

International university–industry collaboration and development
of high-tech industries in China, 1980s-2000s

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Abstract

In this study, we explore collaboration between universities and industrial entities in the development of Chinese high-tech industries from the 1980s to the 2000s. For developing countries, the creation and cultivation of high-tech industries can be the key to economic development in a globalized era. Since the 1980s, China has served as an example of one of these developing countries. In attempting to create and develop high-tech industries in China, the Chinese government has long promoted university-industry collaboration. As a result, the Chinese government has been widely considered as the catalyst behind the development of university-industry collaboration. However, our analysis demonstrates that there are multiple proponents that have advocated multiple paths to successful university-industry collaboration in China.

1. Introduction

The primary objective of the current study is to explore the mechanisms of university-run enterprises that have contributed to the creation and cultivation of high-tech industries in China. Generally, research on collaborations between Chinese industries, universities, and government organizations has focused on government policies related to these collaborations (e.g., Hashida, 2000; Seki ed., 2007; Sunami, 2003). In contrast to this line of research, we focus on specific cases of successful collaborations to more closely evaluate the process that leads to their development.

The two cases we describe in this study are quite different in their respective backgrounds and details. The first case study relates to the Founder Group, which was created in an environment that was favorable for the development of high-tech industries. For example, the Founder Group was backed by government policies and located in the Zhong Guan Cun Science Park (informally referred to as “the Silicon Valley of China”). As the Chinese government has adopted the promotion of high-tech industries as a national strategy, Beijing has received increased support, thereby facilitating the development of successful collaborations between Chinese universities, industries, and government organizations.

Although successful collaborations have begun to materialize in Beijing, there have also been successful collaborations under conditions where a high-tech environment has yet to be established. In this vein, our second case study relates to

Neusoft, a company that achieved substantial growth despite its operation in a region where high-tech industries are difficult to develop.

Figure 1 and Figure 2 show the percentage of total sales and total profits of university-run enterprises by region. Beijing accounts for the greatest percentage of total sales and profits. The percentages were 60.27% and 43.2% respectively, in 2011. Meanwhile, Shenyang Province, where Neusoft is located in, accounts for 4.87% of total sales and 7.78% of total profits. Table1 shows ranking of university-run enterprises in terms of sales and profits in 2011. Neusoft ranked no.4 in total sales and no.3 in total profits. Founder and Neusoft were successful university-industry-government collaborations in China, despite that they are located in different regions.

Given these two cases, the primary objective of the current study is to identify the mechanisms that contributed to the development of successful collaborations between universities and industries in the cases' respective environments. Whereas the first case (located in Beijing) which has received a significant amount of attention as a successful demonstration of the national strategy's effectiveness, the case of Neusoft has also achieved success, despite the lack of overt government support or a favorable business environment. The disparate contexts for these two success stories give rise to an important research question: How did the latter attain collaborative success without the benefits afforded to the former?

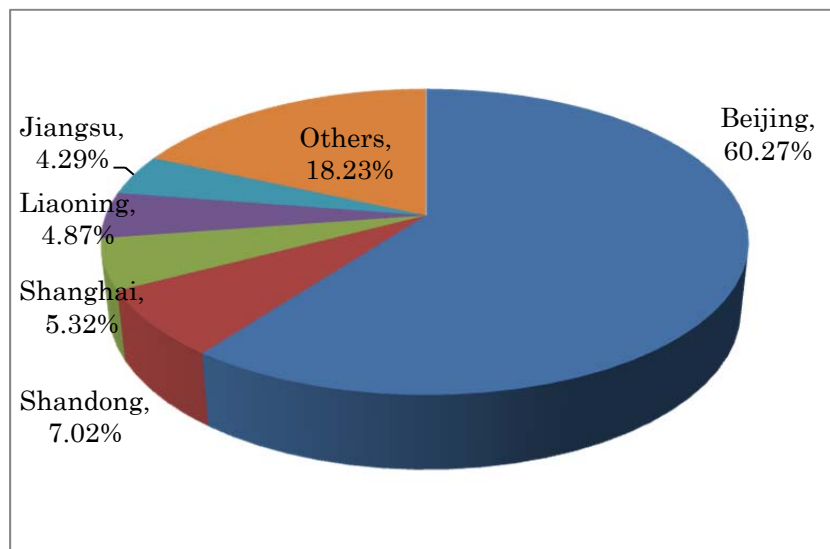


Figure 1. Percentage of total sales of university-run enterprises by region (2011)

