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SEARCHING FOR MORE INNOVATIVE CAPABILITIES: THE CASE OF ZHONG'GUANCUN, CHINA*

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This paper seeks to examine the agglomeration of new-tech facilities in Beijing, and to present new perspectives for rethinking local development policies relating to the tasks facing the Beijing municipal government and their attendant requirements. The main body of the paper is divided into four sections. The first section introduces the development of the Zhong'guancun new-tech center in Beijing. The second section illustrates the prospect of a local innovation milieu in the Zhong'guancun area, which offer a promising sign of a growing trend toward local networking. The third section turns to examining symptoms of weak local innovation milieu in response to exogenous changes caused by globalization. The fourth section analyzes the logic behind polices promoting local innovation networks. In conclusion, the paper raises some suggestions for bringing local actors together for discussion.

INTRODUCTION

The United Nations Industrial Development Organization (UNIDO) reported in 1996:

> The rapid pace of technological development and innovation and the establishment of new organizational structures in developed countries pose a formidable challenge to developing countries and economies in transition in their efforts to develop new technological capabilities, to innovate and to ensure sustained industrial growth. The emergence of generic technologies … has significantly changed the nature and scope of industrial competitiveness and the organizational structures at the firm level. (UNIDO 1996: 4)
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> Many developing countries, and especially LDCs, have only a small manufacturing base and have not yet established a position in international markets for manufactures …. These countries would then have to adapt to new form of competition arising from rapid technological change, because low wages will no longer guarantee success in sustaining

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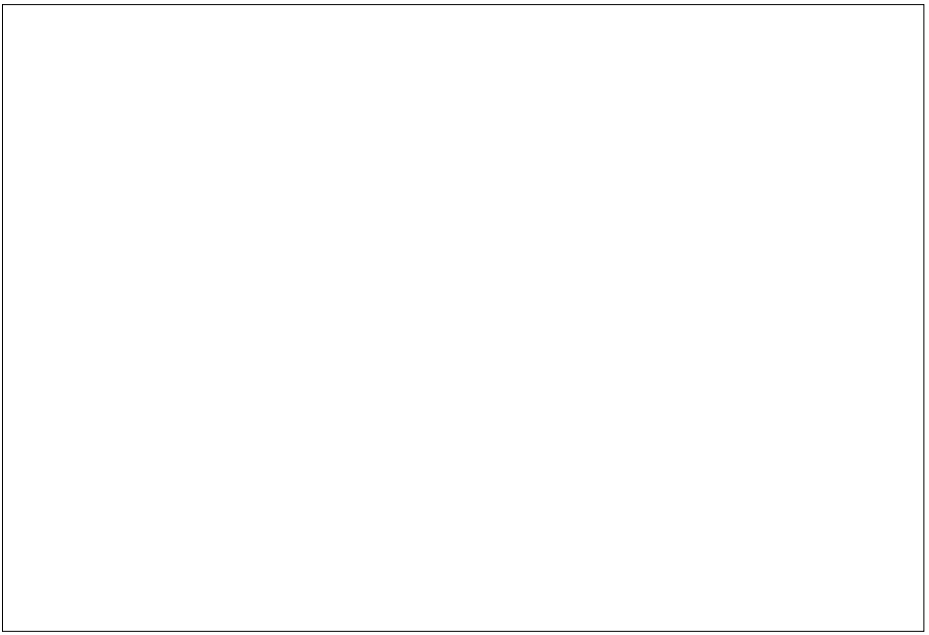
competitiveness. (UNIDO 1996: 10).

The points made in this report are stronghy supported from a Chinese perspective. At one time, the economic growth of the country depended largely upon the building of more production facilities rather than seeking advances in science and technology. As a result, research institutes and the potential for firms to explore their innovative capability is far from being fully developed. At the same time, the amount of money spent annually on scientitic and technological research accounts for a meager 0.5 per cent of china's gross domestic product, compared with 2 to 3 per cent in developed countries(Si Nan 1997). On the other hand, skilled labor shortages are evident in rapidly growing cities, due to continuing inter-regional and inter-firm restraints on migration and the low percentage of the population receiving tertiary education. Although China's economy is advancing at an impressive rate, continued economic growth and sustained competitiveness will requires great efforts to boost science, technology, and education in general. With the rapid expansion of cultural exchange onto a global scale, the competitiveness of the local innovation milieu has become essential.

In this context, the Zhong'guancun area provides an interesting example of a Chinese local innovation milieu. The area is situated in the western suburb of Beijing and the southeast part of the Administrative District of Haidian (Figure 1). With a radius of about 1.3 kilometers, it has long been renowned as the largest intellectually-intensive area in China in which important state-level research and education establishments are located. In this largest "brain-aggregation", china's most outstanding professionals are concentrated in research institutes and universities, and have been engaged in nationally-planned high-tech projects. It picked up momentum in the early 1980s with the advent of China's multifaceted reforms. In 1988, the Beijing new-tech Experimental Zone (BEZ)[1] was established in the Zhong'guancun area. The first of 52 high- and new-tech industrial development zones approved by the State Council, its development was stimulated by demands proceeding from the national policy on industrialization and merchandisation of research results.

The experiences of Zhong'guancun are noteworthy in two respects. On one hand, it is successful with respect to the following points: First, the area

[1] BEZ was zoned by the Beijing Municipal Government as a well-defined area of approximately 100 square kilometers. Because most of the powerful high- and new-tech firms of BEZ are concentrated in Zhong'guancun area, the distinction between the administrative "BEZ" and the address of "Zhong'guancun" is usually blurred. People used to refer to firms as "Zhong'guancun's firms". This paper adopts that usage.



