Science parks as a force in employment

Science parks are all the rage, not just as locations for new industries but as means of making universities grander places. What follows is a symposium of sometimes fulsome opinions, often by managers of science parks, of their advantages to researchers.

Bordeaux Technopolis and sustainable development

Yann Couvidat

THE very concept of sustainable development means thinking in terms of adaptation. To be sustainable means also to be adaptable to the constant evolution of the environment. Thus, to think in terms of sustainable development, one has to find good answers not only to the problems of the moment but also to the problems of tomorrow.

In September 1994 the Bordeaux Technopolis project welcomes participants from the world of science parks to a conference on the theme of 'sustainable development and science parks'. This has been an underlying theme of developments at Bordeaux.

Durability and sustainable development do not mean no economic activity and no industry, and being worried about durability does not mean forgetting the development necessary for the evolution of society. Development implies at least two phases. First, emulation, which is still too often a simple copy of the industrialized countries' development. Then, autonomization, with not only the improvement of products from the industrialized countries and the means of producing them, but also new products, so that developing countries can compete with developed countries. This is where science parks have an important role to play. At the same time, the very local development of a science park must not mean irresponsibility and distortion in the local economies and urban structures.

We all know that the twenty-first century will be an urban century. Then, we have to think about development and sustainable development through the city, and to think about the city through policies for evolution. This is one of the lessons the Bordeaux Technopolis can help to illuminate. It may well be one of the oldest science park projects in the world. Its origins go back to 1963, but the site became operational only in the early 1990s.

So, what did happen in 1963?

French local and national authorities decided to build a campus intended to be the largest in Europe; it could not itself develop without a companion area where enterprises could develop and grow. This kind of planning, which has been going on for more than 30 years, with its share of local accidents and political incidents, has produced not only the largest and one of the greatest campuses in Europe, but a fairly efficient urban network of science parks; the webs of this network are now building the city of tomorrow.

The Bordeaux Technopolis is certainly not the most developed, and it is not even the best planned. But it is, undoubtedly, the one that has received the most attention from the largest number of people over the longest period of time. This approach can sometimes have its drawbacks. For consensus is not always reached on many issues, and debates are and have been the constant backdrop to the policies on science parks in that city.

Out of that long gestation came a project that is now mature and very specific. The project is linked to the best of the local universities, built on local strengths, managed with understanding of local conditions, and yet involving the whole area,

without overlooking one side of the city, or one area of excellence, or setting aside any one path of development. After those hesitant years, the best result may be the scope of the thinking that has been lavished on the project.

What are the local strengths? Bordeaux's immediate fame rests on wine. But the trouble is that the vineyard somewhat overshadows the other qualities of the area.

Bordeaux Technopolis is in fact a city of technical advance and science. First, Aerospatiale, SEP (European Company of Propulsion), Dassault and so on: 20,000 people are employed in an area with no equivalent in Europe in aeronautics, space and ballistics. Ariane rocket engines are built here. Bordeaux Technowest, close to the international airport, is networking these activities, making sure that they will develop by taking into account progress in science and technology, and today's needs as well as tomorrow's for space and urban planning.

Bordeaux ranks third among medical and health science areas in France. From classical drug manufacture to the most advanced molecular implant engineering, more than 6,000 employees work in health industry companies. It is thus natural to have devoted part of the Bordeaux Montesquieu site to life sciences and techniques. However, as we shall see, it is not the only peculiarity of Bordeaux Montesquieu.

Electronics is also very strong. At first it went hand in hand with the aeronautics industry, but it quickly developed as an area of growth in its own right. IBM, Motorola, Siemens — the big names are here. But over and above these, the strength of Bordeaux lies in small and medium enterprises that have embraced quality production. COM1 and Lectra Systems, for instance, are two of the principal emerging ones. But as well as research and development, there is also high quality production — as Pioneer and many others witness.

Bordeaux Hauts-de-Garonne, on the upper right bank, will be the home of what the French call middletech and logistics. It is so far the less developed aspect of the technopolis.