Source: Zhonguo Gaodengxuexiao Xiaobanchanye Tongjibaogao (2012)

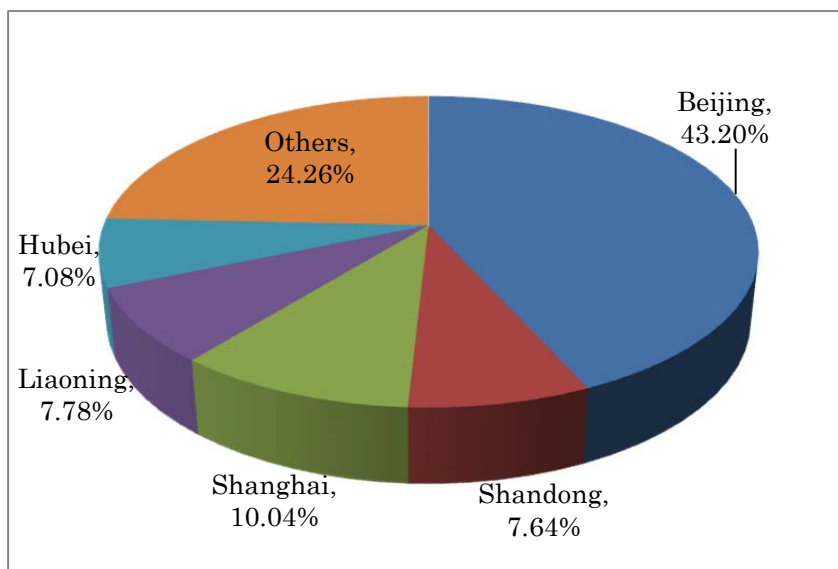


Figure 2. Percentage of total profits of university-run enterprises by region (2011)

Source: Zhonguo Gaodengxuexiao Xiaobanchanye Tongjibaogao (2012)

Table 1. Ranking of university-run enterprises in terms of sales and profits (2011)

	Total Sales		Total Profit	
1	Founder Group (Peking University, Beijing)	581.6	Founder Group (Peking University, Beijing)	15.6
2	Tongfang Co., Ltd. (Tsinghua University, Beijing)	215.3	Tongfang Co., Ltd. (Tsinghua University, Beijing)	10.6
3	Shandong Star Science & Technology Group (China University of Petroleum, Huadong)	81.4	Neusoft Corporation (Northeastern University, Liaoning)	4.9
4	Neusoft Corporation (Northeastern University, Liaoning)	59.8	Shandong Star Science & Technology Group (China University of Petroleum, Huadong)	3.0
5	PKU Resource Group (Peking University, Beijing)	59.3	Huagongtech Co., Ltd. (Huazhong University of Science & Technology, Hubei)	2.99

Note: Measured in hundreds of millions of Yuan

Source: Zhonguo Gaodengxuexiao Xiaobanchanye Tongjibaogao (2012)

2. Peking University and the Founder Group's industry-university-government collaborations

The Founder Group¹ is an enterprise operated by Peking University and located in Zhong Guan Cun. It is currently known as a major player in the information technology (IT) industry, particularly for its operations related to computers. Although the company enjoys current success in the IT industry, its origins can be traced to its development of the laser photo-typesetter, which many considered to be a revolution within China's print industry. In this section, we will explore and explain the success of the laser photo-typesetter. In addition, we will describe the process of industry-university-government collaboration.

