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Science and Technology Parks in China

The Case of Nanjing

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1. INTRODUCTION

China, one of the few countries in the world still powering ahead with enviable economic growth in the midst of global economic down-turn, is also starting to immerse itself in the development of science and technology parks. After over a decade of sustained and rapid economic growth, averaging over 10% per annum during the 1990s, China recognizes that it must go beyond being a cheap labor manufacturing base if its economy were to continue to expand. While China has started science and technology parks (S&TP) development some time ago, it is only in recent years that China has taken on the model of science and technology parks in a sustained and integrated manner to assist with its drive for economic transformation. This is not to say that China has not developed numerous industrial parks but these have chiefly focussed on manufacturing. This type of S&TP China has in multitudes but the more strictly defined science technology park is still a rarity.

This brief paper surveys the range of science and technology park developments in China and focuses on one example in the city of Nanjing to illustrate what may be a new approach for China.[2] This survey hopes to answer the following questions: what is occurring in China in the area of science and technology park development? Is China doing anything different from other countries more experienced in such developments?

The next section of this paper outlines the context in which China's science and technology park programs have emerged. A section follows this on the recent national programs to encourage the development of science and technology parks. A brief case study of Nanjing then follows.

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[2] Nanjing is the capital of Jiangsu Province. It was for a time the capital of the Republic of China and the burial place of Dr. Sun Yet-Sun, the founder of modern China.

2. NATIONAL CONTEXT

a. Rapid economic growth

During the decade of the 90s, China's economy powered ahead while the rest of the industrialised economies stagnated. From the hay days of early 90s when China's GDP growth reached 14.2% in 1991, it has now moderated to around 7% even as the rest of the world languished. At the same time, China has attracted the largest inflow of foreign direct investments, seemingly at the expense of other Asian industrialising nations.

There are several notable features of this rapid economic growth. An obvious feature is the regional imbalance it has exacerbated. Much of the growth, especially foreign investment driven economic development has concentrated in the coastal regions, particularly in the main coastal cities of Shenzhen, Guangzhou, Shanghai and Beijing. A second feature is that much of the growth is driven by foreign investments in labour intensive sectors, especially at the beginning of this long period of economic growth. These investments have both locational and sectoral preferences. For example, in southern China, much of the initial labor-intensive development is through the shift of manufacturing activities first from Hong Kong and then from Taiwan to the provinces of Guangdong and Fujian.[3] A third feature is the commensurate growth in heavy industries concentrated around the existing industrial centres of China, such as Beijing, Dalian and Shanghai where much of the iron and steel industries and automobile industries are located. A further feature is the rapid development of tourism and service industries as part of this rapid economic growth.

b. National programs of science and technology development

In 1979 as the first wave of its liberalization policies, China established "special economic zones" in four cities along the coast: Shenzhen, Xiamen, Shantou and Zhuhai. Of these four, the most widely known is Shenzhen which is located across the border of Hong Kong. Much of the first developments in Shenzhen were based on industrial park, sometimes also called high tech parks. However, these were a far cry from what the rest of the world known as science and technology parks.

As part of its drive towards industrialization and in recognition of China's lack of international experience, in 1994 China invited Singapore to invest in the Suzhou Industrial Park as an attempt to import management and development methods successful elsewhere.[4] Unfortunately, this particular example has not achieved the early goals established for its development. What this well-publicised joint-venture unleashed was a nation-wide fervour of developing industrial estates as a means of promoting industrialization. It led to uncritical, over optimistic and often unwarranted investments in real estate developments touted as industrial estates which are sometime touted as high tech parks. One of the reasons driving such feverish industrial estate development was that the lease of land is one of the few ways that local governments can generate significant revenues. This approach has a legacy that also characterizes the drive to establish science and technology parks.

Science and technology development has been part of China's national agenda for decades but it has manifested itself in different guise over time. The Chinese government started a series of reforms in the mid 1970s starting with rural reforms aimed at stimulating the moribund rural economy. The results were very positive. In the mid 1980s, in response to the rapid development of rural and village enterprises, the national government tried to

[3] FDI was most heavily in Leather Manufacturing, plastics, scientific instruments, mechanical, food and food processing, textiles and garments (in ranked order).

