University Commercialization In China

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How universities in China have used commercialization of their technologies in training students

Tsinghua University is one of the top comprehensive universities in China. It stresses engineering. It has five Schools and 29 Departments, including 17 Engineering Departments covering most engineering fields. Its faculty totals about 3,300. Among them are nearly 2,000 members engaged in research work part- or full-time.

There are about 3,700 Ph.D. and Master Degree candidates in the university, and most of them do research work with their supervisors. Every year nearly 1,500 research projects are conducted by such a research team. Besides basic research projects, most projects are applied research and development projects. About 85% of the researchers are engaged in applied research and development with a research fund accounting for 90% of the total fund. The university gets its applied research and development projects from different channels such as the state key programs, commission projects funded by industry, joint research and development institutes with industry and engineering research centers.

THE STATE PROGRAM

The Chinese government attaches great importance to strengthening relationships between academic institutions and industry to promote economic growth and development of science and technology. The central government has established a variety of programs to support applied research and development such as the State Key Program, High-Tech Program, Technology Propagating Program, the Torch Program, the State Spark Program, the Eighth Five-Year Propagating Program, New Product Prototype Program, New Product Trial Manufacture Program, and so on. As a key comprehensive university with engineering as its main focus, Tsingham University has been involved in all these state programs from the very beginning.

The State Key Program is organized by the State Planning Commission for developing important technologies for Chinese economy. Tsingham University has got some projects of this program such as Nuclear Heating Reactor at Low Temperature, Air Cooling Nuclear Reactor at High Temperature, Clean and Efficient Combustion of Coal, Computer Simulation of Power Generation Plant Operation and so on.

The High-Tech Program was designed by the State Science & Technology Commission in 1986 to develop some high technologies available for Chinese industry. Important programs such as Computer Integrated Manufacturing System, CIMS, Artificial Intelligent Technology and Customs Large Container Inspection are conducted by Tsingham University.

The Technology Propagating Program was carried out in 1989. It was designed for promoting propagation of key technologies. The State Science & Technology Commission provides technology fee to the University whose technology is selected to be propagated as the key technology. The enterprise where the key technology is applied can get interest-free loan for the technology and the priority of exemption from sales taxation or tax discount. Some of the key technologies come from Tsinghua University.

For example, betheng structure steel, a new kind of steel developed by Tsinghua University, has been produced by several Chinese iron and steel plants through the Technology Propagating Program. The Torch Program was designed for high-technology industrialization and internationalization. The technology in a torch project should be advanced, perfect and useful in production and should find a big potential market and have high profit. This program provides loan with reduced interest and exemption from taxation or tax discount.

◄ Technologies ►

Tsinghua University has provided several high technologies such as computer simulation of power generation plant operation. The State Spark Program was implemented in 1986. It aims at propagating technologies to the vast countryside and guiding a great number of peasants to use the technologies for agriculture development.

One of the best technologies provided by Tsinghua University is a highly reinforced cast iron containing several rare-earth elements, which made a township enterprise become a large-size one. In recent years, the State Economy & Trade Commission has designed "The Eighth Five-Year Propagating Program," "New Product Prototype Program," and the "New Product Trial Manufacture Program." These Programs were carried out in 1991. Tsinghua University has 26 projects from them. From all programs mentioned above Tsinghua University has received funding to support its applied research and development activities. It has made great contributions to the Chinese economic

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growth through the implementation of the projects.

COMMISSION PROJECTS SUPPORTED BY INDUSTRY

Tsinghua University has also a lot of applied research and development projects funded by industry through contracts or agreements. In this case, the enterprise asks the University to solve some technical problems and provide funding for the projects. The University conducts research or development and provided research report or technical documents to the enterprise.

The amount of funding coming from the industry is considerable. For example, in 1994 Tsinghua University obtained funds of about 50 million yuan RMB from the industry for applied research and development, which accounts for about one third of its total research fund.

Some of the commission projects are applied basic research, which can meet the long-term or middle-term needs of enterprise. For example, the Sino Petrochemical Engineering Company has given some applied research projects on extract separation and distillation to Tsinghua University in the past 10 years. Most of the commission projects are development projects. An example is the "continuous milling production line of train wheel ring" developed by our university for Maanshan Iron & Steel Company, which is one of the largest iron and steel companies in China. There are also some engineering projects and some of them are turnkey projects. In this case, the university is responsibile for not only research, development, design and equipment purchase, but also installation, adjustment and trial-production of qualified products.

JOINT R&D INSTITUTES WITH INDUSTRY

A number of large enterprises in China are willing to establish long-term cooperation with universities in order to use the resources of faculty and technologies of universities. They have set up jointly with universities some research and development organizations. For these units, generally, the universities offer manpower resource, equipment and laboratories, and the enterprises provide funds to support the institute's operation. In this case, the institutes are located on campus usually.