2.1 The 748 Project

Although the inclusion of Chinese characters on computers is now a common practice, Chinese computers lacked this basic feature until the 1980s. In relation to this, the Chinese government launched the 748 Project in 1974. This initiative was geared towards developing and industrially producing a laser-electron photo-typesetter. To achieve this goal, the Chinese government performed a nationwide recruitment drive to identify and secure a talented individual to lead the research and development practices associated with the development of the photo-typesetter. As a result of this search,

¹ "Founder" was first used in 1992 to represent the "Peking University Founder Group." The company had previously been referred to as "Beijing Like Xinjishu Gongsi" and "Beijing Daxue Xinjinshu Gongsi." In this paper, however, these names have been unified, and the firm is hereafter referred to as "Founder."

Professor Wang Xuan of the Peking University Institute of Computers proposed a world-class technological development protocol for the development of the photo-typesetter (fourth generation). As a result of his proposal, Professor Wang took charge of the R&D processes for this project. Professor Wang's research team received substantial financial support from the state. Between 1976 and 1995, the research team was provided 10 million yuan, allowing them to successfully develop a plan for the production of the photo-typesetter.

The central government led the project and created a system for the industrial production of the laser photo-typesetter. More specifically, the government headed the development of a system whereby the laser photo-typesetter could be commercialized. In addition, the Chinese government established a collaborative framework with which different types of organizations could work together to produce the typesetter. Some of these organizations included Peking University, Weifang Computer Co., Ltd., Wuxi DianbiaoChang, Hangzhou Tongxin ShebeiChang, and Zhongkeyuan Changcun Guangjisuo. Ultimately, the government sought to create an integrated system for industrial production and establish a structure comprised of domestic companies that could perform production activities. Through its efforts associated with the 748 Project, the government supported the construction of an integrated system that promoted both R&D and industrial production. These efforts proved successful, as in the ten years following the launch of the 748 project, R&D for the laser photo-typesetting

technology was successfully conducted, and the product was developed and commercialized.

2.2 Computer sales and venture capital in Zhong Guan Cun

In the period immediately following its establishment, Founder was only partially involved in Professor Wang Xuan's project. However, the company was achieving growth on its own in Zhong Guan Cun through sales of computers and related products². At that time, there were many enterprises in Zhong Guan Cun selling computer products, and Founder also decided to enter the market there. To facilitate Founder's entry into the market in Zhong Guan Cun, Peking University provided the company with 400,000 yuan in May of 1987. Founder used this capital to fund the launch of its computer sales business. In July of 1987, Founder invested 300,000 yuan to establish Beida Keji Fuwubu as its own subsidiary. Due partly to governmental preferential treatment for enterprises in Zhong Guan Cun (i.e., three years of tax exemptions), Beida Keji Fuwubu successfully began selling computers at this time.

Founder also expanded its computer sales business by attracting venture capital. While Founder was exploring the possibility of computer sales in the spring of 1987, the company was restricted to small-scale operations due to a shortage of funds. At this time, Yuyuantan Shangye Fuwu Company was searching for opportunities for the

² Another of its main operations involved the development of software for Japanese enterprises (e.g., Canon).

transfer of technological results and industry-university-government collaborations. Therefore, company personnel visited Peking University to identify opportunities to this end. Yuyuantan Shangye Fuwu Company possessed a surplus of capital and it was interested in investing in companies in high-tech industries in Zhong Guan Cun. Following discussions related to a possible collaboration, Yuyuantan Shangye Fuwu Company provided Founder with 12 million yuan. As part of the collaboration, Founder agreed to evenly split all profits derived from the sales of computer with Yuyuantan Shangye Fuwu. Founder also used this capital to further expand its computer sales business being conducted by Beida Keji Fuwubu.³

In addition to the capital that Founder had already received, it received another 12 million yuan from the Industrial and Commercial Bank of China (Peking University provided the collateral to secure this funding). Yuyuantan Shangye Fuwu Company also contributed an additional three million yuan, further increasing Founder's financial liquidity. As can be seen by this business expansion, Founder was able to achieve major results for its sales of computers and related products within the environment of Zhong Guan Cun.