[4] The SIP has an area of 70 sq. km and it was established as a model park based on the Singapore experience. China hoped that the SIP will bring the Singaporean management method to China and expected rapid development to ensue.

leverage that significant growth by establishing the "Spark Program". The aim of the Spark Program was to start a large number of technical projects in rural areas and leverage small amounts of investments to encourage rural managers and entrepreneurs.

Soon after the Spark Program was established, the national government sought to stimulate science and education and started what it called the "Torch Program" to identify project that will bring together science and technology with applications for the promotion of the national economy. To this end, the national government encouraged high technology development zones and the establishment of Science and Technology Industry Parks (STIPS). A total of 53 National STIPS (including those called New and High Tech Zones) have been established since but the national government has since the mid 1990s added new elements to this program. In 1997, the State Council approved 10 of the STIPS to be open to investment from APEC members.[5] In the year 2000, the Ministry of Science and Technology and the Ministry of Foreign Trade and Economic Relations together identified 20 STIPS as National High Tech Export Bases.[6]

c. Reforms and investments in the university sector

In order to understand the full spectrum of recent science and technology park development in China, it is necessary to first gain some understanding of the closely related development policies of the higher education sector in China. In all, there are just over 1,000 universities in China funded respectively by the Ministry of Education (MOE), other ministries, provinces and cities. Starting in the mid 1990s China instituted a number of reforms aimed at streamlining its universities and to promote a number of them to become "world class" universities. China's universities were reformed in the 1950s along the Soviet lines into universities and colleges administered by functional ministries such as forestry, health and mining. A number of comprehensive universities were in fact deconstructed to become mono-discipline colleges. For example, the then Central University located in Nanjing was split into the Nanjing University (science and humanities), Southeast (Dongnan) University (engineering) and the Nanjing Medical University. This policy was implemented at the national as well as provincial levels.

The reforms introduced in the 1990s recognised the inefficiencies and the lack of interdisciplinary approach among Chinese universities due partly to the systems under which they are organized and funded. Many smaller universities, particularly those of single or few disciplines, were amalgamated to form larger comprehensive universities or the smaller specialist universities were merged with larger universities to become large comprehensive universities. For example, the Beijing Union Medical University was merged with Peking University. At the same time, universities were encouraged to introduce new disciplines that were lacking. Consequently, several universities, including Peking University and Nanjing University established architecture schools. Reorganizing the universities is not the only reform implemented. Universities are given greater autonomy to organize its internal affairs and to hire academic staff on contracts. Tsinghua University in Beijing, for example, recently took the unprecedented steps of appointment non-Chinese nationals to become professors or head of department.[7]

Germane to the subject of this paper is the national government's decision to select a few universities and provide them with significant resources for new facilities, new staff members and funding for research and travel. In 1998, State education funding represented

[5] APEC is the Asia Pacific Economic Committee which was speared by Australia and of which China is a key member.

[6] This section describes the national program but there are similar programs at the provincial and municipal levels throughout China. Most of these developments mimic the national programs and are not the subject of this paper.

[7] Tsinghua University appointed a Unites States academic to head it manufacturing engineering department and is reported to have offered a chair professorship to a merchant banker from Goldman Sachs.

2.4% of China's GDP and by the year 2001, it rose to 3.19% GDP. The significance of this increase has to be put in the context of a fast growing economy which averaged 10.3% per annum during the period of 1990 to 2000.[8] In terms of government support for research in universities, funding has increased on average of 20% each year in the last few years.[9]

This major injection of funding reflects the Chinese leadership's belief that China must catch up with the rest of the world in terms of advanced science and technology if it were to become a truly modern economy. One of the direct consequences of this decision is the implementation of reforms aimed at encouraging universities to commercialize its research and intellectual properties. The successes of universities such as Peking and Tsinghua universities in Beijing to create spin-off companies in ICT encouraged the leadership to promote bolder reforms. In this respect, the Chinese learns from the United States and European countries and the synergy of developing advanced technologies that flow between universities and the private sector.

Universities in China are intimately associated with the various national, provincial and local government science and technology programs as it is unsurprising that universities are now an integral part of the new science and technology park developments.

