranking private universities have in average of around 1000 staff members, 900 postdoctoral fellows, 600 graduate students; whereas top-ranking public universities have around 2000 staff, 700 postdoctoral fellows and 10,000 graduate students. Since the late 1970s and the early 1980s, higher education in China recovered and developed further. Especially entering the end of 1990s, a "big jump" of higher education occurred. The university system undertook an expansion strategy. So far, there are over 1000 universities and over a 25% gross enrollment rate. There is a rough equivalence in staff and undergraduate student numbers, structure of student levels, professional curriculum. In other word, the difference is not in educational scale, but quality; not in teaching, but research capability.

The difference typically embodies: (1) staff: far away from US, in which all professors in top-ranking universities have got their PhD. (2) educational quality: in recently years, getting worse, hard to recover or go forward. (3) research capability: weak and hard to strengthen from disordered graduate education, i.e. "educational corruption", for example, professors, as grafters, control enrollment and finish examination without serious rules, as well as allow those with bad dissertation to finish school [reference]. (4) the number of postdoctoral fellows should be increased but there is inadequate financial support. These gaps must be filled by accumulation, rather than an "educational big jump".

As to technology transfer, today among university system in US, non-centralization state power model of university technology transfer evolved from research firms in the early of the twentieth century. Research firms played medium actors between academy and industry then. Recently, the office of technology transfer in university can adopt multi-methods to transfer technology in campus. Some of them operate incubator or a science park. Most of original research firms have become venture capital firm to university.

In China, technology transfer is attracting greater attention. Up to now, national centers of technology transfer has been established in six top-ranking universities, i.e. Tsinghua University, Shanghai Jiaotong University, Xi'an Jiaotong University, China East University of Science and Technology, China University of Science and Technology and Sichuan University. Some universities have even set up international centers of technology transfer by themselves. The problem is how a university can generate technologies, instead of importing from the outside, that is, how to enhance research, and the commercialization of research, from the

university campus.

Although universities in both US and China are encouraged to create enterprises, they are spin-offs in US, whereas they are university-run enterprises in China. These two organizations are quite different in their essential nature.[define both and contrast here. A spin-off by definition is an economic entity of academic origin that becomes an independent entity. A URE is an economic enterprise that remains part of the administrative structure of the university. Spin-offs in Boston and Silicon Valley exemplify that universities have made tremendous contribution to local economic and social development. Many university-run enterprises (UREs from some universities such Tsinghua University, Beijing University, have also taken the leading role in Chinese high-tech industry. Tongfang, Wangxin, Dongruan Gufen and Founder respectively established and operated by Tsinghua University, Zhejiang University, and Northeastern University, have become the No. 3, 12, 15 and 25 Chinese Top-100 S&T Firms in 2002, .(Wu) They exemplify the advantages of UREs as high-growth enterprises.

The rise of UREs in China started from 1980, because old style enterprises in the planned economy were poor in absorptive capacity, to say nothing of R&D and innovation. The research results with commercialization potential were rarely transferred into industry. Thus the university has to fulfill technology transfer and knowledge capitalization through establishing UREs. As a whole, UREs have three characteristics: (1) university takes up absolute or relative holding status to its UREs in asset relationship; (2) those who operate UREs basically come from university staff or students, especially at the very beginning of them; (3) R&D of UREs mainly rely on their mother universities. Therefore UREs actually are “enterprises possessed by universities”. Thus, UREs bring various problems to Chinese university system, which will be considered later.

Government Policies and Laws

Government in US, including federal, state and local levels, supports the innovation in university and industry, through making policies, enacting laws, direct investment or indirectly encouraging (venture) investment, government stock, as well as developing medium and small firms and so on. The development of aviation, electronic computer and semiconductor industry greatly depends on government support. During the 1960s, government bought 37%-44% of all integrated circuit products, thereby accelerating the development of the industry even though the overt purpose was simple military procurement. In Silicon Valley, one- fourth order forms are from US government. In conclusion, the policies and laws, which have powerfully stimulated high-tech industry in US, are relatively stable, consecutive and effective, despite the absence of a coordinated industrial policy.