Source: Beijing Strong High-Tech Development Corp.. 1995. *Beijing Shangdi Information Base*, pp. 15-16.

FIGURE 1. THE LOCATION OF BEIJING'S NEW-TECH AGGLOMERATION

has become a gold mine of new-tech products for China since the early 1980s. Second, it represents a new industrial area based on flexible production, even as mass production is in crisis in other parts of Beijing, attended by plant closures and layoffs. (Beijing Academy of Social Sciences Research Group 1997). Third, as a microcosm of technological changes in much of China's economy since the early 1980's, the story of Zhong'guancun provides valuable insights. Fourth, with the globalization of economic activity, increased localization of economic and social processes has been accomplished to some extent in this area.

On the other hand, the area amounts to little more than a new-style administrative district with respect to the creation of a true innovation milieu at any critical level. A technology-oriented complex characterized by synergistic interactions between new firms has not been constructed. Compared to some Chinese conceptions and prescriptions for technological innovation reinaccurate. Biases pushing in diametrically opposite ways—such as preferences as for vertical integration as opposed to reliance on net-

work mechanisms—merit our attention. In light of this, there appears to be a lack of real awareness of how to develop high technology, compounded by a lack of sufficient change in management and organization practices. It must be emphasized, however, that place-specific systems of innovation in China have some unique features that are very different from Western experiences and can not be illustrated within the Western theoretical context.

This paper reflects the need to search for more capacity for innovation within the recently developed long-term strategy of the local government of BEZ. The paper serves to paint a picture of the challenge facing Chinese policymakers. The main body of the paper is divided into four sections. The first section introduces the development of Zhong'guancun new-tech center in Beijing. The second section illustrates the prospect of a local innovation milieu in the Zhong'guancun area, which shows promising networking trends. The third section turns to symptomatizing the weak local innovation milieu in response to exogenous changes caused by globalization. The fourth section analyzes the rationale behind policies designed to enhance local innovation networks. In conclusion, the paper explores ways of bringing local actors together for discussion.

THE DEVELOPMENT OF ZHONG'GUANCUN NEW-TECH CENTER IN BEIJING

Since the late 1970's, China has undergone a period of dramatic change. Through multifaceted economic reforms, China has issued a set of programs and measures which have provided the conditions to "decompose" rigid institutions and to liberate productive forces. These conditions have created a macro environment for a market-oriented economy, which is open to more domestic and international competition and cooperation in general, as well as an innovative atmosphere for the birth and growth of flexible, self-financing, and technology-based firms. The best illustration of latter is "Electronics Street" in Beijing and its surrounding region, — the Zhong'guancun new-tech center.

1. The changing environment and initiators for the new-tech Zhong'guancun

An atmosphere emerged in the early 1980's which was more conducive to innovation, due to the advent of Chinese economic reforms. The central government's strategy centered on economic construction promoted as the blueprint for the reforms introduced at the historic Third Plenary Session of the 11th Central Committee of the Communist Party in 1978. Reform mea-

sures had been introduced into universities, CAS research institutes, and State Council ministries which concern the development of science and technology.

The state government managed to restructure existing research institutions by introducing market-oriented mechanisms. For example, the state made heavy cuts in basic funding for research and development (R&D) in all CAS institutes, while encouraging CAS to set up self-financing and market-driven firms. The state also initiated projects directly supporting certain potential areas for development which had been identified in the country. A case in point is the Program 863,[2] a mandatory state plan for high-tech R&D. The program was intended to "narrow the gap between China and the world in high-tech development." Program 863 was followed by the pro-hgih-tech Torch Program, which was directly responsible for the boom of the small new-tech firms (see Wei 1988). Both the restructuring of the research institutions/universities and the adoption of new programs and projects have formed a favorable environment for new-tech development in China, and have encouraged state-owned institutes to establish research intensive and market-driven firms to tap their own potentials for innovation. As the old economic system was shifted from a hierarchical to a network organizational structure, the region of Zhong'guancun began to develop as an agglomeration of new-tech industries.

A bottom-up trial period started in 1980, with a few professionals took risks and devoted themselves to early experiments in establishing non-state-owned firms in the region. Among other pioneers, Mr. Chen Chunxian and his partners from the Institute of Physics of CAS created an innovative organization — Advanced Technology Development Board of Plasma Association (ATDBPA). This embryonic firm attempts to probe a Chinese model of "technology diffusion", patterned after the success of Silicon Valley in California. These few engineers and scientists, although they possessed the necessary creativity and imagination, were constrained by social pressures working against cumulative innovation and change (Higgins and Savoie 1995). During the initial two years in Zhong'guancun, firmly rooted conservative opinions pressed against the newly established firm. The engineers and scientists were constrained to carry out the research agendas assigned to them by their research institutions and universities, and had little leeway for entrepreneurship. This situation did not change until the beginning of 1983, when the local government sided with Chen and the central government included a positive assessment of Chen's business in its

[2] Named to reflect the March 1986 approval date for the project.

instructional guide for further development in the Zhong'guancun region. Since then, new firms have emerged one after another, opened by academic researchers. By the end of 1983, eleven firms were operating in Zhong'guancun. The number of firms had grown to 40 by the end of 1984, when the Resolution for the Reform of the Economic System was promulgated by the central government. "Electronics Street" appeared in direct response to this resolution.

2. The boom of small firms gives rise to entrepreneurship

From the beginning of 1985, more and more organizations, including CAS and ministry-based research institutes, universities, military, and state-owned firms of medium and large size, have been involved in the innovative activities of "Electronics Street". They deliberately adopted development strategies which would establish their technology—based attempted to set up technology-based firms as try-out pioneers in business in their development strategy firms as pioneers, and would draw fully upon the full initiative of the staff. Consequently, the population of newly created firms increased from ninety in 1985 to four hundred in 1988. These firms are highly concentrated along one street and its surrounding area, forming a new-tech agglomeration in Zhong'guancun.