3. NATIONAL PROGRAMS OF SCIENCE AND TECHNOLOGY PARKS

Over the years, the Chinese government has shown itself to be prone to promote various policies by unleashing nation-wide programs. Symptomatic of a highly central government system, national programs tend to be one-size-fit-all approach, not always leading to the desired results. Often it reflects what national leaders consider desirable or fashionable at the time without much regard to efficacy or efficiencies. At the same time, due to the highly structured government system in which ministries vie with each other for resources and attention, bureaucratic jealousies sometimes get in the way of logical program design and implementation. The science and technology parks strategies of China are no exception.

The first S&T program was the 1982 "National Program for Key Science and Technology Projects" which was part of the Five-Year Plan. This was followed by the National High Technology Research and Development Program (also known as the 863 Program) which was aimed at eight selected areas of technology. In 1986 the government launched the "Spark Program" aimed at developing the rural economy through science and technology. Much of this funding was to come from bank loans, enterprises and seed money from the State.

In 1988, the "Torch Program" was launched with the aim of promoting "high and emerging" technology industries via commercialization, industrialization of high technology and globalization. Under this program, 53 "High and Emerging Technology Industry Development Zones" (HETIDZ) have been developed in major cities in the eastern and central regions of the country. These continue to be the key STP of China. In the same year, the Ministry of Science and Technology (MOST) started a "National New Products Program" with the purposes of encouraging enterprises and research institutes to collaborate and accelerate technical innovations. Fields such as microelectronics, photoelectrical and opto-mechano-electronics integration were identified as of high priority. Certificates of National New Products were to be issued as part of this program. This being the 15th anniversary of the Torch Program, there is much reflection on the achievements of this program. It is reported that in 2001, the 53 HETIDZ realized total income of RMB11, 928,400 million

[8] World Bank, World Development Report. According to Liu, Wang and Chang (2002) China's GDP growth rates were 7.8% (1998). 7.1%(1999), 8.0% (2000) and 7.3% (2001).

[9] This contrasts starkly with the funding strictures put on universities in the United Kingdom, Australia and the United States. In 2003, due partly to economic downturns in the United States, many of its universities face funding cuts of up to 20% and private universities have not escaped. In Hong Kong, universities have been told to cut funding by around 10% this year.

which is an increase of 29.4% over the year 2000. Much more telling is the claim that about one-quarter of the increase in national industrial value was due to the HETIDZ (Zhao 2002).

A Science and Technology Program for Social Development was started in 1996 to last until 2010. This is part of China's Agenda 21 program to enhance social development through science and technology.

Universities are an integral part of the science and technology advancement programs of China. Universities received about 50% of national awards in natural science and 66% of national awards of technical inventions.

In 1992, universities in Shanghai and Harbin started science parks with MOST support. Central ministries are not the only authorities that supported the development of STP with universities however. For example, in Guangzhou, Zhonghan University developed a science park with the support of the city government. In Wuhan, Huazhong University also developed a similar STP with the support of the local government.

However, much of the STP programs have been developed through MOST funding. It was not until 1999 that the Ministry of Education (MOE) and MOST decided to joint forces to develop university science parks. Since then, a number of major initiatives have been implemented. In the year 2000, MOST & MOE authorized the first group of 22 state university science parks. These are funded by the national ministries and regarded as the base for incubators, research training, and scientific innovations and to stimulate economic development. In mid 2002, MOST and MOE jointly proposed a new Chinese Science and Technology Innovation System based largely on universities. This program has three elements. The first is the reform of the management system of science and technology in China. The second element is the construction of scientific research based through the establishment of a group of national key laboratories in the universities, akin to the United States model. The third element is to encourage transfer of universities science and technology achievements to industries through the construction of university science parks to house incubators and high tech corporations. The national government's objective is to establish 50 model state university science parks to house 5,000 high tech enterprises in the next 5 years and to develop 50 internationally competitive enterprises through them.