Since 1980s, China has created policies and laws to promote the development of science and technology, knowledge industrialization and high-tech industry. However, sometimes the policies lack stability and continuity. For example, there has not been a follow-up to the ambitious promotion of UREs as took place in the Resolution on Accelerating S&T

Development, which was jointly promulgated by the State Council and the Chinese Communist Party in 1995. This resolution encouraged universities to establish high-tech firms using their own research results, and promoted the formation of strong linkages between academy and industry. It coincided with a sharp decrease in funds for teaching and research that left entrepreneurial activities as the only recourse for university development. On the other hand, state funds through loans and easy credit made possible the construction of university science parks and rapid expansion of firms. These high growth firms took advantage of imported technology, low wage rates and expanding local and international markets for their products. However, in November of 2001, the State Council issued the "Circular on the Experiment of Standardizing University-run Enterprises Management at Peking University and Tsinghua University" that seems to restrain university-run enterprises and call for the separation of UREs from universities.

In China, there has been lack of foresight in policy-making. It seems policies and laws in US aim at guidance and prevention in advance, whereas in China greatly they are ex post facto used as tools to control or remedy. Moreover every official, who has taken an important action, is typically followed by another person who has his/her new ideas to put forward in order to demonstrate achievement in the post. This leads to less-consistent policies but is a commonplace of policy and politics everywhere. However, it may weaken government's role in promoting innovation.

R&D Investment

Knowledge-based economies are essentially based on input of R&D resources. The R&D investment in the US has been far higher than other countries, even other developed countries. In 2000, R&D financial input in US was $265.3 billion, $142.0 billion in Japan, $46.3 billion in German, $27.8 billion in France and $26.2 billion in UK. [2]

As to the proportion of government and industry investment, in recent years, remains at around 3:7. See Table1.

Table1 Structure of R&D Investment in US, UK and France

	1970~1979		1981-1982		2001-2002	
	government	industry	government	Industry	government	industry
US	55	43	47.8	49.4	28.7	66.2
UK	55	39	48.1	42.1	30.2	46.2
France	51	42	53.4	40.9	33.2	40.0

Source:[OECD] Indicators of Science and Technology(1984)，P53，57，117，119，122; [OECD] S&T and Industry Summary (2002)，P284，291.

The numbers for of China are 33.4: 57.6 in 2000, recently remaining at this rate. In US, the R&D system which consists of government, university and industry forms the source of

technological innovation and constructs the national competitive strength of US. Three institution spheres cooperate with each other and jointly share innovation risk. For example, Information Superhighway Project needed $400 billion, but government only put in $30 billion. The others were mainly provided by private corporations, encouraged by government policies.

In China, at present, government and firms are primary investors for R&D. The problem is not the proportion between government and industry investment, but the absolute amount. In 1996, gross R&D expenditure in US was $196.7 billion, $94.4 billon in Japan, but only $2.7 billion in China.[3] In 2003, it is up to ¥153.96 billion, less than that of US in 1996. [4]

Before 1990s, the value of R&D/GDP was 0.5%-0.7%, in 2000 it went up to 1%, 1.32% in 2003, whereas in US and Japan it holds at about 3%. Therefore, even though the enterprise R&D investment is up to 60%, the actual expenditure is very little, not enough to support a strong industry R&D system.

In US and Japan, national corporations are the main power of technological innovation. This is based on huge GDP and R&D input. China now is still on mid. or low tech stage, as a whole. To redress this weakness, university innovation should be paid more attention to, rather than only emphasize enterprise's status as main body in national innovation system.

Industrial Firms

Industrial firms in US provide most of the researchers and expenditures to conduct research work possess broad R&D financial sources and pay more attention to training. Thus they have strong self-innovation capability. Some corporations, such as IBM and GM, keep large-scale research labs for basic research, which have made significant contributions to innovation. Some of them work together with other corporations and national labs to develop and improve technology. Most of them have established their own office of technology transfer, in order to track the research in universities and national labs and sell technologies to other companies.

In US, industry firms typically view intellectual property right (IPR) as the core of their strategy for development, and attach importance to protecting IPR. They compel government to protect IPR powerfully, and then protect US enterprises' competitive advantages all over the world.

Most of Chinese industry in which manufacturing is dominant, operates at a low-technology level in a labor and natural resources economy. Forms are very weak in absorptive capacity and innovation ability in traditional industries. The transition to understand and respecting IPR requires a longer time. Enterprises are also in transition from Plan to Market Economic System. They can not yet become the main sources of technological innovation. That is why university-run enterprises could develop increasingly. University takes on innovation tasks to form new firms and industries. Based on this premise, universities in China may play an increasingly important role in economic and social innovation. Thus, the

entrepreneurial university and the future of higher education in China will be a significant issue.