Since 1988, a group of Chinese entrepreneurs and their firms have become well-known and ready to take their place in the world. For example, Xuan Wang, a professor of Peking University, has gained a reputation as the father of the Founder Group (Fangzheng Jituan) of Peking University. A shift from traditional Chinese methods of mechanical printing and typesetting to electronics occurred as a result of his work. Over ten thousand units of his product—Electronic Printing System for Publishing—have been sold in China and overseas.

Another example is Mr. Chuanzhi Liu and his Legend Group. Relying heavily on its own innovative capacities, Legend focused on designing and developing mother boards and attachment cards designed for the international computer market, and manufacturing personal computer systems loaded with advanced Chinese word processors intended for the domestic market. Approximately 0.2 million QDI motherboards and cards have been sold each month in about forty countries and regions, comprising about ten percent of the international market.

Not every new-tech start-up was lucky enough to establish itself quickly, however. Among other difficulties, the lack of venture capital has been a major obstacle for many entrepreneurs. Instead of focusing on their own

innovative products, many would-be entrepreneurs have been forced to concentrate on commercial activities in order to accumulate capital. In the early 1980's, when the domestic computer market in China was growing, about 80 percent of firms along Electronics Street initially accumulated capital by selling imported electronic products. This trend displays both a distinctive Chinese way of developing new-tech industry from scratch, and the development of a peculiar spatial phenomenon—the "Electronics Street"—and its surrounding area of new-tech agglomeration.

3. The growth of Zhong'guancun supported by governments at different levels

The Electronics Street phenomenon prompted a serious study by the Beijing government at the beginning of 1988. The government decided to make the Zhong'guancun region an experimental zone for new-tech development in China. In May of the same year, a well-defined area of approximately 100 square kilometers centering on Electronics Street was delineated as the Beijing Experimental Zone for New Technology Industries (BEZ), and wide-ranging benefits for new-tech firms were enacted into law.

The BEZ administration is a main framework of regulatory agencies overseeing new-tech firms (See Gu 1996). As a regulatory institution, the Management Commission of BEZ handles affairs such as licensing, taxation, international trade, finance and investment, employment, and intellectual property for new-tech firms, largely in accordance with national policy stipulations, but subject to slight local modifications. As a supporting institution, the Management Commission of BEZ invests in the infrastructure needed for new start-ups, some initial capital, and managerial guidance. It also works as an interface between new-tech firms and funding sources. Interviews conducted by Gu showed that the zone administration quite often provided recommendations on new-tech firm applications for bank loans and government funds (Gu 1996).

While supporting new-tech firms, the BEZ Management Commission also constrains them to abide by the law. It awards certificates to the firms performing well—a prerequisite to qualifying for State Scientific and Technological Loans. The Commission removes poorly-performing firms from the list of the new-tech firms which are eligible for preferential treatment in BEZ.

The Management Commission of BEZ devotes much attention to promoting entrepreneurs and improving their image. It has implemented an incentive policy to encourage individual innovation. The BEZ policy of promoting new-tech firms has taken the form of various kinds of incentives and

relief, such as tax exemption and reduction. The power of this policy has subsided, however, because of the establishment of an additional 51 state-level new-tech zones under the same tax policy. The Management Commission has also been tolerant of the illegal "misoperations" of some founders, such as buying quotas from some state-owned firms in order to import computer components without permission from the government. This tolerance actually created more free spaces for pioneer activities.

In addition to local government efforts through the Commission, the central government also has a grants system which aims at stimulating innovation, including such incentives as the State Invention Award, the State Torch Award, the State Award for Science and Technology Advance and the State Natural Science Award. Small firms benefit from access to a wide range of grants. Such initiatives have improved the image of technology in the media, creating a more conducive social atmosphere for innovation. Furthermore, in order to increase the flexibility of capital accumulation, the government has minimized its intervention in the region. Since firms are responsible only to their management, they are not accountable to the government, and are able to respond quickly to the volatile market.

The annual growth rate of the new-tech firms recognized by the Management Commission of BEZ was 48 percent from 1988 to 1994, and the total number of the new-tech firms reached 4299 at the end of 1994. The record number of the new-tech firms registered within a month was 200, set in 1993. A detailed survey conducted by Gu (1993) found that BEZ new-tech firms held the lead in the field of "computer parts and peripherals" and "character and graphic processing technology and apparatus". The competitiveness in both categories is underpinned by a special ability in Chinese Character Processing (CCP) technologies, which were commercially developed in new-tech firms. CCP was developed both for the imported computer market and the market for Chinase-developed application-technologies (Gu 1996).

Separated from "Electronics Street", a planned industrial park of 1.81 square kilometers, named Shangdi Information Industry Base (SIIB), was constructed for production activities. SIIB was sponsored by the state-owned Beijing Strong High-tech Development Corporation. The park welcomes firms from all over the world.

LOCAL INNOVATION MILIEU: AN ANALYTICAL FRAMEWORK

It is proved by international experiences that the process of innovation is highly complex, incorporating feedback from the market to production,

engineering, and design components. It requires the integration of a firm's R&D and manufacturing with related activities of suppliers and customers. In order to deal systematically with barriers to innovation, regional and local innovation networks based on long-term co-operative relations between businesses, politico-administrative authorities and scientific institutions are the focus of research literature (Braczyk and Heidenreich 1996). From this perspective the idea of the local innovation milieu — a network system — corresponds to an analytical framework aimed at understanding technological change in local systems.

