CREATION SCIENCE AND TECHNOLOGY PARKS AS A COMPONENT OF INNOVATION IN ECONOMIC DEVELOPMENT

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1. Introduction

Science and technology research parks are seen increasingly as a means to create dynamic clusters that accelerate economic growth and international competitiveness. A concept that is now 60 years old, research parks are widely believed to encourage greater collaboration among universities, research laboratories, and large and small companies, providing a means to help convert new ideas into the innovative technologies for the market. In this way, research parks are recognized to be a proven tool to create successful new companies, sustain them, attract new ones – especially in the science, technology, and innovation sector – and make existing companies.

Today, countries as diverse as China, Singapore, India, and France are among those undertaking substantial national efforts to develop research parks of significant scale and scientific and innovative potential.

In many cases, these research parks are expected to generate benefits that go beyond regional development and job creation. Indeed, to the extent that research parks are effective, they have the potential to shift the terms of global competition, not least in leading technological sectors.

The first research park was established in Menlo Park, California, in 1948. Early successful parks, established in the 1950s and early 1960s, include the Stanford Industrial Park (est. 1953) in California, Research Triangle Park (est. 1958) in North Carolina, and Waltham Industrial Center (est. 1954) in Massachusetts.

To better understand the role that research parks can play as sources of innovation, should explore the international experience of technology and innovation parks, which play an important role in national economy.

A university research park is a cluster of technology-based organizations that locate on or near a university campus in order to benefit from the university's knowledge base and ongoing research.

The university not only transfers knowledge but expects to develop knowledge more effectively given the association with the tenants in the research park.

The elements of:

- a national innovation system include competitive firms and a competitive environment;
- an effective educational system, strong university research;
- a legal system with property rights;
- a capital market that includes venture capital.

All this determines important science and research parks in the national innovation system of economic.

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The extant literature in economics, geography, management, and public policy does not offer a fully developed theory about the formation of parks. Case studies have documented the institutional history of a number of research parks, university affiliated or not.

2. The theoretical basis for the creation of technological and scientific parks

Scholars have not yet formally tied the emergence of parks to cluster theory, although cluster theory has been applied to the formation of biotechnology and other science-based agglomerations of firms near universities so the potential application is not unreasonable.

Drawing on cluster theory – and location theory was, in part, a prequel to the popularization of cluster theory, as reviewed by Goldstein and Luger, and Westhead and Batstone – one could argue that there are both demand and supply forces at work that result in the clustering of research firms near universities [1, p.249-263; 2, p.72-93].

On the demand side, there are sophisticated users of developed technologies within a park, and the search costs for such users are minimized by locating on a park. Of course, there are disadvantages associated with being in a park, mainly greater competition for the developed technologies. On the supply side, there is skilled and specialized labor available from the university or universities involved in the park in the form of graduate students and consulting faculty, although there is also more competition for that pool of human capital.

Also, for a firm, location on a park, especially a university park, provides a greater opportunity for the acquisition of new knowledge – tacit knowledge in particular. As well, for the university, having juxtaposed firms provides a localized opportunity for licensing university-based innovations.

The theory of agglomeration economics emphasizes knowledge spillovers and enhanced benefits and lowered costs caused by the presence of multiple organizations and the externalities they create. And, Audretsch, Breschi and Lissoin provide empirical support for the agglomeration effect [3, p.673-709; 4, p.975-1005].

Henderson and Krugman emphasize conceptually as well as empirically the importance of location per se with regard to knowledge spillovers. Localization has an effect on resource prices. To the extent that new technology embodies new knowledge, geographic closeness implies lower new technology prices and thus presumably greater usage. Firms achieve economies of scale more easily with newer technologies [5, p.47-70; 6, p.11-13].

Arthur underscores the related importance of network externalities with regard to such scale economies [7, p.116-131]. If that technology had a university origin, then creating such a park, from the university's perspective, and locating in the park, from a firm's perspective, gives positive feedback to continue the path dependency of the particular technology.

3. The role and features of the establishment and functioning of technology and science parks in some developed economies

Here are some examples of scientific and research parks that operate in both developed and developing countries, but in both cases, play an important role in the innovation component of the national economy.