The technopolis wove its network into those existing strengths, to make them more interconnected and to evolve into new directions — in short, cross-synergy. From the technologies of composites needed to serve aeronautics, to health sciences, the Institute of Advanced Materials, located on Bordeaux Montesquieu, tests every day the requirements of cross-synergy.

Bordeaux Unitec is located on the university campus and weaves through the neighbouring cities to unite local strengths, create synergies and make them prime forces for local development. Promising fields will be chemistry, mathematics and their intermixture with other sciences.

Bordeaux Technopolis has developed five sites in all. And, by respecting local strengths, forecasting or trying to forecast urban development, and building on the

PARK OWNERSHIP

	North American parks		Other parks		Worldwide parks	
Type of ownership	Parks	%	Parks	%	Parks	%
University	37	34	13	15	50	26
Government	15	14	29	33	44	22
For profit	19	18	9	10	28	14
Private not-for-profit	22	20	4	4	26	13
Joint venture	15	14	34	38	49	25
Totals	108	100	89	100	197	100

The type of park ownership inside and outside North America is quite different. In North America, universities own a large proportion of parks, with other types of ownership evenly divided. Parks outside North America are largely owned by joint ventures and government entities. Almost half of parks worldwide are owned by universities and government entities.

WORLDWIDE PARKS ESTABLISHED BY YEAR

1950–59	5	1985	34
1960–69	11	1986	39
1970–74	12	1987	31
1975–79	9	1988	24
1980	9	1989	25
1981	4	1990	21
1982	10	1991	9
1983	25	1992	8
1984	36	1993	3
	Planned		29

Source of data as for table on page 172.

specific local ecology, it is slowly succeeding in showing how sustainable development can be achieved through development of local enterprises. But it would have been impossible to develop such a scheme without taking into account the necessary growth of the city and respect for the environment. On the edge of the largest forest in Europe, one could not develop a science park without considering water management, trees and links to existing infrastructure that does not destroy local ecology.

"Bordeaux Montesquieu is emerging as one of the first ecological technology and science parks around the world. "In saying this, the Bordeaux Technopolis team does not only mean having companies dealing with ecological issues, or laboratories checking the ecological balance of the site. Located in a forested area, and on the edge of the vineyards, it had to be ecologically aware during the planning process. Ten years ago, when the actual planning took place, this was not a common preoccupation of science park planners. Bordeaux Montesquieu is the only science park in the world that deals with surface water by using its roads as waterways and filters. Surface water is collected by the roads, filtered by the road surfaces, then lagooned by the lake. The same kind of awareness has been shown when building, respecting most of the local trees and planting new ones when necessary.

The lessons from Bordeaux may be applicable elsewhere. Science parks and technopolitan projects nowadays need to be woven into the texture of urban complexity, taking into account its dynamics and evolution and trying to promote the emergence of new technologies, without impeding tomorrow's development. The cities have traditionally been the places where wealth accumulation takes place, where trade and exchange take place. The city is also the place where decisions are taken. It is the setting for everyday life. It is also where most science parks have been developed around the world.

Science parks are tools for sustainable development, for they help to bridge the gap between rich and poor nations. But they can do more: through cautious and necessary planning, they can help cities to grow, without forgetting the requirements of tomorrow.

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Research Triangle Park

Jeanne P. Brewer

JANUARY 9, 1994 was a milestone in the history of Research Triangle Park in the state of North Carolina. On that day, the park marked its thirty-fifth anniversary. That, in retrospect, is when North Carolina embraced new technologies, new products, new strategies and new thinking all at once.

After 35 years of growth, the 6,800-acre Research Triangle Park touches the lives of people throughout the world. Whether it is from viewing a football game played on Astroturf, an artificial turf product invented in the Park; using products that carry a UPC code and were scanned at a local store, a process invented in the park; or using one of the many medical products created by the companies there, products such as AZT, Exosurf, Adenoscan, Zovirax or Zantac, the park's effect is truly global. Even employment in the park has led the growing trend to globalization. Since the first internationally based company, Burroughs Wellcome Co., located itself in the park in 1972, employment has been evenly balanced between nationally and internationally based companies. Companies from Britain, France, Germany, Japan and Sweden grow side by side with companies that moved from New Jersey, California and Connecticut.