Historically, under the former Chinese command economy system, the development model of the Zhong'guancun area is extremely hierarchical. Universities and research institutes were authorized by more than 40 supervisory agencies of different sectors at national and local levels. By the end of 1970's, although there had been great potential for innovation, the hierarchical, bureaucratic organizations inhibited fast innovation. Under these circumstances, the same or similar research project was often carried out repeatedly by different individual research groups. Consequently, a considerable amount of research results remained at the local laboratory level.

Zhong'guancun appeared to represent a genuinely entrepreneurial new-tech agglomeration as reforms attempted to replace the old economic system by shifting from hierarchical to network organizational structures. A favorable atmosphere for innovation and a bottom-up trial period became apparent in the early 1980's, just as the economic reforms began to take effect. Reform measures and market-oriented mechanisms had been adopted in universities, research institutes, and state-owned industrial firms. In the beginning, a few professionals took the risks inherent in devoting themselves to an early experiment for establishing non-state-owned firms in the area (See Wang and Wang 1997). Consequently, universities, CAS and ministry-based research institutes and military or state-, army-owned firms of medium or large size, have increasingly established technology-based and market-driven firms as experimental business pioneers for the purpose of developing strategies for converting research results into marketable products. During the past decade the population of newly created firms had increased rapidly in this area that has undergone far-reaching changes (Table 1).

The research institutes and universities directly provided their high- and new-tech firms with technical personnel, capital, sites, and equipment. For example, The Institutes of Computing Technology attached to Chinese Academy of Sciences made an investment of 0.2 million *yuan* to establish Legend Computer Group Co. in 1984. Peking University invested 0.4 mil-

TABLE 1. FOREIGN INVESTMENT IN BEZ

Year	1989	1990	1991	1992	1993	1994	1995
Number of firms	36	70	140	300	700	780	806
Account for firms' total (percentage)	4.2	7.2	10.4	12.3	18.6	18.4	18.2

Sources: Information Statistics Center of BEZ. 1996. *Research Report of BEZ, 1996*, p. 13.

lion *yuan* to set up Beijing Founder Electronic Co. Ltd. in 1986. Unis Group Corporation was set up by Tsinghua University with 1.2 million *yuan*. Meanwhile, entrepreneurial professionals make full use of "four-self principles"[3] and actively set up joint ventures (non-state-owned high- and high- and new-tech firms) with local governments and other organizations.

In the 1990's, BEZ receives powerful assistance by attracting foreign firms, such as IBM, AT&T, Intel, HP, DEC, Microsoft, General Electric, and Bell South of the United States, and Mitsui, Mitsubishi, Matsushita, Hitachi, NEC and Canon of Japan. The number of foreign firms has increased rapidly (Table 1). Compared with that of other firms, the growth of the firms involving foreign capital experienced the fastest growth. Total foreign capital invested in BEZ reached over one billion U.S. dollars, including registered funds over 700 million, and direct foreign investments of $ 400 million U.S. dollars.

The annual growth rate of the high- and new-tech firms recognized by the Management Commission of BEZ is 35.6 percent since 1988. At the end of 1995 the total number of high- and new-tech firms reached 4500. The annual gross income of BEZ reached 25.8 billion *yuan*.[4] The total industrial output value of BEZ accounted for 80 percent of the Haidian Administrative District's total and 8 percent of the total for the Beijing Municipality. Twenty-one BEZ firms achieved industrial output values in excess of 0.1 billion *yuan* (RMB). Domestic creative firms include Stone Group, Peking University Founder Group, Legend Computer Group, Beijing Huasun Computer Co., Beijing YaDu Sci-Tech General Co., Hope Computer Co. Ltd., Beijing Four-Ring Pharmaceutical Factory, Time Group, Tsinghua Unisplendour Group, and New Auto Group, among others. Most of them are engaged in the field of electronics (Chen 1997).

[3] Most new-tech firms of Zhong'guancun comply with the "Four-self-principles" encouraged by the government. The "Four-self-principles" are: self-chosen partners, self-financing, self-operation, and self-responsibility for all losses caused by the venture.

[4] The annual gross income indicates the annual gross income of technology, industry and trade. It is defined as the sum of annual sales income from firms' three activities - manufacturing, technology transactions and other trade.

TABLE 2. DIMENSIONS OF BUREAUCRATIC, HIERARCHICAL ORGANIZATIONS AND REALISTIC NETWORK ORGANIZATIONS IN THE CONTEXT OF CHINESE INNOVATION

	Bureaucratic, hierarchical organizations	Realistic network organizations
Relationship between higher and lower levels of administration	Many levels. Controlled, command relationships	Few levels. Appropriate or desirable to deal with lower levels, free to accept or reject the offers from higher levels
Management style	Autocratic	Participative
Boundaries between actors	Fixed. Vertical integration	Permeable. Outsourcing and alliance
Forces driving innovation	Government command from above	intense commercial competition from below
Expenditure	From government	From government and firms
Innovation process	Sequential	Parallel
Features of innovation	Slow	Fast, productive and quality
Type of innovation	Technological	Technological and institutional
Benefit	Government	Share of actors
Economic system	Command	Market

Source: Chen Yilong. 1997. "The Role of the University in Regional Innovation Network of Zhong'guancun". Master thesis, Research Institute of Science and Society, Tsinghua University, p. 30.

The industrial output values of the information and photo-mechanic-electronic integration industries account for 35 and 24 percent of the BEZ industrial structure respectively. This indicates the electnonics specialization which has occurred in BEZ.

The process of new firm formation in Zhong'guancun area has resulted from networking-reorganization of technological personnel resources and a restructuring of science and technology systms. Table 2 shows the Dimensions of bureaucratic, hierarchical organizations and realistic network organizations in the context of Chinese innovation.