The early science parks in the United Kingdom of Great Britain (more U.K.), built in the 1980s, tend to be owned by universities and operated as income-generating properties. Since technology transfer and business incubation have emerged as important drivers in the development of modern economies.

In the 1990s and in the 21st century, parks have been developed in the U.K. and in Europe with capital funding from regional development agencies which see science parks as tangible evidence of their region's developing knowledge economy.

Many of these parks are partnerships between government and local universities, which in the U.K. receive funding from central government for this "third-mission" activity.

Today about 11 percent of parks are privately owned, 19 percent are university-public partnerships, 27 percent are university-owned, and 43 percent are partnerships between universities and other public or private.

In 2003, the UKSPA contracted with Angle Research to examine the impact of science parks on the U.K. economy. UKSPA is the authoritative body on the planning, development and the creation of Science Parks that are facilitating the development and management of innovative, high growth, knowledge-based organizations. They examined some 900 companies altogether, comparing the economic and innovation performance of park tenants with similar firms located outside parks. The results showed that the single most important factor affecting the performance of science parks is the state of the sub-regional economy in which they operate. Also, the companies in parks were found to have higher growth rates, in terms of both turnover and employment, and better access to risk financing [8, p.23-28].

Manchester Science Park (MSP) which is one of the older science and technology research parks (more S&T parks) in the U.K., started in 1984 as a 22,500-square-foot building on a 15.5-acre site. Today there are 305,000 square feet of buildings on three sites that employ about 1,100 people.

Like so many parks, MSP was created as an economic development initiative. Manchester was badly weakened by the downturn in manufacturing of the 1980s, suffering job losses and much personal pain. Having heard about and visited Research Triangle Park, representatives of Manchester government, the university, and the commercial sector came together to set up a science park, raising an initial capital investment of 210,000 Pounds.

The park has received only limited public funding in its 24-year history, in the form of gap funding for three of the buildings. All the partnership activities of tenants and the university have been paid for out of MSP's profits. The park has never paid a dividend to investors, who are content to see the value of their holdings increase as a result of park activities.

In measuring success, the park uses the strategic objectives of economic development and knowledge exchange. The first metric is growth in tenant companies.

The park management also provides assistance to its companies and even tracks the alumni companies to monitor their development. In 2007, for example, MSP found that 79 percent of the companies operating in 2001 were still in business. By comparison, the average survival rate of all firms in Manchester is 64 percent. MSP also found that 70 percent of companies that left the park were still operating in the city region [9, p.661-674].

A new S&T park is unfolding in Monterrey, Mexico. The core ingredient in the Monterrey park strategy is to prepare for long-term alliances among universities, businesses, and government. The park will be oriented to achieve economic growth and quality of life through the "triple helix" of education and innovation.

Main features of the park include a total area of 175 acres, investment in infrastructure of $100 million, and investment in buildings and equipment of $150 million. Projected employment over the next five years is 3,500 researchers and engineers.

Two business incubators have been designed, one for nanotechnology and one for biotechnology, at a cost of $20 million. The state's first seed and venture capital fund is being assembled by private partners, the government, and the national bank to a level of $30 million.

Six years ago, Mexico began providing tax incentives for those who invest in R&D, absorbing 30 percent of annual R&D expenses.

Long-term goal of creating a science park in Monterrey (2025):

- increase the state's GDP per capita from $15,975 to $35,000 by 2020;
- become one of the world's 25 most competitive regions;
- consolidate a world-class education, research, and innovation system;
- demonstrate to the regional population the importance of education, knowledge and innovation in their lives;
- redesign the curricula of the education system in Nuevo Leon to innovation;
- enhance the existing universities and centers, and attract new research centers and investment in technology-based companies;
- promote innovation in existing companies through tax incentives and other measures;
- create new innovation-based companies using appropriate financial instruments;
- generate the necessary legal framework, governance, programs, strategic projects, and mechanisms to sustain park development for 25 years [10, p.304-342].

Main centers in the park include a variety of groups, in operation or under construction. These include universities and public research centers in different fields, including electronics, biotechnology, and mathematics, advanced materials, food industry, nanotech, water research, and others. The three major universities are critical in providing the expertise to compete in these complex new fields.