Entrepreneurial University and the Future of Higher Education in China

Jong-Hak Eun, Keun Lee and Guisheng Wu "depart from the critique that the 'Triple Helix' and the 'New Economics of Science', which assume typical situations of advanced countries, fail to provide a satisfactory theoretical framework to address the university-industry relationship in developing countries", [5] to explore university-run enterprises in China. The New Economics of Science has revealed the commercialization feature of science, and based university-industry-government cooperation on reciprocal principles. In their new framework, the authors admit the hierarchy of UREs, which can freely use the mother university's resources, including labs facilities, and are controlled by the university. There is an umbilical cord connecting baby to mother. Apparently, the hierarchy was generated by the political system of China. This partly is due to most universities in China are public. Therefore, to neglect the government sphere's influence in the study of UREs is improper.

Thus, can Triple Helix theory be used to investigate the specific situations in developing countries? Are there any essential differences between the innovation processes of developed and developing countries?

From Entrepreneurship Activities of University to Entrepreneurial University

There are various levels of universities, including national, province and city levels in a hierarchy, Universities, may also be categorized as technology academy, teaching university, research university and entrepreneurial university, according to the priority of their objectives. A matrix is formed here. See figure5.

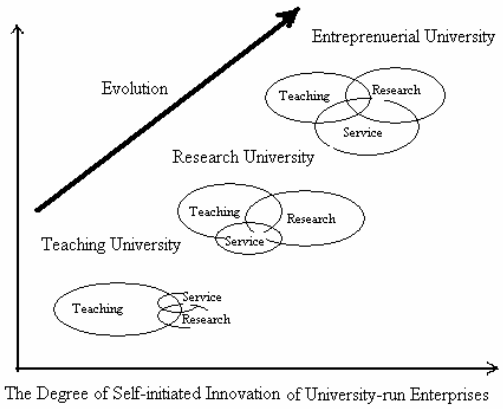

Figure 5 the Evolution of University

In Chairman Mao's era, it was proposed that education should be related to the practice of industry and agriculture. Schools have their own factories or workshops, some of them have experimental fields. Intellectuals in universities had to participate in industrial practice. This is mainly for some political intention: to change intellectuals, but there is a byproduct: to draw university-industry closely. Since 1950, there have been more or less entrepreneurship activities in universities of China. See Figure 6.

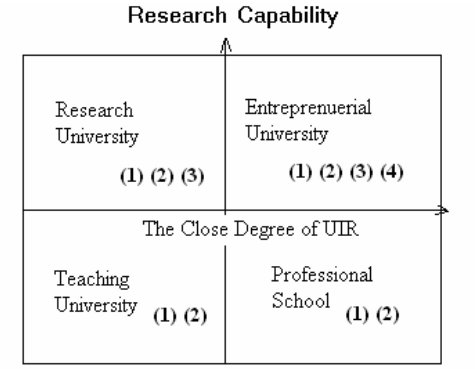

Figure 6 The Quadrant of Universities

The universities with entrepreneurship activities are not by all means entrepreneurial universities, although the increase of the activities can lead to the formation of an entrepreneurial university, on one hand. Only an entrepreneurial university can conduct both basic research and direct technological innovation from their research results. On the other hand, a university closely working with industry is not necessarily an entrepreneurial university. For example, the operation of a technology academy is the closest to industry, even focused to meet the development of industry, but such a professional school is not an entrepreneurial university. See appendix II.

The Starting Point of China Entrepreneurial University: Consultation

From MIT's experience, the start of entrepreneurship is not spin-offs, but consultation of its faculty for industry. In 1930s, Professors such as V. Bush in the university learned practice requirement from industry and the process of firm operation through consultation. They brought problems back to labs in the university to do theoretical investigation while they tried to deal with them. At the same time, teaching was greatly improved by introducing some vivid examples to the classroom. Consultation is the starting point of US entrepreneurial universities, having been an important practice of professors in some US universities as well as bringing a financial return to them.

Consultation for industry is arising among a few top-ranking universities such as Beijing University and Tsinghua University, but it is at the very beginning, even lagging UREs. The resources are concentrated in a few highly reputed universities. For example, faculty in Beijing University, as a head, organized a consultation firm, with more than 200 business or technology experts living in different cities and divided into five groups depending on their expertise. A series of books on consultation edited by some authors in Beijing University were

just published by Zhongxin Press.

Nevertheless, UREs in China occurred earlier and to a greater extent than consultation, so that UREs prevailed in 1990s. Nevertheless, the industrialization rate of research results still was very poor, less than 25%. Lack of consultation led to that teaching and research in university becoming separated from industry practice. Moreover, there has been lack of industry's absorptive capacity and self-innovation ability. These two gaps resulted in poor university-industry relations. To sum up, consultation is fundamental and important aspect of the development of an entrepreneurial university. Systematically enhanced consultation must be introduced in the educational policy of China.