Figure 2 shows a simplified model of Chinese hierarchy in which circles of three sizes represent three levels of organizations and actors. Expressed by solid-lines and one-way arrows in the figure, the higher-level actors exercise absolute control over the activities of the lower-level. In other words, lower-level actors only obey their authorities. There is almost no direct linkage between actors at the same level. In reality, the pyramid controlling rela-

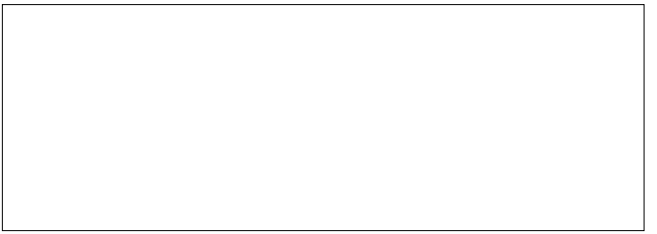


FIGURE 2. HIERARCHY MODEL IN CHINESE CONTEXT

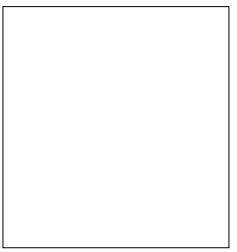


FIGURE 3. WEAK LOCAL INNOVATION NETWORK MODEL IN CHINESE CONTEXT

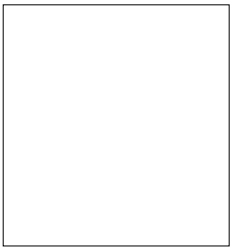


FIGURE 4. STRONG LOCAL INNOVATION NETWORK MODEL IN CHINESE CONTEXT

Source: Chen Yilong. 1997. "The Role of the University in Regional Innovation Network of Zhong'guancun". Master thesis, Research Institute of Science and Society, Tsinghua University. p. 30.

tionships is more complex. Each lower-level autor is subject to control by many authorities at complicated higher levels. This situation happens frequently in China, especially in Beijing where institutions have existed at many different levels. According to a Chinese saying, "the firms of Beijing have too many mothers-in-law".

Figures 3 and 4 show the realistic transformation process from weak to strong local innovation networks in Chinese context. Leading actors at all levels still perform administrative functions, but some control over the lower levels has been relinquished, as indicated by the dotted lines, so that actors at lower levels have more discretion to handle their own affairs. As a result, widespread connection and cooperative relationships could be established among actors sharing a common goal, as indicated by the solid lines and two-way arrows. In other words, horizontal economic co-operation increases in strength and closer network relations form gradually.

The local innovation network in Zhong'guancun, although still week,

should be regarded as an open system. The actors involved are small and medium firms, universities, research institutes, and government agencies—including central and municipal industrial bureaus—and the BEZ management commission. Innovation-related resources such as capital, technology, information and personnel, should flow along channels between these actors.

We can deduce from the above that some important task involved in building the innovation network at the Zhong'guancun area include weakening hierarchical relationships, strenghtening inter-sectoral links, and developing continual cooperation between actors. These are keys that will tap the innovation potential of this area through synergy and cross-fertilization.

Unfortunately, despite an increasing international understanding of the innovation process, there is still a mistaken perception among the Chinese public that innovation follows a linear sequence. It has been impossible, therefore, to improve the ability of firms as a whole to achieve competitiveness—a factor that underlies Zhong'guancun's limited capacity for innovation. In this respect, I suggest that the Zhong'guancun area should seek additional innovative capabilities through the development of its local innovation network (Wang 1997).

In the next section, the following problems are treated as symptoms of weak innovation networks: a new trend toward hierarchy biases, weak local networking and weak local embeddedness.

1. Hierarchy biases

Porter writes in *Competitive Advantage of Nations*:

"Conventional wisdom argues that domestic competition is wasteful: it leads to duplication of effort and prevents companies from achieving economies of scale. The 'right solution' is to embrace one or two national champion companies with the scale and strength to tackle foreign competitors, and to guarantee them the necessary resources, with the government's blessing. In fact, however, most national companies are uncompetitive, although heavily subsidized and protected by their government. ... Domestic rivalries, like any rivalry, create pressure on companies to innovate and improve." (Porter 1990)

Seven years later, after ten years of promoting the development of small firms, Chinese policy-makers still adhere to the model of large-scale vertically-integrated corporations. They are unaware of Porter's criticism and of the Western experience that "the key problem for small firms appears not to

be that of being small, but of being isolated" (Pyke and Sengenberger 1990). The belief still prevails in China that small firms can overcome their deficiencies in capital and technology and acquire the attributes of larger organizations only through vertical integration. Such a belief has resulted in an increase, rather than a decrease of vertical integration and a new form of hierarchical control in the past decade.

Some background information on the Chinese industrial system is in order here. As recognized in existing literature, the Chinese economic system has basically faced a general choice between integrating activities and fragmenting them across distinct firms. This choice is quite different from the "markets versus hierarchies" choice in Western market economies. In China, the alternative to integration is not the market but rather the administrative allocation of goods flowing between separate entities. The choice is not a natural, although empirical regularities may be observed in decision-making process and outcomes. It is subject to administrative fiat, and outcomes are influenced both by bureaucratic conflicts and administrative power, including at times, the power of large firms. For these reasons, inefficient outcomes are not surprising (Byrd 1992).

In the last half of 1990, the greater part of the Chinese industrial system still remains in a stage of mass production and consumption with the exploitation of economies of scale. Since the middle of 1996, a "sounding voice" could be heard in Chinese public opinion, asserting that, "A system of small scale firms in our country cannot compete with international giants in a global economy." "Organize large Chinese corporations!" "Up size!"