Because of this ongoing research, the park already has an important set of private firms located or planning to locate in the park, including AMD, Motorola, PepsiCo International, Owens Corning, and Infosys.

Sandia National Laboratories were established in New Mexico in the late 1940s to develop nuclear weapons. While Sandia remains a national security laboratory, its mission has broadened into other national security arenas, including energy and microelectronics, which rest on a broad base of science, technology, and engineering research.

The new Sandia Science and Technology Park has grown out of that research base and sits at the opposite end of an "innovation corridor" from the laboratories. Between them is the multi-building complex of MESA, Microsystems and Engineering Sciences Applications. This corridor represents a $500 million investment by the Department of Energy (DOE).

The 240-acre park was founded in 1998 to attract industry in support of the Sandia mission. The park is unusual in having three founding partners: Sandia, Technology Ventures Corporation, and the city of Albuquerque.

The initial purpose of the park was to create joint research and development opportunities, commercialize technologies, bring in new business, strengthen supplier-based "collaboratories," and foster regional economic development.

Statistics the dimensions of the park: 27 companies, 2,113 employees, 18 buildings, 897,000 square feet of occupied space, 67 developed acres. Funds-in and in-kind services flowing from tenants to Sandia, such as CRADAs and licensing agreements, have totaled $17.6 million, and DOE/Sandia in-kind services to tenants (CRADAs) have totaled $2.7 million. In the other direction, contracts from Sandia procurement to tenants amount to $244.5 million.

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NASA Ames Research Center in California – one of ten NASA centers – has an unusual history. It began as a 500-acre NASA property in 1939, to which an additional 1,500 acres was transferred following the deactivation of the Naval Air Station at Moffett Field in 1994.

Since 1998, NASA has sought to develop the NASA Research Park (NRP) on the property, with the goal of creating a world-class, shared-use S&T campus for government, academia, nonprofits, and industry.

Its research programs, in addition to the educational institutions mentioned above, include CREST (Center for Robotic Exploration and Space Technology), M2MI (machine to machine intelligence), Bloom Energy (fuel cells), and UAV (unmanned autonomous vehicles.) It also includes collaborations and contracts with many small firms.

In 2005 the park signed an MOU with Google to build 1 million square feet of new facilities for large-scale data management and collaborations in massively distributed computing and bio-info-nano convergence. In 2006 a NASA-Google Space Act Agreement for Research and Development Collaboration was signed, with plans for up to 100 rental units of housing on 40 acres and new R&D labs.

NRP has also begun discussions to build a major campus with a consortium of universities, led by UC Santa Cruz. The consortium will lease about 70 acres for research, education, and innovation. Goals are to develop new technologies emerging from the convergence of bio-info-nano-scientific research, autonomous systems and robotics, renewable energy sources, technologies for long-term sustainability of human life, and managing innovation in the emerging world.

Research Triangle Park was founded in 1959 by business, government, and academic leaders. The park has had a long-term economic impact on the region. Per capita income growth in Raleigh-Cary and Durham were far below the state average and national averages before the park was formed; today the per capita income of the region significantly exceeds the U.S. average and far exceeds the North Carolina average.

In the 1960s it was one of the poorest regions in the southeastern United States and today is among the wealthiest regions in the southeast. The park's university connections are "rich and robust," and each of the three university partners is involved in governance, leadership, and helping set strategy. The park employs some 40,000 full-time workers in 24.5 million square feet of developed space. The economic impact is $2.8 billion in capital investment and $2.7 billion in annual payroll.

When the park began operation, about 11 percent of the employment in the region was in new-line or high-technology industries, and today this proportion exceeds 50 percent. Strength of the park is its diverse industry mix: 29 percent of tenants specialize in life science, 21 percent in information technology, 13 percent in materials science and engineering, 15 percent in business and professional services, and 11 percent in scientific associations, foundations, and institutes.

It was not always so: the early park was dominated by a few large companies. Between 1997 and 2007, the number of companies increased three-fold, with the number employing fewer than 250 employees rising from 53 to 150 [10, p.208-246].

The Beijing Park. The park hosts over 20,000 enterprises and 950,000 employees, receiving total income of 850 billion Yuan (about US$ 110 billion). More than 800 enterprises have income exceeding 100 million Yuan.