From UREs to Spin-offs: Necessity and Possibility

As we have shown, UREs in China are in the core area of the university institutional sphere, but spin-offs in the US are in the external field space, where university and industry interact. As a result, UREs brought confusion in ownership and became one of sources of corruption, while they created revenue for universities in question. The development of UREs has raised the issue of c university's character and missions. There has increasingly been complaint that the university is becoming "industry." For example, university is taking on enterprise actors in innovation, through its advantage in high-tech research; it is increasing the tension between university and industry. Since university has its own companies; excessively competitive university-industry relationship will eventually induce a difficult technology transfer from university to industry; and so on.

According to Branscomb et al.(1999) and OECD (2002), the role of university in a society is determined not only by the economic logic, but also by the "social contract" concerning the division of labor. A "Social contract" has prescribed that the university as an institution for education and production of knowledge. Thus, ownership of UREs which have intruded industries into the university really becomes an improper focus of university-industry relationship. In addition, university should be a social commonweal enterprise, i.e. non-profit, by "social contract", however, UREs made them rich now. In China, poor professors before the end of 1990s now have already become one of "Seven Wolves"[1].

Based-on interest considerations, universities are reluctance to give up the ownership to UREs. However, as a university expands enrollment opportunities and the absorptive capacity of industry is enhanced and the university improves its capabilities in technology transfer, there is a tendency to devolve UREs and explore other forms of entrepreneurial activity. See Table 2.

Table 2 University-run Enterprises in China (1992-2001) [6]

Year	Number of total UREs	Number of S&T UREs	Number of Non S&T UREs
1992	Not available	850	Not available

[1] Seven Wolves means the first seven groups of top wealthy.

1996	Not available	2912	Not available
1997	6634	2564	4070
1998	5928	2355	3573
1999	5444	2137	3307
2000	5451	2097	3354
2001	5039	1993	3046

Source: Year 2001 Statistical Report of University-run Industry in China, 2002, P.10, China University Industry (Zhongguo Gaoxiao Chanye), 2000, No.6, P.10, University S&T Industry News (Gaoxiao Keji Chanye Tongxun), 1998, No.3-4, P.2

Jong-Hak Eun et al. suggest that the absorptive capacity of industry affects university's decision to establish UREs. When it is weak, the university feels that it is the only path to fulfill its technology transfer or industrialization mission is to set up UREs and make them flourish. As absorptive capacity increases, universities prefer transfer technology and UREs decline.

In addition to the decrease of UREs related to the improvement of absorptive capacity of industry, there are at least three factors: new government policies, development of (venture) capital guarantees and enhanced knowledge production abilities on university campuses. Certainly, another important factor to affect UREs is traditional culture. The solution of ownership problem is the focus of current policy changes. In the recent past, unstable policies have caused uncertainty in universities. Since 2000, some universities in China have been supported by expanded government R&D investment, "211" Project, Innovation Project and increase of enrollment (tuition), which reduced greatly financial pressures on universities. Moreover, teaching universities can get enough money from tuition. These factors make the university lose their willingness to establish UREs, even those low-tech UREs that they can set up. Furthermore, no president wants to involve the university in ownership due to the problems it creates. From the long term views, it seems that university, industry and government want to see UREs disappear. Of course, whether they will be replaced by spin-offs is another issue.

Periodic Character of the Third Mission of University

The third mission of university takes on a periodic character with the change of absorptive and innovative capacity in industry. See Figure 7. In the figure, UER means University's Entrepreneurial Role in innovation; T: time. B→: (now) beginning to accelerate; based on the weak industry absorptive and innovative capacity; B→C: industry capacity is increasing; C (top) : UER is the strongest; C→D: industry capacity increases continuously; D →E: stable stage; E→: next period. As we know, Silicon Valley area has provided evidence for the tendency. Table 2 has also showed such a tendency.

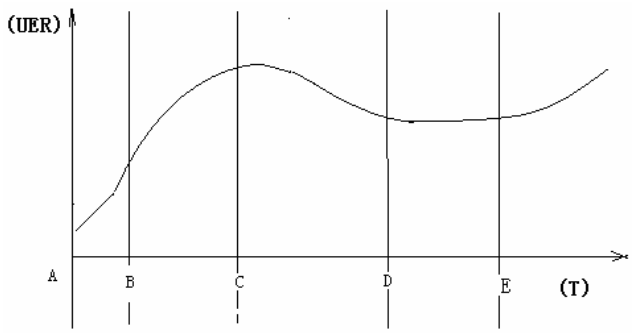

Figure 7 Periodic Character of The Third Mission of University

Moreover, realization of the university third mission is also affected by the technological innovation cycle. At the early period of innovation, the university as an institution of knowledge production takes on service tasks, including consultation, technology transfer and firm-formation. After industry has enough strong absorptive and innovative capacity, the technological innovation cycle will become a relatively important factor.