This momentum creates the jobs and challenges that drive companies to succeed and grow. The park's 65 research companies and 55 service companies employ 34,000 people. People working in the park live throughout the Triangle area and hail from a wide range of scientific disciplines, cultures and countries. Not only has this growth brought jobs within the park, but its influence has spread wealth to the whole area. A 1989 study showed that an additional 20,000 jobs have been created that would not have existed without the park. That net effect — 54,000 jobs by 1989 figures and some 60,000 by 1993 estimates — represents more than 10 per cent of the entire workforce of the Raleigh–Durham region.

Research Triangle Park has met the expectations of its founders in creating

employment for the state and the region, and for graduates of the Triangle universities. We have been able to reverse the brain drain, the trend that 35 years ago saw many of the brightest graduates leaving North Carolina to find suitable employment. Today, the Research Triangle Park is a net importer of PhDs and influences life in the Triangle in many ways. The Raleigh–Durham International Airport recently received confirmation of a route to London, based largely on the number of international companies in the park and across the state. An array of conventions choose the Raleigh–Durham area as a venue because of the presence of the park, and groups from around the world come to see a research park that looks like a true 'park', with green spaces and acres of trees.

With each passing year, the park receives increased attention. Magazines such as *US News & World Report*, *Location*, *Site Selection* and *Fortune* have kept a consistent spotlight on the Triangle area. *US News & World Report* has highlighted the Triangle universities regularly in its rankings of universities. In 1992, the first year in which *Fortune* magazine included the Triangle area in its rankings, Raleigh–Durham was ranked the sixth best area in the United States for global competitiveness. The momentum picked up as *Location* ranked the Triangle in the top six markets in which to locate a business, and *US News* ranked the area as among the top 20 markets in which to buy a home. *Business Week* then covered North Carolina and the growth of the I-85 corridor, including the Research Triangle Park, noting it as an area to watch for continued growth in high technology and business. *Money* magazine ranked the area in the top five best places to live, *World Trade* magazine rated the Triangle in the top five locations for international companies, and *Places Rated Almanac* said the region was the sixth best place to live in the United States. Best of all, however, was the 15 November 1993 ranking by *Fortune* that listed the Best cities for business: Where to find America's knowledge workers. "Raleigh–Durham, no.1 on our list, is a smart choice" was the description on its cover.

For those who live and work in Triangle, the ranking came as no surprise. Not only are there the larger companies in the park and around the Triangle, but also the small, start-up companies and mid-sized, growing companies. Since 1959 more than 358 technology-orientated start-up companies have been created and survived. And the park's newest tenant, Medco Research, a small pharmaceutical firm, has just announced that it has received Food and Drug Administration approval for its new drug Adenoscan.

The Research Triangle Park today is a no less exciting place to be than it was 35 years ago. The tradition of commitment, cooperation and excellence continues as the Research Triangle Foundation of North Carolina — the owners and developers of the park — strives to bring the park to the attention of new companies worldwide. The growth of the park continues at a steady pace, with the remaining 2,500 acres of rolling, wooded sites gradually being sold. In short, the park continues to meet the goals of its founders: to bring new, technology-based jobs to North Carolina and provide a base of employment for its citizens and graduates.

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Cambridge Science Park

Lindy Beveridge

THE Cambridge Science Park celebrates its twenty-fifth anniversary next year and now boasts 73 tenant companies, most of them locally born, small and newish, and operating mainly in niche markets worldwide. They are intermixed with UK subsidiaries of multinational companies based in the United States, Japan, France, Germany, Sweden, Finland and the Netherlands. All attract high-quality applicants when they advertise jobs, and as the competition for good scientific and technical staff is fierce, the scope for selection from a good list of applicants is an important reason why they want to be at the park.

The decision to develop the Cambridge Science Park was taken by Trinity College, Cambridge, its owner, in 1970 in response to a government initiative to encourage stronger links between universities and industry in the United Kingdom, and to the Mott Report which recommended the creation of a special location in Cambridge to encourage the growth of high-technology industry. The creation of 2,000 new, highly skilled jobs was one of the targets proposed for this development. Twenty-four years later, more than 3,500 new jobs have been created and the park's success has been influential in encouraging the development of other science parks in the United Kingdom and elsewhere.