Of the industries represented in the park, the majority (56.6 percent) are classified as

information technology, 12.5 percent as "new energy," 12.3 percent as biomedicine, 9.4 percent as advanced manufacturing, and 8.4 percent as new materials. The park has attracted almost 10,000 "sea turtles," she said, who have set up 4,200 companies in Zhongguancun Science Park.

The Suzhou Park established in 1994 in a location. Suzhou today is known for its "innovative spirit and ability to attract top talent world-wide." It is a joint development between the Chinese and Singapore governments, unprecedented, it is considered first among all regions in China in "pro-business mentality," efficiency, and consistency of policies.

Located 80 kilometers west of Shanghai, Suzhou has taken its place at the high-tech frontier of the global economy. In land area only 0.1 percent and in population 0.5 percent of China, it accounts for 2.3 percent of GDP, 1.5 percent of financial revenue, 10 percent of imports and exports, and 8.3 percent of foreign investment [11].

Government support is critical. The Chinese government has invested more than US$ 1.4 billion in the Suzhou park alone.

Indian Institute of Technology-Madras. By about 1999, the S&T park movement began to take off, he said, as India's entrepreneurial spirit was being liberated. Initially, India took advantage of its strong cost advantage, but this advantage is disappearing as India moves up the value chain.

The backbone of Indian higher education in science and engineering is formed by its 12 S&T institutes of national importance. These include the seven Indian Institutes of Technology, five of which were formed soon after independence in the 1950s (including Dr. Ananth's institute in Chennai); one was added in 1995 and another in 2001. The strong national recognition and status of the ITs makes them logical anchors for research parks as they provide leadership in every field of science and engineering.

The objective of the Indian science and technology parks is to promote and foster the spirit of innovation. The nation's parks still have a long way to go in terms of the infrastructure and support systems necessary for competitive R&D. Nonetheless, economic growth has been remarkable – consistently.

The objective of the Indian science and technology parks is to promote and foster the spirit of innovation. Nonetheless, economic growth has been remarkable – consistently around 9 percent, he said, with manufacturing growing at 12 percent.

The parks are intended to:

- incubate early-stage entrepreneurial ventures based on technology and innovation;
- facilitate networking with professional resources for the incubated companies;
- identify technologies and innovations that have potential to be commercial ventures.

Indian research parks are still relatively small and not generally associated with universities. The bigger ones have varying mixes of tenants and partnerships. One group of parks is the Andhra Pradesh Biotech Parks.

These include:

- Shapoorji Pallonji (SP) Biotech Park near Hyderabad. It has about 140 acres under development and contains about 17 companies with an investment of about Rs 4 billion (or approximately US$93 million).
- The Marine Biotech Park occupies 218 acres near Visakhapatnam. In association with the Andhra University, it focuses on marine resources, marine foods, nutraceuticals, and fisheries.

- Additional IITs will be inaugurated in 2008-2009. The ICICI Knowledge Park is focused on facilitating business-driven R&D. It is located on 200 acres of land near Hyderabad and holds 13 companies with about Rs 420 million (or approximately US$9.8 million) invested.
- The state of Andhra Pradesh also has an Agro Park on 200 acres in the International Crops Research Institute for the Semi-Arid Tropics campus. The park comprises an Agri-Biotech Park, an Agri-Business Incubator, a Hybrid Seeds Consortium, and SAT Ecoventure. Three ventures have been developed in the Agri-Biotech Park, among them a facility for testing aflatoxin contamination in food crops.
- In Tamil Nadu Ticel Bio-Park has been developed in 2004 by the Tamil Nadu Industrial Development Corporation on a five-acre site at a cost of Rs 625 million (or approximately US$14.5 million), in collaboration with Cornell University; it now has three occupants.
- A newer research park is the Society for Innovation and Entrepreneurship, set up in 2004 on the campus of IIT-Bombay (located in Mumbai) as a business incubator. It now includes facilities covering 10,000 square feet and is supported by the Department of Science and Technology, the Technology Development Board, the National Entrepreneurship Networks, the IIT-Bombay alumni, and the Ministry of Communication and Information Technology [12, p.78-95].