Nanjing State University Science Parks

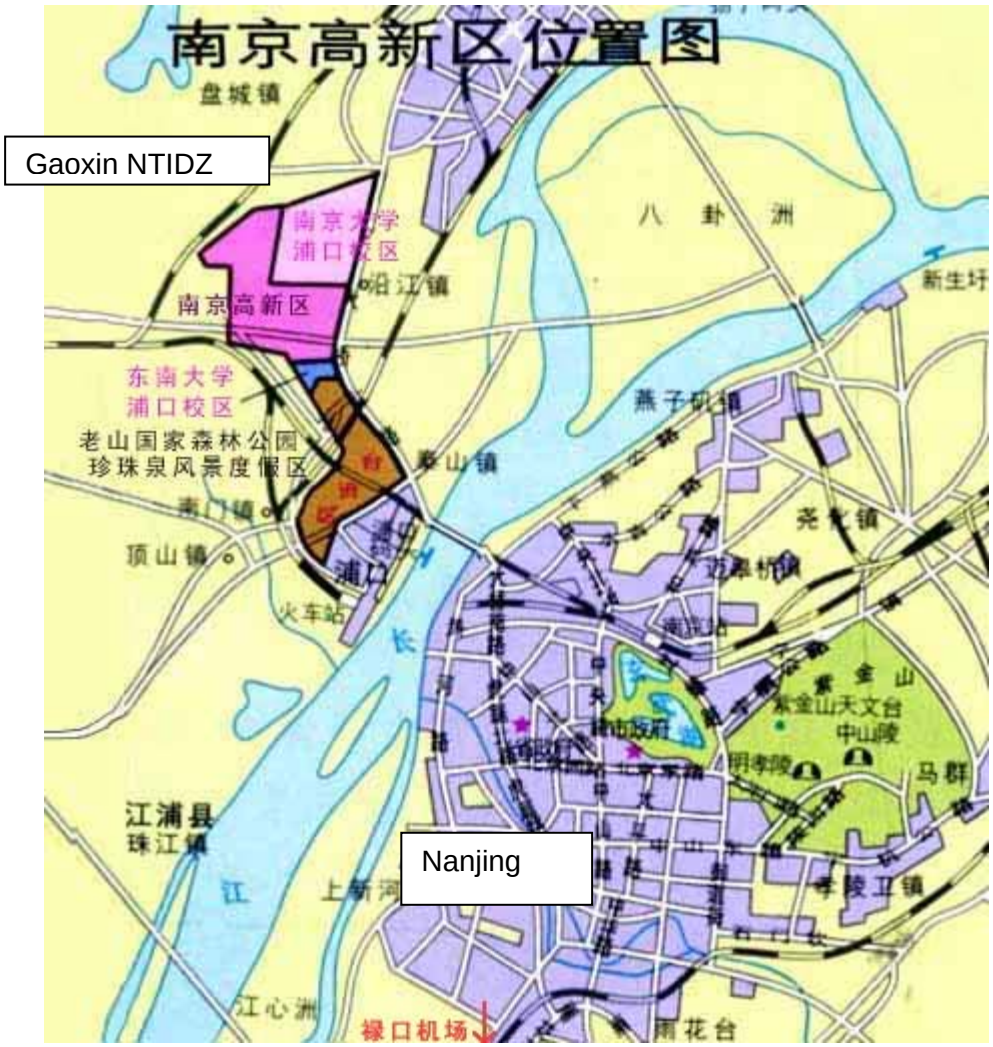
The initial 22 state university science parks are sponsored by 67 colleges and universities. Some of the universities and colleges are in consortiums but others are sole sponsors. Just under US$2.1 billions has been invested with about three quarters coming from industries. About 1 million sq. m of floor areas are in use with another 1.6 million sq. m. under construction.

Nanjing is one of the major cities of Jiangsu province about 2.5 hours by train west of Shanghai along Zhangjiang, the major river running east-west through the middle of China. With a population of 5.3 million in 2001, of which 34.3% are in the urban core, it is the provincial capital as well as its commercial and education center. It is the home of more than 23 universities and colleges, the most famous being Nanjing University and Southeast University. Nanjing University is recognized as the third ranking university in China, after Peking and Tsinghua University.[10]

In terms of science and technology development zones, there are 8 provincial level ones located in Nanjing. There is one national level development zone and one new town development zone. The national level Nanjing High and New Technology Industry Development Zone has three parts, in Gaoxin, Xinkang and Jiangnin districts. All of these NTIDZ have the characteristics similar to most traditional science and industry parks of being located in a well-defined area that is often fenced off to outsiders. The physical separation is

[10] Nanjing University has consistently ranked among the top one or two universities in China with the highest number of citations in the Science Citation Index---one of the internationally recognized indicators of academic excellence. Thee are also 58 research institutes variously funded by national, provincial and local government located in Nanjing.

partly due to the need for security, but often due to a design concept that regards such zones as separated from the rest of the city to give it a distinct identity. In this respect, most of China's S&TP are no different from the S&TP of most other countries. This design concept is the case of Suzhou Industrial Park and the industrial parks developed in the much publicized Pudong district in Shanghai.