2.3 Founder foreign and domestic collaborations

Because Founder successfully sold computers and related products in Zhong

³ Founder also performed software development for Japan, which further increased revenue.

Guan Cun, company personnel felt confident about the potential of the production and sale of the photo-typesetter that was being developed by Professor Wang Xuan. The photo-typesetter that Professor Wang Xuan was developing was based on the national 748 Project. Founder and Technology Licensing Organization within the Peking University, which sought to industrially produce the technologies developed by university personnel, were unable to accept they were not involved with the typesetter's production and sales. As such, Founder sought to implement a change in the integrated structure that had been developed under the 748 Project for the production and sales of the laser photo-typesetter.

First, Founder appealed to the government department with jurisdiction for the 748 Project. Through its appeals, Founder secured the rights to produce and sell in-company core parts. However, and despite having won the rights to produce core parts for the typesetter, Founder lacked the production equipment, plants, or labor needed to do so. To ensure the quality of the typesetter's parts, Founder looked to procure those parts that it could not produce from domestic or overseas companies. To produce a high-quality controller (one of the laser-typesetter's core parts), Founder collaborated with state institutions with superior technologies capable of developing complicated parts.

The parts that comprise the output equipment for the laser photo-typesetter were also key components of the overall product. Although Hangzhou Tongxin

ShebeiChang had been chosen by the government to industrially produce these parts, the laser printer it produced was inferior in terms of the clarity of its output and stability. Given the importance of the laser printer to the typesetter, the inferiority of the laser printer produced by Hangzhou Tongxin ShebeiChang represented a potential impediment to the typesetter's sales. Therefore, Professor Wang turned his attention to a printer from Canon, a foreign company. By connecting the laser-typesetter to a Canon printer, Professor Wang and the other R&D personnel successfully realized stable laser output.

To this point, Founder had attempted to construct parts in-house. However, the company experienced notable difficulty in securing the equipment necessary to achieve sufficient production capacity. To market a laser photo-typesetter that guaranteed the highest possible level of quality, Founder was forced to go beyond the existing framework for cooperation to overcome the problems it was facing. Because Founder sought to produce a fourth-generation photo-typesetter that would become the leading technology for its time, the company needed to broaden the scope of its collaborative relationships to procure parts outside the existing collaboration structure. By expanding its collaborative scope, Founder successfully produced the laser photo-typesetter and strengthened its competitiveness in the market.

Because the Chinese central government retained a planned-economy mentality, Founder faced pressure to integrate the companies involved with the

development of the laser photo-typesetter under the umbrella of a state-owned company. However, Peking University resisted the concession of university-run enterprises to the government-controlled umbrella organization. Having finally acquired the rights to production and sales, Founder expressed a strong desire to engage in its business activities independently. Ultimately, Peking University and Founder were left to develop independently.

3. Northeastern University and Neusoft's industry-university-government collaborations

Although development of high-tech industries is currently being promoted in the northeast region of China, this region was characterized by heavy industries in the 1980s and 1990s. As a result, the northeast region of China was not a suitable environment for creating or developing high-tech industries at that time. Still, it was within this environment that Northeastern University and Neusoft attempted to cultivate their own high-tech industrial enterprise.

3.1 Neusoft and its international collaboration with Japan's Alpine

Neusoft traces its roots to a computer networking engineering laboratory started by three young educators at Northeastern University in Shenyang, China, in 1988. This laboratory began with a modest scientific research grant of 30,000 yuan and

three 286-computers. As China's first Ph.D. in computer applications, Liu Jiren (current CEO of Neusoft) was appointed as head of the laboratory soon after his arrival at Northeastern University. While studying in the United States, Dr. Liu developed a strong affinity for collaborations between the university and industry sectors, as well as the industrialization of technology between universities and research institutes. Originally, Northeastern University was renowned for metallurgy. However, a lack of funding rendered it impossible for the university to foster industries that required such large-scale investments. As such, Dr. Liu focused his efforts on software. Though Dr. Liu expected his work in software development to contribute to the university's future in a positive manner, a lack of funding for research and development to this end nonetheless posed a significant challenge. To overcome this challenge, Northeastern University developed a close working relationship with Japan's Alpine Electronics, Inc.