4. Conclusions

Science parks, in their many different forms, now exist in most parts of the world and they are seen as a proven policy tool to spur the economic growth and to enhance the technological competitiveness.

The wealth and competitiveness of nations increasingly depends on their ability to convert new knowledge into products for the market. It should be noted to highlight the growing role of research parks in helping universities balance their 21st century missions in education, research, and commercialization.

Given the growth of new research parks around the world, important is the development of their successful performance in the future. You can select a set of factors required for success. One of the most important factors is the presence and involvement of a large research university or laboratory supporting a critical mass of knowledge workers.

Also, key is availability of funding over a sustained period. Strong and committed leadership is also essential to facilitate and guide the development of the park's physical infrastructure and quality-of-life amenities. Finally, and not least, a successful park needs skilled entrepreneurs and managers.

Talented and motivated individuals and teams in the private sector are needed to commercialize the knowledge generated. If the benefits of a successful park are to be realized over the long term, a critical combination of these factors must be present, although they are not sufficient to ensure success.

That research parks should not a priori be considered a primary element of a nation's innovation system. While successful research parks stimulate two-way knowledge flows between universities and industry, the conditions where such beneficial interactions can take place require further study.

References

1. Goldstein H. A. University-based Research Parks as a Rural Development Strategy / H. A. Goldstein, M. I. Luger // Policy Studies Journal. – № 20 (2). – P. 249–263.

2. Batstone S. The Development of Science Parks and New Technology-Based Firms in Russia. In The Economic Impact of New Firms in Post-Socialist Countries / S. Batstone Westhead, P. Brezinski: Edward Elgar // Bottom-up Transformation in Eastern Europe. – 1996. – P. 72–93.
3. Audretsch David B. The territorial dynamics of innovation: a Europe United States comparative analysis / David B. Audretsch // Journal of Economic Geography November. – 1, 2007 7. – P. 673–709.
4. Breschi S. Knowledge Spillovers and Local Innovation Systems: A Critical Survey / S. Breschi, F. Lissoin // Industrial and Corporate Change. – 2001. – № 10 (4). – P. 975–1005.
5. Henderson J. V. The Efficiency of Resource Usage and City Size / J. V. Henderson // Journal of Urban Economics. – 1986. – № 19(1). – P.47-70.
6. Krugman P. Geography and Trade / P. Krugman. – Cambridge, MA: MIT Press, 1991. – P. 11–13.
7. Arthur W. Competing Technologies, Increasing Returns, and Lock-in by Historical Small Events / W. Arthur // Economic Journal. – 1989. – № 99(2). – P. 116–131.
8. Leyden D. P. A Theoretical and Empirical Analysis of the Decision to Locate on a University Research Park / D. P. Leyden, A. N. Link, D. S. Siegel // IEEE Transactions on Engineering Management. – 2008. – № 55(1). – P. 23–28.
9. Link A. N. The Economics of University Research Parks / A. N. Link, J. T. Scott // Oxford Review of Economic Policy. – 2007. – № 23(4). – P. 661–674.
10. Association of University Research Parks. 2008: The Power of Place: A National Strategy for Building America's Communities of Innovation. – Tucson, AZ: Association of University Research Parks. – P. 304–342.
11. Government of the People's Republic of China. – National Development and Reform Commission. 2006. – The 11th Five-Year Plan. – March 19. – [Electronic source]. – Access: http://english.gov.cn/2006-07/26/content_346731.htm.
12. National Research Council. India's Changing Innovation System / Charles W. Wessner and Sujai J. Shivakumar, eds. – Washington, DC: The National Academies Press. – 2007. – P. 78–95.

Summary

The article is devoted to the functioning of technology and science parks in developed economies. The analysis of scholarly works on problem creates innovative structures in the national economy. The role of technology and science parks as innovative component of the state economy is defined. The experience of the world's leading science and technology parks in various developed economies: the experience of the United Kingdom, Singapore, India, the United States and China. The basic ingredients for success in creating innovative structures in national economies and the factors that require further study.

Keywords: science research parks, technology research parks, university research park, innovative technologies, elements of a national innovation system, scientific and technological development.

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