Map 1: Location Map of the Gaoxin NTIDZ in Nanjing.

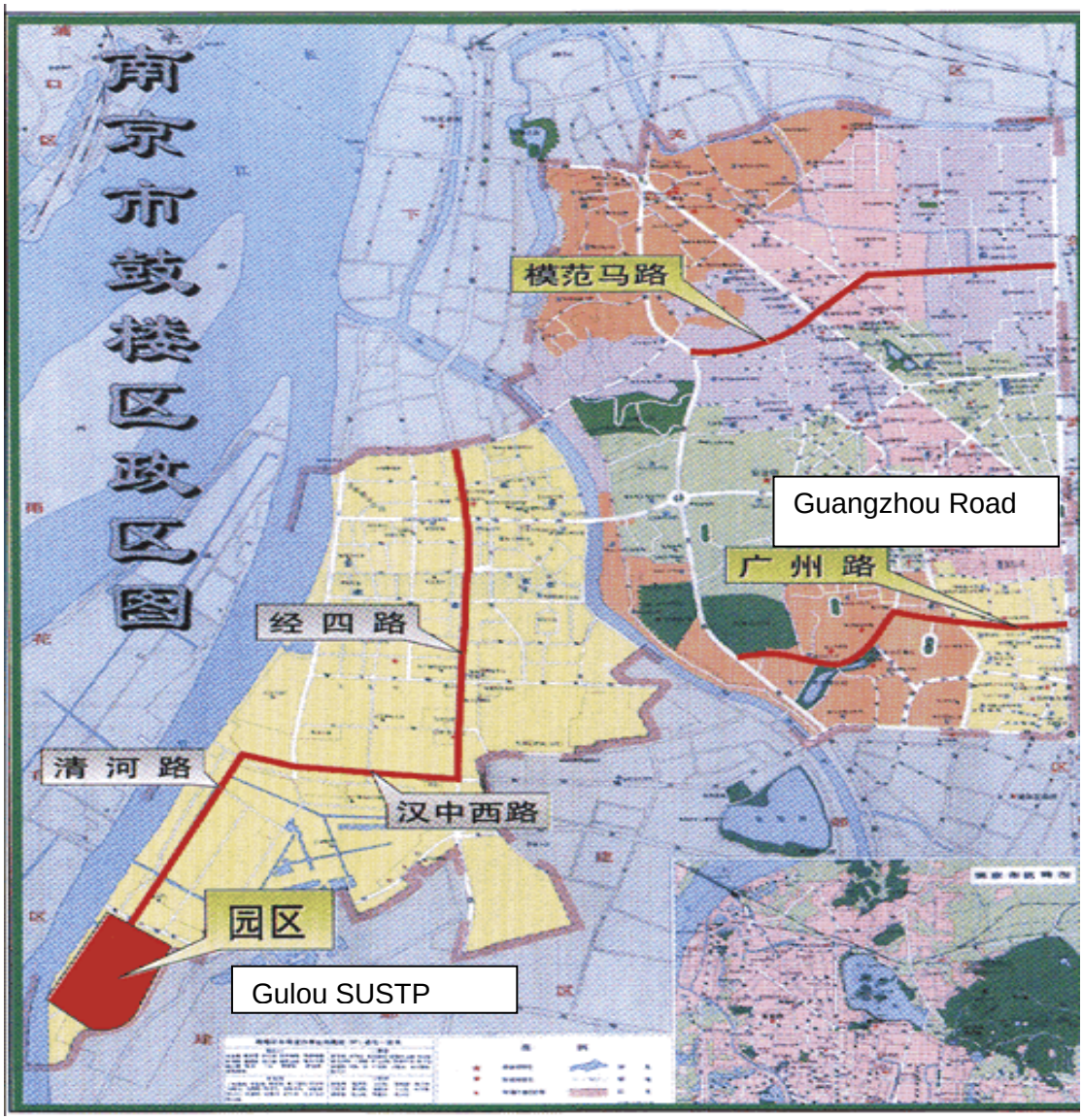
Gulou State University Science and Technology Park (Nanjing)