Most companies at the park concentrate their financial resources on recruiting and keeping good technical staff and equipping them with the best laboratory facilities. Services needed for manufacture and marketing of products are generally bought in from local sources and most concentrate their activity on research and development, testing and marketing rather than on manufacture.

Conditions of work are excellent. Park companies occupy purpose-built accommodation in green and pleasant surroundings, and are surrounded by like-minded people, as the planning use clauses for the park restrict its tenants to only three kinds of activity — applied research, development of products and services which require a continuous input of research and development, and specialist services.

Social and conference facilities are especially important to smaller companies which may have only a small staff and limited work space. There is a pleasant social facility — the Trinity Centre — where park tenants can eat and meet throughout the day, with squash courts nearby and a variety of social clubs and other activities such as keep-fit classes and blood donor sessions. In general, park companies do not poach each other's staff,

but there is some scope for changing jobs within the park community and this is the place to hear about new opportunities.

In the past, and especially in the early days of the park's development, University of Cambridge scientists often regarded scientific staff in the park companies as being involved in rather unchallenging work. But there has been a sea change in attitudes over the years, largely thanks to a special research fund available to park

The 'Phase 3 Lake' and saplings in Cambridge's park.

companies for collaborative research. This has led to many fruitful working relationships between park scientists and university staff. A nexus of contacts now exists, with university scientists acting as consultants, advisory board members or directors of park companies as well as having more informal friendships with them. In the past ten years, an increasing number of companies founded by university scientists has moved to the park, bringing valuable opportunities for contact with them and facilitating the sharing and overlap of the university culture with that of the local high-tech industry for which the park acts as a flagship.

Park companies rely on the excellence of their science for their competitive position in world markets and they are often among the top five in their fields. They need the best microbiologists, chemists, electronics specialists and physicists and, often, people who can combine traditional disciplines in new hybrids for such developments as biosensors. In many cases, they seek to recruit young, talented scientists who are up to date with recent developments in their field and have had a year or two of industrial experience. Communications skills are important, not only for commercial purposes but also because companies at the park have unusual opportunities to meet visitors from all over the world and are often asked to explain or demonstrate their work to government ministers and civil servants, politicians, heads of universities and research institutes as well as royalty.

From the start, Trinity College set out to protect the park companies from unnecessary bureaucracy. It has an agreement with the local planning authorities that enables prospective tenants to know from their first meeting if they will be acceptable in terms of the park's planning restrictions, and the park is run by a loose group of professional specialists from local companies who report direct to Trinity College and to whom the park tenants have direct access to solve problems quickly as they arise. This 'no bureaucracy' system of running the park — it has no central office and only two employees (the gardeners who look after its landscape) — also ensures direct contacts with Trinity College and university departments. Cambridge's university departments and laboratories have long operated a very simple system for dealing with requests for use of their facilities by other scientists, into which the park companies are easily accommodated. Staff also have access to libraries and to seminars and lectures by simple request direct to lecturers or through Trinity College.

It is easy to see a science park as being more about high-tech equipment and products than about people. Cambridge Science Park had a scientist, Dr John Bradfield, as its first director and the tradition has been carried on in the appointment of his successor, Dr Jeremy Fairbrother. From the start, the conviction that the only successful way to encourage collaboration between park companies and university scientists was through creating oportunities for individuals to meet and work together voluntarily, on a basis of mutual liking and respect, has informed Trinity's approach to industry/university links at the park. From time to time it holds special social events to which both staff from park companies and university scientists are invited and arranges or facilitates many informal contacts. Both university staff and science park companies have their own differing daily agendas. Through Trinity, a large college with the finest traditions of scientific achievement and headed by the present president of the Royal Society, both communities can hear news of the other and build the contacts they desire to their mutual benefit.