Toward the end of the 1980s, Japanese audio manufacturer, Alpine Electronics, Inc., was searching for a production location in China to reduce production costs. While researching the northeastern region of China as a potential production location, Alpine visited Northeastern University, where company personnel learned of the computer networking engineering laboratory. Upon becoming aware of the laboratory, Alpine officials became interested in the research of Dr. Liu and his colleagues. This interest culminated in 1989, when Alpine engaged in a collaboration with Northeastern

University. The two organizations used the university's lab as their shared location, where they engaged in technology exporting and software outsourcing. Through the use of \$250,000 provided by Alpine, Dr. Liu was able to continue his research in the software field. Alpine represented Northeastern University's first foreign alliance partner, and was a critical factor in resolving the funding difficulties that plagued the initial phases of research and development.

As the research and development efforts of Dr. Liu and his colleagues began to succeed, the researchers established their own company, called OPENSOFTE System Development, in 1991. In that same year, Northeastern University established the Neu-Alpine Software Research Institute (a limited liability company) in coordination with Japan's Alpine. Initial capitalization of the venture was \$250,000 dollars, 49% of which was contributed by Alpine. In 1993, OPENSOFTE merged with Neu-Alpine to form Shenyang Neu-Alpine Software Co., Ltd. In 1996, this company was listed on the Shanghai securities market, making it the first China-founded software company and first Sino-Japanese collaborative effort to be listed on the Shanghai exchange. In 2001, Neu-Alpine changed its name to Neusoft Co. Ltd.

3.2 Opening up the domestic market

While outsourcing certain operations to Alpine Electronics, Neusoft had also been opening up its domestic market. In parallel with its drastic expansion, Neusoft

needed to secure human resources that were employable in high-tech industries. To this end, Northeastern University assisted Neusoft by establishing a “Software Strengthening Class” to train potential employees and redress any problems associated with a lack of capable IT human resources. Moreover, Neusoft also dispatched the graduates trained in this class to locations throughout the country. In the span of just a few years, Neusoft had established a nationwide sales network of 35 bases in China’s major cities, including Beijing and Shanghai.

Alpine Electronics President, Kentaro Kutsuzawa, was a strong proponent of active marketing techniques. As such, he had a number of marketing materials prepared in Japan translated into Chinese. He also personally gave lectures related to marketing for Neusoft. By engaging in these activities, President Kutsuzawa provided Neusoft with the expertise necessary to cultivate fruitful markets. In this way, Alpine Electronics supported Neusoft not only in terms of management capital, but also in terms of marketing and accounting functions. Because Kutsuzawa was frequently busy with operations at Alpine Electronics headquarters, he largely entrusted the management of the joint venture to Dr. Liu. This collaboration served to eliminate the shortfalls in management resources that Neusoft experienced during its initial period (i.e., lack of operating funds and management expertise). Given the complementarity of Alpine and Neusoft’s capabilities, the two organizations can be said to have engaged in a strong, comprehensive partnership.

Through its collaboration with Northeastern University, Neusoft leveraged strengths in the software field to advance into the medical computed tomography (CT) market. In November 1995, the Northeastern University Software Center (a Neusoft subsidiary) merged with the Northeastern University Computer Imaging Center, which was experiencing management difficulties. Using this merger as an opportunity for continued growth, Neusoft took its first steps into the medical CT industry.