The current decision of the reform policy for state firms—to promote large firms and invigorate small ones—(*Zhua da fang xiao*) is implemented in state-owned sectors all over the country. This trend necessarily influences other parts of the economy, such as township firms (Beijing Review 1997) and non-state-owned high- and new-tech firms. The following is from an official statement:

"We will implement the large company and large groups strategy, with the greatest efficiency as the principle, brand name and fine-quality products and firm groups as the carriers. We encourage association between strong firms and merger of inferior firms with superior ones, so as to concentrate resource elements on superior firms in the regrouping process." (Wang 1997)

The same voice sounds in the high- and new-tech sectors, as well. This reveals that the Chinese strategy of developing high- and new-tech industry from lower levels displays a particular method which is largely different from contemporary Western countries. After a decade of fierce rivalry, there

has been a shift from isolated organizations to vertically integrated corporations, following the Western model of mergers and amalgamations. It is believed that the preference for vertical integration over network mechanisms is justified to a certain extent in China.

- *The need for capital concentration*: The development of most high- and new-tech firms has been greatly hindered by a lack of venture capital. High- and new-tech firms also have difficulty in acquiring financial support from the government. Vertical integration, therefore, is a response to current conditions in Chinese economic and technological development. It is a practical necessity to find the "right solution" criticized by Porter. It is recognized that the principal result of the bitter competition between small high- and new-tech firms is that China benefits little from economies of scale and experiences only poor synergy among R & D and manufacturing concerns.

China has long been lacking in venture capital. Major firms in the area, including Legend, Founder, Jinghai, Daheng, Hope, and Stone, have followed similar developmental paths. Their entrepreneurs, eager to advance their own innovative products initially, had to involve themselves in commercial activities such as selling computers and computer components and developing real estate, in order to accumulate capital.

As Table 3 shows 65 per cent of all BEZ firms received loans from financial institutions. Since 1984 national financial institutions, such as Industrial and Commercial Bank, Agriculture Bank, China Bank, China Construction Bank and China Insurance Company, established branches one after another in the Zhong'guancun area. Lately, City Financing Company which has served both collective and individual economies has also established itself there. By the end of 1993, all kinds of financial institutions have been granti-

TABLE 3. THE FINANCING CHOICES OF FIRMS IN BEZ

Financing choice	Per cent of firms' total number
Loans from financial institutions	65.0
Foreign capital	12.7
Share financing	7.6
Venture capital	5.6
Joint venture	4.1
Others	5.0

Sources: Information Statistics Center of BEZ. 1996. *Research Report of BEZ, 1996*, p. 10.

ng a total of 3.8 billion *yuan* in loans to BEZ, including fluid capital loans of 3.18 billion *yuan* and the scientific development loans of 0.62 billion *yuan*. This quantity is 2.8 times greater than that of 1988. By 1995, there were almost 200 financial organizations with about 4000 staff members in BEZ.

- *The need to shelter weaker firms*: Larger high- and new-tech firms could serve as incubators and seed beds for smaller firms. Eighty-eight percent of BEZ firms have a total income of less than RMB 5 million *yuan*, indicating a structure strongly oriented to small firms (Information Statistics Center, 1994). The rapid shift from a very rigid planned system to a partial, underdeveloped market led to widespread impulsive acts and a severe lack of marketing experience. At that time, profits from computer sales—a major source of capital accumulation—decreased considerably. The difficult conditions in which small firms are situated is described in the Chinese phrase "*jiu si yi sheng,*" meaning that, among every ten firms only one survives (Xuan Wang, the Founder of the Founder Group).

The Founder Group, a noted large and young printing corporation of Peking University, illustrates this point. In early 1990, Peking University had 15 high- and new-tech firms at the university level. Spin-off activities were common and mainly ocurred in applied science departments (or colleges) (Wang and Wang 1997). At present, five groups (Founder, Ziyuan, Weiming, Qingniao, Weixin) constitute the main industrial body of Peking University. Among them, the Founder Group Corporation represents the university's power.

In 1986, Prof. Wang Xuan founded the Beijing Founder Electronic Co. Ltd. with assistance from Peking University. A decade later, the corporation earns an annual net profit in excess of 130 million *yuan*. The scale of its business has extended into many fields of electronic publishing. The Group consists of 37 subsidiaries and a large chain of more than 300 distributors across the nation (Jiang 1997). In 1996 it employed about two-thirds of the 3,000 industrial employees at Peking University. Industrial output value accounted for more than 90 percent of the University total in 1996. Its performance can be attributed to the processes of acquisition and mergers, which have been encouraged by the University and the central government. Founder is taking over firms inside and outside Peking University, leading to an oligopolistic structure. As stated by an executive of the Group: "More comfortable it is to have a rest in the shadow of a big tree. Most of the small firms should stay under the shadow of a big firm." "A car could run faster when

it is on the highway."

Meanwhile, in order to find a "right solution" in order to benefit from large business, the Chinese Academy of Sciences, Tsinghua University also implements a large business strategy (Wang and Wang 1997). It may be seen that, through merger process, the number of BEZ's firms should decrease from now on.

• *The need for management experience*: It is evident that many Chinese professional firms produce good research results but lack management personnel and experience. This problem can be solved when experienced larger firms assume control over the results of their research.

• Such integration may be rational if large hierarchical firms could increasingly give way to more decentralized organizational forms, in which the transfer of intermediate responsibility to lower levels and inter-networking takes place, assisted by new technologies. One member of the staff at Peking University's company, which is to be merged expressed the hope that his company could enjoy relative independence and flexibility after merging. It is possible, however, that the Zhong'guancun area could become more hierarchically oriented.