Conclusion

In the triple helix – field interaction model, the cores and outside space of the helices are separated. It is helpful to explain China's current state of the art with respect to the triple helix. According to the theory, first of all, China should resolve the problems existing in the core area. The present situation of cores of triple helix spheres involves the transition from a statist model. This transformation is shown by Figure 8. It is against Figure 1, with three spheres' cores apart from each other but better than a pure statist triple helix. China still has a long way to form an ideal triple helix model for innovation.

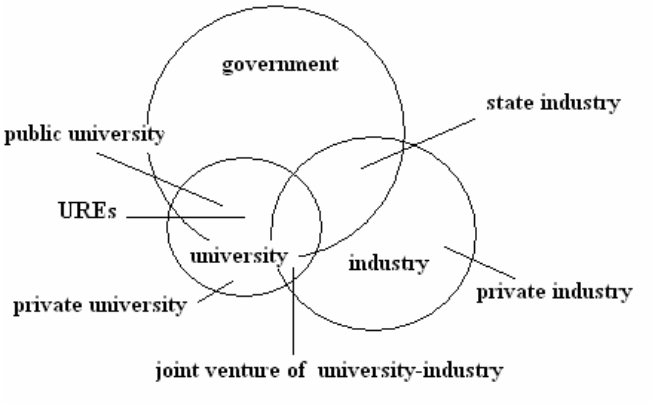

Figure 8 University-industry-government Triple Helix In China

In order to accelerate the construction of entrepreneurial universities in China, several measures for university development should be taken:

(1) actively upgrade research universities and encourage the transition from teaching to research universities

(2) encourage consultation practice

(3) change UREs to spin-offs

(4) make policies more stable and continuous.

(5) work with government and industry to develop hybrid organizations like science parks and incubators around the universities in question.

The research ability of universities in China has to be enhanced. The universities are still secondary to the research institute sector, a situation which does not take full advantage of the human capital flow through and idea generation capability of the academic research group format. Nor does it take advantage of the research capacity of graduate students and post-doctoral fellows as a cost-effective R&D strategy in contrast to higher paid advanced Institute research personnel.

Universities need more financial support and policy assistance. In 2003, only ¥16.23 billion of total R&D outlay, ¥153.96 billion, was for universities, ¥96.02 billion for enterprises and ¥39.90 billion for research institutes. From the investment to science and technology activities, the total amount is ¥312.16 billion, including ¥212.62 in enterprises, ¥68.13 billion in institutes and ¥25.39 billion in universities. Obviously universities are not seen as main source of research. [7] China also has a long way to go achieve world-class research universities.

During recent years, many universities in China have been merged by government at the central and local level. After the “merging motion”, a relative stable university system will be formed. The next task should be to create their specialties. The professional schools or German-style polytechnic school will increasingly become a complement to the technology universities. A national conference in profession education held on Nov.7-8, 2005, in order to enhance training technicians. There will continue to be many technology academies in China. Tsinghua University could be an entrepreneurial University; Zhongnan University is trying to be an innovation university. Most universities will continue transforming from teaching to research universities.

Reference:

[1] Chunyan Zhou ,*Science and Technology Field*，Science of Science and Management of S&T, Vol 22, 2001.4, P13-15; or Chunyan Zhou, *Transforming from Science to Technology: the Scientific Basis of the Technological Era.* Shenyang. Northeastern University Press, 2002.2

[2] http://zys.mofcom.gov.cn/aarticle/b/200603/20060301623015.html

[3] http://www.biocas.org/news/show.php?id=3133

[4] http://www.stcsm.gov.cn/statistic/detail.asp?id=50809133200

[5] Jong-Hak Eun, Keun Lee, Guisheng Wu. Explaining the University-run Enterprises in China: A New Theoretical Framework and Applications. http://www.kiep.go.kr/inc/download.asp/

[6] Jong-Hak Eun, Keun Lee, Guisheng Wu. Explaining the University-run Enterprises in China: A New Theoretical Framework and Applications. http://www.kiep.go.kr/inc/download.asp/

[7] http://www.stcsm.gov.cn