Specifically, Dr. Liu proposed that Neusoft carry out software development and system design operations, with hardware parts to be procured from international manufacturers. Using this business plan as a guideline, Neu-Alpine Digital Medical Systems Co., Ltd. was established in April of 1998, when it commenced R&D and production of CT and other digital medical equipment. In addition to procuring management resources from within China, Dr. Liu actively procured resources from overseas. This allowed Neu-Alpine Digital Medical Systems to actively compete with industry counterparts in a relatively short period of time.

3.3 Construction of a software park

As Neusoft continued to grow, it also strengthened through the expansion of its industry-university-government collaborations. As an illustration of this expansion, Neusoft led the construction of a software park to function as a business cluster. In addition, the company established the Neusoft Institute of Information. With Neusoft's

involvement, construction of the Northeast Software Park began in Shenyang in 1995. In May of 1988, the Shenyang New High-Tech Industrial Development Zone was established. However, and despite the fact that the Shenyang City government constructed a high-tech industrial development district in the southern part of the city, this district was unable to attract enterprises to the degree expected. Still, developers of the Shenyang high-tech district believed that Neusoft were to join the district, other enterprises would join the district as well. Operating under this assumption, developers sought to convince Neusoft to enter the district. Because (a) Neusoft had become convinced about the potential of the software industry through its collaboration with Alpine Electronics, and (b) company personnel understood the need to cultivate an active business network, relocation to the Shenyang development district was an attractive prospect for the company. Therefore, in 1994, Dr. Liu created a plan to construct the company's own software park within the Shenyang development district.

However, a substantial investment was needed to facilitate construction of the software park. At that time, Neusoft's sales totaled less than 50 million yuan and its profits were less than 10 million yuan. Despite these relatively modest earnings, the company needed to raise 500 million yuan just to cover construction costs. Following the company's listing in 1996, Neusoft was able to raise 100 million yuan. However, this was still far short of the funds it required to move forward with the project. To overcome this shortfall, Dr. Liu with the president of Northeastern University at that

time visited the Baogang Group, which belonged to the same metallurgy department in the central government. As a result of this visit, Dr. Liu was able to secure an additional 240 million yuan in funding. The fact that Neusoft's parent organization was Northeastern University played an integral role the funding agreement.

As described above, China's first university software park (Northeast Software Park) was constructed in Shenyang in 1995. The software park opened the following year. In addition, Neusoft began construction on the Dalian Software Park in 1998, which opened in 1999. In total, Neusoft has constructed software parks in Shenyang, Dalian, Nanhai, and Chengdu.

One unique feature of these software parks is the close relationships that develop between Neusoft and the other enterprises that enter the parks. These relationships offer several benefits to the parties involved, because many of the enterprises share the same objectives. As such, the enterprises within the park are able to build relationships on the basis of complementary resource pools. As a result of these complementary relationships, Neusoft has effectively circumvented competition with other enterprises in the park in which they have invested. Therefore, they can avoid overlapping construction optimize the use of complementary resources. The construction of these software parks signifies the creation of opportunities for Neusoft's further growth. However, the construction of these parks is also important in the sense that it promotes the development of the high-tech industries within the region

in which they are built.

3.4 Establishment of the Neusoft Institute of Information

In addition to the activities outlined above, Neusoft has established and implemented a structure for developing IT human resources at its institutes that are needed within its software parks. Historically, the biggest problem facing the IT industry has been a shortage of human resources that are knowledgeable about relevant technologies. Having anticipated the potential of the software industry (as well as the human resources-related problems inherent to it), Neusoft trained staff in its own IT vocational school to populate the software industry with capable human resources of its own development.

Although the training of human resources provided Neusoft with capable personnel to fill the ranks of the company itself, it also enhanced the supply of human resources that worked at other enterprises in the software parks that Neusoft had constructed. In particular, first, the company needed to provide support to its existing business partners that had entered its software parks by enhancing the supply of human resources they received. Second, through the supply of capable IT staff to enterprises within its software parks, Neusoft hoped to encourage a greater number of enterprises that required trained IT staff to enter the parks as well. Third, the company believed that the entry of new tenants would stimulate business activity within the parks, thereby attracting enterprises that could serve as business partners for Neusoft. In this

way, Dr. Liu established a mechanism not only for educating potential human resources, but also cultivating a key element for the future development of Neusoft. To streamline this process, Dr. Liu and Neusoft established the Neusoft Institute of Information. The Institute's curriculum was customized to meet the needs of various enterprises and emphasized the training of skilled human resources who could start work immediately following their departure from the Institute.