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Taiwan's park attracts researchers home

Angela Yao

TAIWAN'S science-based industrial park in Hsinchu has been a strong magnet for drawing Taiwanese researchers and entrepreneurs back to their home country. Since its establishment in 1980, the park has lured back more than a thousand engineers and scientists, many of them from Silicon Valley in the United States. The park is now entering its third phase of development which will focus on biotechnology rather than the electronics and telecommunications industries that have made the park so famous, and the park is keen to attract people and companies in biotechnology and the biosciences from around the world.

The park was established by the Taiwanese government to develop high-tech industry and provide a venue for the many talented overseas Chinese engineers and researchers. Although there are other industrial parks or zones in Taiwan, Hsinchu is the only high-tech park. Like Silicon Valley, the park is based on the principle of collaboration between scientific research and entrepreneurship, but, unlike most other such parks in the world, the Hsinchu park is planned, developed and managed by the government, or more specifically, by the National Science Council, which has a traditional role as a funding agency for academic research.

The park is located in Hsinchu, approximately 80 km south of Taipei. The site was chosen for its easy accessibility to an international airport and harbours and the plentiful technological resources nearby, including two national universities and a government-sponsored industrial technology research institute.

Since its inception, the park has received more than US$400 million from the government, mainly for acquisition and development of land and construction. The developed land now totals 400 hectares and is divided into distinct industrial, residential and recreation areas. Another 200 hectares is being developed for the third phase expansion of the park.

To help companies to set up operations, the science park has built standard factories for rent. As an alternative, a company can also rent land to build a custom-designed factory to meet its own needs. To attract managers and engineers from overseas to the park, residential units have been built, along with recreation facilities, restaurants, and a man-made lake to provide a pleasant living environment. In addition, a unique school providing a bilingual curriculum has been set up. The school is an important attraction for the returning expatriates.

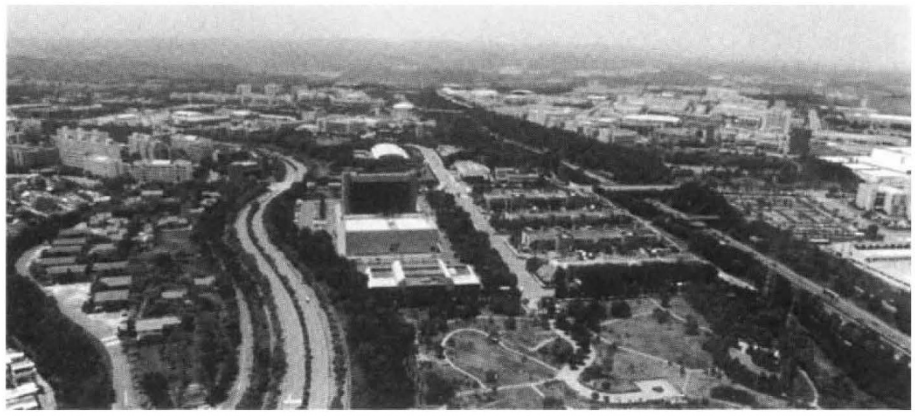
Incentives such as tax credits to encourage automation and human resource development and low-interest loans from the

government bank are being provided to companies in the park. To stimulate innovation, the park administration provides grants for innovative high-tech research and development projects to develop strategic products and components. It also selects the ten companies that put the most effort into research and development each year, and presents annual innovative product awards. Manpower training programmes sponsored by the administration in cooperation with local universities ensure a constant supply of engineers in the areas of integrated circuits, optoelectronics and integration of computers and communications. Similar programmes will be introduced in bioscience for the next phase of growth.

In spite of the threat of worldwide

recession, the park's companies continue to show an impressive record of achievement. The total number of companies operating in the park has now reached 150, of which 78 per cent are locally owned and the rest foreign-owned. Combined annual sales have grown by an impressive 48 per cent to US$5 billion and aggregate investment by 8 per cent to US$2.5 billion.

Six major industries are represented in the science park. In order of the number of companies engaged in each, they are integrated circuits, computers and peripherals, telecommunications, optoelectronics, precision machinery and advanced materials, and biotechnology. The number of integrated circuit manufacturers, which now total 43, has for the first time overtaken the number of computer-related companies to become the largest industrial sector in the park. Biotechnology, with only seven companies, is considered the new kid on the block, but the number of companies in this field is expected to expand significantly with the new phase of development.