◄ Exchanges ►

Sometimes the institutes are placed in enterprises and their equipment, laboratories, junior researchers and funds come from the enterprises, but senior researchers are professors of the universities. The professors work both in the institute and in the university.

Tsinghua University established a Chemical Engineering & Applied Chemistry Institute [North] jointly with Sino Petrochemical Engineering Company in 1984. Since then, the company has given more than 30 million yaun RMB to support the R&D activities and daily operation of the Institute and has received seven advanced technologies from the institute and recruited more than 100 quality graduates from Tsinghua University. It has greatly improved the technical level of the company and increased the company's profit.

◄ Another Example ►

The Technology propagating center is another kind of long-term joint organization formed by enterprise and university. Supported by the State Science & Technology Commission, some universities have established technology propagating centers that aim at propagating specific research achievements.

The university provides specific technologies and asks related enterprises to join the center. The SSTC provides financial support to the center and offers some favorable conditions such as governmental loan and exemption from taxation for the enterprises. For example, the New Air Cooling Betheng Steel Spreading Center and the New Ceramic Cutting Tools Spreading Center have been established in Tsinghua University since the University provided the related technologies.

ENGINEERING RESEARCH CENTER ON THE CAMPUS

Nearly 70% of the applied R&D achievements of Tsinghua University are applied to a different extent in the Chinese industry, but only about 15% of the achievements are well used by industry. Although there has been much input from industry to university, the output from the university is still insufficient. The major barriers to the application of scientific achievements in industry are as follows:

- Lack of recognition of the importance, arduousness, and the complexity of the engineering research phase in the whole chain from the R&D in laboratory to industry. In fact, there is a long distance to go from the prototype in the laboratory to the product manufactured in factory. To go through the distance needs more efforts, time and investment than that in prior prototype phase. No other engineering research unit than an institute can transfer research results to the industry more effectively. The Chinese enterprises have a weak capability of applying technologies. There is no perfect mechanism to coordinate the relationship between research, development and economic growth.
- To put up a bridge between scientific achievements and final products some engineering research centers have been established with the support of the State Planning Commission and the State Science & Technology Commission. There are several Engineering Research Centers on the campus of Tsinghua University. They are the "CISM ERC," "The Driving Technology of Optical Disk ERC," "The Coal Combustion of Industrial and Civil Boilers ERC," and "The Nuclear Technology ERC."

Although the engineering research centers are located on the campus they are independent legal persons and operate according to the company's mechanism instead of the university's mechanism, that is, industry-supported, government-aided, plan-guided, market-oriented and financially balanced

through transferring their technologies and selling products.

TECHNOLOGY LICENSING

The universities in China have conducted much applied research and development as mentioned above. Therefore, they have become one of the important resources of technologies that Chinese industry needs. Many of the technologies can be directly applied in production and create high profit for industry. The relevant rules and regulations allow universities to own industrial property such as patents. For this reason, Chinese universities have their patents and know-how and can commercialize the technologies through technology licensing. For example, Tsinghua University files about 100 patent applications and obtains nearly 90 issued patents every year. The university has set up "Tsinghua University Patent Affairs Office," "Technology Transfer Office," and "Tsinghua University Technology Service Company," which are responsible for its patent affairs and technology licensing at home and abroad. Through technology licensing Tsinghua University transfers its technologies not only to large- and middle-size enterprises but also to smaller town-owned enterprises and to domestic and foreign enterprises. For example, Tsinghua University has transferred its technology of computer recognition of printed Chinese characters to Motorola Company. The university has got more than US$1 million of royalty from foreign companies and 20 million yuan RMB from domestic enterprises.

UNIVERSITY'S TECHNOLOGY ENTERPRISE

The universities in China have offered courses since 1949 to give students industrial practice in factories. But in recent years, because of development of a market economy and strengthened R&D activities on the campuses the factories have become university technology enterprises. Some enterprises have advanced technologies that are important units to commercialize university's technologies.

Generally speaking, these university's enterprises have kept close relations with the researchers, and some of the presidents of the university's enterprises are researchers having important technologies. They can touch the newest technologies of the university and select high-level technologies having large potential market and high profit to be commercialized.

Tsinghua University has five high-tech companies that make products by applying the university's technologies, sell their products and receive profits from the market. The profit is used for running the companies and some of the profit should be submitted to the university to support teaching and R&D. For example Tsinghua Special Materials Company produces a variety of crystal display materials and receives 70% share of the domestic market and a good profit. It is a model to commercialize a university's technologies.

The policy has become "the development of science and technology should suit to the economy, and the economy should rely on the development of science and technology." Much applied and development projects as well as basic research projects have been successively carried out at Tsinghua University with remarkable achievement. And a great number of high-quality students have been trained.

Although we have made great progress both in research and in student training, we still have a lot of difficulties to be overcome and problems to be solved. We will continue our work in applied research and development, and will try our best to make more contributions to the growth of our national economy.