Starting at Dalian, Neusoft established branches of the Neusoft Institute of Information in various locations throughout the country. In 2000, the Dalian Neusoft Institute of Information was established in the Dalian Software Park on the strength of financial backing from Neusoft (who provided 60% of the funding) and Dalian Software Parks, Ltd. (who provided 40% of funding). In 2002, new branches of the Institute opened in Nanhai (Guangdong Province) and Chengdu (Sichuan Province). Then, in 2004, the Northeastern University Neusoft Institute of Information was established as a faculty of Northeastern University. By 2008, this institute became independent from Northeastern University and began offering four year courses as a private university.

All branches of the Neusoft Institute of Information were established within Neusoft's software parks. Graduates of the Neusoft Institute of Information go on to work not only for Neusoft but also other enterprises that operate within Neusoft's parks. This supply of human resources promotes collaboration among the enterprises in the

software parks through a network of Institute graduates. In addition, by developing human resources, Neusoft contributes to the accumulation of enterprises within the software parks that require IT specialists. In this way, Neusoft simultaneously encouraged its own development and contributed to the supply of human resources to other enterprises.

4. Conclusion

In this paper, we have identified several commonalities and differences associated with the development mechanisms in different regions. Specifically, we have illustrated the nature of the collaborations in which Founder (Beijing) and Neusoft (northeastern China) have engaged.

In both cases, the developments of industry-university-government collaborations were based on mechanisms that achieved growth through an industry-led approach. Although the government's role in the Founder Group's development cannot be ignored, the collaboration shifted such that it was more industry-focused as its development continued. This phenomenon was even more pronounced in the case of Neusoft, which operated in a region that was largely outside the scope of national strategy at that time. As a result of its geographic isolation, Neusoft's collaborations were largely industry-led from the organization's inception; its development was achieved independent of assistance from the Chinese central

government.

Despite their similarities, there were also some differences in their respective development processes and collaborations. Founder benefited from an advantageous cluster environment (Zhong Guan Cun) in which it was able to acquire management resources and expertise, and ascertain market needs during its development stage. However, Founder's international collaborations were only partial in nature; the company was unable to secure parts of necessary quality domestically. Therefore, it procured parts from Canon in Japan.

In stark contrast, Neusoft formed a close, collaborative relationship with Alpine Electronics, another Japanese company. As a result of this collaboration, Neusoft was able to supplement its capital, management expertise, and market information, all of which were critical during the company's initial stages. In addition, and owing to the trust of its partner, Neusoft was afforded discretionary power over its own management. As a result, the company was capable of independently addressing a number of challenges, one of which involved the formation of a cluster. Given these affordances, Neusoft played a central industrial role in a region that had historically focused on heavy industry. For example, because of its collaborations, Neusoft was able to create its own software park and cultivate its own human resources through internal training programs.

These differences are largely attributable to the regional disparities that

characterize the two companies. Whereas Founder is centrally located in an urban center (Beijing), Neusoft is located in a more rural area (northeastern region of China). Neusoft was able to overcome the disadvantages associated with its environment by cultivating high-tech industries and achieving sustained growth.

Although this paper has provided a number of contributions to the literature on university-industry-government collaborations, a number of unanswered questions remain. For example, what were the conditions associated with the investment of foreign capital, and to what extent did these conditions affect the respective successes of the companies mentioned above? In addition, how were the clusters formed and what was the nature of the relationships between the enterprises that comprised them? These questions represent avenues of future research that the author seeks to investigate in greater detail.

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