As the process of merging occurs, the economy of BEZ is dominated by a small number of larger firms. The four largest firms account for about fifty percent of the total industrial output value of BEZ. And, the number of high- and new-tech firms registered in 1992 and 1993 was highest when retired Chinese leader Deng Xiaoping paid a visit to south China in early 1992 ("Deng the Whirlwind"), indicating an overwhelming enthusiasm to create high- and new-tech firms. The number of startups has reduced continually since then. On the other hand, the number of deregistered firms has increased quickly. Individuals with experience in starting up new firms in this area are difficult to find, indicating a lack of adequate entrepreneurship. From this, we would expect the number of high- and new-tech firms to decrease continually from now on.

The merger process is not proceeding without problems. As the following saying goes: "There are a lot of children whose mothers don't have breast milk. They are going to die. However, mothers are usually unwilling to give their children's lives. The children would rather die than change their names." That is to say that borders cannot easily be taken over simply by integration. It is necessary to take into account some of the costs of integration that are usually overlooked. Moreover, administratively imposed name changes are unpopular, as this process results in equating some well-performing "small giants" with other, less successful firms.

In addition, diversification (both related and unrelated) occurs in conjunction with merger activities. Almost all firms of Zhong'guancun are seeking to extend their activities in other fields. Notably, the Founder Group penetrates into the chemical industry, and the Stone group operates in food industry. Because most electronic firms which receive loans from banks can not afford high interests solely with the proceeds from their electronic products, they must make more money from other fields. This trend may inhibit innovations in the fields of specific technologies.

Although merger activities in Zhong'guancun are rationally to a certain extent, it is necessary to realize that changing competitive conditions could overwhelm the independent firm-based industrial system. As demands for a variety of products increasingly replace demands for cheap, standardized products, large business organizations designed to achieve economies of scale will face the risk of internal segmentation and bureaucratization. There is a big danger that the hierarchical structure of some corporations can limit their ability to adapt quickly to changing conditions. Their inward focus can also limit the development of a sophisticated local infrastructure, leaving the entire area vulnerable when large firms falter.

2. Weak local networking

Two types of local inter-firm linkages are evident in the Zhong'guancun area: information sharing and physical input-output transactions, constituting a week network pattern (Figure 3). Apart from the price-report periodicals of certain information networks, information exchange in Zhong'guancun occurs through several non-profit organizations, such as the Beijing New-tech Enterprise Association, and the Non-state-owned Enterprise Association. They attempt to hold regular meetings to allow members to exchange experiences about each other's operations. These organizations have maintained an informal character. These face-to-face circles exist in different periods to solve concrete problems: adapting to the changing policies of the economic reform, seeking credit guarantees by small firms, or finding ways to deal with new situations. Perhaps the most powerful of such organizations is the Chinese Software Alliance which plays a role in protecting the property rights of firms. Such informal communications and information exchange do not seem to increase the chances of co-operation for innovation. The Taisun Industrial Community (TIC), TIC was formed in 1994 by representatives from 15 non-governmental firms including famous "small giants" such as the Legend Group and the Stone Group. However, the real purpose of Taisun Industrial Community was not to promote technological

development. It has failed to integrate the financial real estate, and other businesses of 15 firms as originally planned.

Physical input-output transactions have been low, with few materials flowing between firms, such the exchange of components, finished products, or sub-assembly work. The needs of the demanding customers are increasingly being met by large stores selling electronic accessories, both locally and nationally.

As mentioned in above section, the process of forming new firms can be recognized as networking. Defined thus, we can identify a few network-style and flexible organizations in this area. Two cases in point are companies located near the south gate of Tsinghua University, hiring part-time personnel from universities or research institutes. One is the Greatwall Enterprise Institute (GEI), a noted non-state-owned consulting company, which hires a staff of less than ten. Nearly fifty personnel, however, continue to work part-time at GEI even after three years. Most are students or professors from Peking University, Tsinghua University, and Chinese People University. At present, more than ten postgraduates and three faculty members are working at GEI, with a range of specialties related to the business of GEI. Another example is the Huafu Electric Power Corporation, established by a professional who formerly worked in a large state-owned plant. Its R&D staff members are drawn almost entirely from students and postgraduates at Tsinghua University (Chen 1997).

A few joint training projects can be identified as well. For example, the Stone Group, the largest non-state-owned high-technology firm in China, invested a large amount of money in 1994 to cooperate with Peking University in a two-year project to offer MBA training courses to higher-level Stone staff members. Another example is the New Auto Group, which invested 1 million *yuan* in 1996 to cooperate with Beijing Broadcasting College, Beijing Science University, and Beijing Aerospace University, among others, to train postgraduates in high-technology fields (Chen 1997).

The links between universities and industry, however, particularly those links with small business, have not been as strong as they should have been. University business-related departments and schools are not as sensitive to local economic circumstances as they should be. It is important to stress the fact that a lot of graduate students are interested in trade business, rather than in other fields leading to the long-term advancement of Chinese technology.

The co-operation among actors in the Zhong'guancun area is still inadequate. In the absence of co-operation, a number of firms have established their own supply sustems and services for their personnel. Scienctific inter-

actions between scientists and professors from different institutes, and even between different departments of the same institutes or between different persons with similar interests, are still rare, as well. For the time being, this isolationist situation, which steadily erodes the local innovation system, is becoming increasingly serious. Evidence in state-owned universities and research institutes shows that each distinquished researcher working on a specific line of research receives a small or medium amount of funds from central or municipal government foundations for science and technology. The funds serve not only to cover R&D expenditures, but also salary supplements. They expect to report their research results only to the foundations, or to publish in those academic journals which will advance their prospects for promotion. Therefore, they prefer to do research projects alone. Competition is playing an increasing prominent role in the application process for government funding, causing serious waste of national capital and human resources.