In addition to the above, in June 2002, the Gulou State University Science and Technology Park was established under MOST and MOE auspices. The Gulou SUSTP is one of the 22 so far designated by MOST and MOE. Gulou is one of the urban district within the City of Nanjing and under the system of local government in China, it has its own district level government. The Gulou SUSTP has a consortium of 9 universities and colleges and the local government as partner.[11] Due to the fact it is still early days in terms of the

[11] The nine universities and colleges include Nanjing University, Nanjing University of Chinese Medicine and Pharmaceuticals, Oceanography University, Nanjing Normal University, Nanjing Chemical Engineering University, Nanjing Postal and Communications University, Nanjing Medical University and the Nanjing Engineering University.

development of any S&TP, it is only possible to examine some of the key features of the Gulou SUSTP but these indicate quite a different development model compared to other Chinese S&TPs.

One of the distinctive features of the Gulou SUSTP is that it is a distributed park in that parts of the SUSTP is deliberately located within the city center.



Map 2: Location May of Gulou State University Science and Technology Park.

The Gulou SUSTP has three distinctive "districts". The first "district" is to have urban center presence for the Gulou SUSTP for both incubator type of activities and to provide commercial and service outlets for the entities that are located in the SUSTP. These are the areas chiefly along Guangzhou Street which leads towards the city campus of Nanjing University. On the campuses and along the roads leading to the other major universities partners are also expected to be the development of incubator type of developments.

The second "district" is the development of a prototyping and product development center based in the suburban location of the River West district of Gulou which is where many of the academic staff of the universities resides. A third "district" is to make use of the existing Gaoxin and Xinkang High and New Technology Development Zones as the

manufacturing base for a cluster of high technology firms that will be developed as a result of the innovations created by enterprises based in the Gulou SUSTP.

The Gulou SUSTP has the aim of focussing on the following research area: software, ICT, biomedicine, nanotechnology, health sciences and providing consultancy in the above areas.

For the first time, what is planned has the following characteristics:

1. Ministry level collaboration by the MOST and MOE;
2. Consortium of universities working together;
3. Alliance with local district government as a key partner in the venture;
4. A physical design that is distributed across the metropolitan area that incorporates the commercial aspects in the design of the SUSTP which breaks down the highly segregated approach of the past;
5. A recognition that university research needs support to bring to the market its innovations and that such facilities need to have close proximity and relationships with universities and colleges;
6. Explicit links to the existing established S&TP for the location of manufacturing activities.

While some of the above features of the Gulou development are quite different from other Chinese ST&P developments, it does raise several questions.

1. There seems to be an assumption that most of the innovation from the university research and the incubators will result in consumer oriented products. This is the rationale of having such an extensive network of shops and commercial areas on the main streets of Nanjing. Whether this is the case remains to be seen. Much more importantly, the time lag between research and development and a consumer product can be significant. Whether it is prudent to have extensive commercial space and network to start the Gulou development need to be assessed.
2. Incubators generally do not require spaces close to the consumer and the commercial outlets. What they require is certainty of tenure for a specified time, perhaps reasonable rent and technical support. In general, incubator spaces are not located near downtown commercial areas because of the high rental that such locations command. That the Chinese planners place the incubator spaces at or near the commercial interface seems to indicate that they either do not understand what incubators require and/or the urban property market in Nanjing is not sufficiently mature to reflect the high value that their locations would command. This latter aspect is not surprising since China has only in the last decade or so gradually liberalized its property lease and ownership regulations.
3. It is also unclear how the consortium of universities actually works. Is it merely a consortium of convenience which does not reflect true interactions or is it an attempt to encourage the researchers to promote cross-institutional links and collaborate on research projects? If it is the latter, then it is encouraging.
4. It is not clear how the Gulou SUSTP overlaps or interacts with the HNTIDZ of Xinkang and Gaoxin, whether this is merely recognition of their prior existence or are there new mechanisms to facilitate mutual development.

While there are questions about the exact nature of the Gulou development and how its implementation will evolve, there is little doubt that it represents a new approach distinct from previous attempts. It remains to be seen whether the example of Gulou is going to revolutionize China's approach toward the development of S&TP but it seems to be a very promising beginning and one that deserve close watch in the years to come.

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