Convenient access is a major attraction for Hsinchu residents.

The total number of employees in the park at the end of 1993 was 28,500: nearly 48 per cent have received at least a junior college or technical college education. Returning expatriates have played a vital role in the growth of the park.

By promotion through a network of overseas offices of the National Science Council and overseas Chinese professional organizations, the park has gained recognition among the large population of Chinese overseas, particularly in the United States. By 1993 more than a thousand were working in the park, most of them from Silicon Valley companies, and 73 of the park companies had been founded by members of this group, or about half of the companies in the park. With the knowledge and ideas they have brought back, they have done much to raise the overall levels of technology and research and development capability in Hsinchu.

This overseas network of Chinese scientists and organizations is likely also to play an important role in supporting further expansion of the park.

The park's companies are expected to reach combined sales of US$6 billion by 1996. In order to accommodate their rapid growth, the park is undertaking land development for the third and fourth phase expansions. New facilities are being planned by integrated circuit manufacturers, and the administration is working with the industrial and research sectors to bolster the development of the biotechnology industry. Furthermore, the government has approved the Hsinchu Science City project, with an investment of at least US$4 billion over the next 25 years to develop Hsinchu into a true metropolitan science city.

Over the past 13 years, the efforts of many people have given the Hsinchu Science-based Industrial Park a solid foundation for success. Facing the challenges of stiffer environmental protection regulations, rising labour and operational costs, and the rise in value of the New Taiwan Dollar, Taiwan's industries must move towards more technology-intensive, capital-intensive, and high-value-added production. The science park's leading role in the changing industrial structure has made it possible for Hsinchu to become a major centre of high-tech industry in the Asia–Pacific region at the approach of the twenty-first century.

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INTERNATIONAL FACTS AND FIGURES

	North American parks	Non-North American parks	Worldwide total
Hectares	31,043	8,919	39,962
Hectares improved	15,849	3,491	19,340
Companies	4,746	6,369	11,115
Employees	255,425	178,112	433,537
Buildings	1,702	2,200	3,902
Buildings (m^2 in parks)	10,932,414	5,555,932	16,488,346
Hectares of infrastructure	1,513	539	2,052
Hectares with structures	3,345	748	4,093
Hectares leased	1,170	326	1,496
Hectares available lease only	1,410	122	1,532
Hectares sold	4,664	477	5,141
Hectares available sale only	3,359	277	2,636
Hectares available sale or lease	2,234	306	2,540
Hectares under option	104	95	199

The data listed for hectares available for sale, hectares available for lease and hectares available for sale or lease reflect improved hectares.

- The worldwide count for science parks is 403. North American parks increased by 9 and Non-North American parks increased by 60 since 1991. The increase for Non-North American parks is attributed to better access to park information rather than newly established parks.
- North American parks surpassed 50 per cent of the world total for the first time, and have more improved land than unimproved land designated as a research park. Non-North American parks show a 39 per cent to 61 per cent comparison between improved and unimproved land.
- Since 1991, the number of companies in North American parks grew by 68% and the number of employees by 27%. Non-North American growth rates are not computed, due to incomplete data.
- The average size company in North American parks has approximately 54 employees. In Non-North American parks, the average size company is smaller, with 28 employees.
- Land dedicated to infrastructure makes up approximately 10 per cent of improved land in North American parks and over 15% in Non-North American parks. This seems to indicate that Non-North American parks allocate a greater amount of land per hectare for infrastructure. However, when taking into account the average size of improved hectares (14 hectares in Non-North American parks and 103 hectares in North American parks), North American parks provide a greater amount of total infrastructure to support their parks.
- The supply of available land either improved or unimproved in research and science parks is substantial worldwide.

These data were compiled by the International Association of Science Parks, based in the Bordeaux Technopolis Centre, and the Association of University Related Research Parks/4500 South Lakeshore Drive, Suite 475, Tempe, Arizona 85282.