3. Weak local embeddedness

That local firms are weakly embedded in the Zhong'guancun area is reflected in two different aspects. Production facilities of local firms are mostly located outside of Beijing. Additionally, branches of multinational firms are based elsewhere since inward foreign investment began to enter the area in the early 1990s (Wang and Wang 1996).

There are few examples of successful co-operation among the high- and new-tech firms of Zhong'guancun and those state-owned firms operating under the shadow of Beijing's old management system. The essential difficulty lies in incompatible operational systems. Many traditional state-owned firms in Beijing have failed to compete with firms from other provinces in linking themselves with promising Zhong'guancun firms, in terms of production costs and flexibility to meet demanding requirements from high- and new-tech firms.

Tsinghua University and Beijing Airspace University are two cases in point. Tsinghua University signed 124 contracts with the Hebei, Guangdong, Shandong, Zhejiang and Jiangsu provinces for joint projects in 1995. Beijing Airspace University has been networking with firms in the Guangxi Zhuang Autonomous Region and Shandong provinces (Chen 1997).

The trend for the high- and new-tech firms in Zhong'guancun to look outside Beijing for co-operation can be attributed to the following points. First, dispersion is directly related to land requirements and industrial linkages.

Second, rent and taxes for offices and shops are higher than those in many other cities. Third, there is more room and greater flexibility in other provinces, particularly those provinces far away from the capital city. Moving out of Beijing helps the high- and new-tech firms escape some of the rigidity and formality of the old system which is still prevalent in Beijing, and to take advantage of informal, and in some cases illegal, channels to locate their production facilities nationally or even internationally.

On the other hand, the weak local networks found in the new-tech agglomeration in Beijing, motivate the firms there to link themselves with multinational firms for alternative support. China's "small giants" in the fields of high- and new-technology have already cooperated or collaborated with multinationals. Almost all universities and institutes of the Zhong'guancun area have established co-operative relationships with foreign corporations. By the end of 1995, more than 1100 foreign firms had invested in the BEZ, including 820 Sino-foreign joint ventures, and 5 Sino-foreign co-operative firms, of which nearly 800 had been registered as featuring new-tech industries. IBM, a world leader in the information industry, established two research institutes in the Beijing Shangdi Information Industry Base, a new industrial park in BEZ. One is the Chinese Research Center of IBM, the other is 'DingXing Information System Development Co. Ltd.' — a joint venture with the Software Technology Center of Tsinghua University. The main reason that IBM builds up the R&D center in the ShangDi Information Industry Base close to Tsinghua University, is that can sources of intelligence and technology are concentrated in that area (Chen 1997).

DISCUSSION / CONCLUSION

In the previous sections, I draw attention to the analytical framework and policy motivation for enhancing local innovation networks, emphasizing what the actors should do. However, my current survey reveal that, for the firms of Zhong'guancun area, the forces motivating innovation are presently inadequate. The demand for the innovation milieu is inadequate as well. The time does not seem ripe for proposing such a requirements. There are several possible causes of this problem.

• The realistic local innovation network should be built in response to enormous changes in China as it approaches a more market-oriented society. However, as these changes occur, firms are faced with many other basic problems such as concerning property rights, commercial and financial

laws, share-holding. What is unique to the firms in Zhong'guancun is that the lack of these regulations and laws for a market economy and the inconsistent and unclear government policy have hampered the development of networking among local firms.

It must be noted that there is an important difference between the deregulation process occurring in Western market economies and the deregulation process in China. Deregulation in a traditionally market economy is often a process whereby some regulations having supposedly negative impacts on operation are selected and removed to stimulate the vitality of the economy. In China, when the rigid planned system was broken down by a similar deregulation process and the vitality of production was stimulated, there were few laws or regulations which were necessary and suitable for a new market system. This was particularly true in Zhong'guancun area, where both the products and the producers were new. As a result, entrepreneurs stood in a brutal, developing market environment, struggling against unfavorable factors both from the old system and the new. The firms exist in a world of unjust competition. In such a situation, the struggle for survival, not innovation, is considered the most important task.

• With regard to cooperation, "ownership distance (within domestic firms)" is worth noticing. Two or more systems of ownership coexist within the relationships of firms. In Zhong'guancun, a large number of high- and new-tech firms were spun off and continue to receive strong support from their state-owned parent institutions or universities. Such strong vertical ties work against the formation of networks with new innovative firms that are "semi-detached" from their parents, drawing the former back into the old hierarchical systems.

• One of the roots of the problem lies in a general lack of understanding on the part of China's financial community about the need to put money behind technology, and to show patience in waiting for the investment to pay off. This has caused a vicious circle for the firms in this area. The personnel of firms, universities and research institutes must spend much time seeking money from trade, real estate development, or high interest loans from banks, but have few incentives for innovation.

• It is evident from Western experience that the ability to synthesize complex technologies clearly seems to require relationships of trust among actors. Although Zhong'guancun is preparing to enter the information age, the local culture seems seriously behind the times. Its key question, however, revolves not only around the centrality of the family recognized by Fukuyama (Fukuyama, F, 1995). The historical tradition of federal separation has resulted in a sepatatist culture and past separatist political champi-

ons. The Cultural Revolution, for example, seriously damaged trust relationships between individuals. In addition, the conservative ideas of Beijing officials have had a negative impact on local culture.

In summary, I believe that the local actors of the Zhong'guancun area should become more deeply embedded in the local economy and create a local networks in order to generate the self-sustaining growth of the local cluster as a whole. Otherwise, a local cluster could be little more than a set of weak nodes within a wide network of powerful multinationals. For developing countries such as China, understanding and building innovation networks, is necessary, but very difficult.

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