CHAPTER 2

NORTH CAROLINA'S RESEARCH TRIANGLE PARK

Overview, history, success factors and lessons learned

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INTRODUCTION

North Carolina's Research Triangle Park (RTP, or the Park) is the largest and arguably best-known research park in the United States. At more than 2,800 hectares in total size, it currently includes 145 organizations employing more than 39,000 people with combined annual salaries amounting to over $2.7 billion dollars[1]. At least 80 percent of its organizations engage in research and development (R&D), and more than 93 percent of its employees work at those R&D organizations. Even more impressive, at least 80 percent of the employees in RTP work for multinational corporations, and the average salary of an RTP employee is $56,000, which is significantly higher than North Carolina's statewide average salary of $32,689 and the RTP region's average salary of $39,056 (RTF 2006; Bureau of Labor Statistics 2002b; a). Worldwide, RTP is known as a leader in a wide variety of high-tech fields, including biotechnology and biopharmaceuticals, computer hardware and software, chemicals, environmental sciences, information technology, instrumentation, materials science, microelectronics, statistics and telecommunications (RTF 2006).

By these measures and several others, RTP has been a resounding success. Yet that success was far from certain when RTP was envisioned nearly 50 years ago. In fact, at the time of RTP's founding, few people could have dreamed it would achieve the impressive and size and activity level it enjoys today. That the research-park concept moved forward and prospered to such a great extent is due to several interrelated factors, each playing important roles in RTP's germination and growth. The goal of this chapter is to describe those factors in a manner that is brief,

W. Hulsink and H. Dons (eds.), Pathways to High-tech Valleys and Research Triangles: Innovative Entrepreneurship, Knowledge Transfer and Cluster Formation in Europe and the United States, 27-51.

comprehensive and instructive. It should be noted, though, that the information presented here is not new; rather, it is a condensed and repackaged version of what has been told elsewhere in considerably more detail[2].

The purpose for presenting this information is to provide guidance to others who aspire to replicate in their own regions the successes of RTP. Each year, hundreds of visitors from other regions and countries visit RTP to learn about the Park's history, structure and operations. No doubt, their visits are enjoyable, informative and productive. But it should also be said that although RTP is a model for regional economic development, its lessons do not translate easily or seamlessly to other regions. The factors that lead to RTP's success may not exist in other settings. As researchers have noted, regions most likely to host successful research parks have (1) an existing base of R&D and high-tech activity; (2) one or several research universities, medical schools and/or engineering institutes; (3) good air service; (4) a well developed network of infrastructure and business services; (5) medium- and large-sized metropolitan areas; and (6) foresightful and effective political, academic and business leaders (Luger and Goldstein 1991, chapter 9).

Even with those factors, however, the first-mover advantage has long-since disappeared. As of March 2006, the International Association of Science Parks boasts 315 members in 66 countries, and those parks host more than 70,000 companies ("What is the IASP", IASP 2006). Hence, due to the sheer number of research parks now in operation, the ability of any locale to attract a critical mass of R&D activity is harder than in the past, and it has become increasingly difficult for any new park to succeed. More than 15 years ago, researchers found that as many as one half of all the parks that are announced fail in the incubation stage or in the early consolidation stage. And of those that survive, many are converted from research to more general business parks (Luger and Goldstein 1991).

While the odds are indeed stacked against any new research park succeeding, it is also true that opportunities still exist for new parks to arise and prosper. For any region, the key to creating a prosperous research park is to find the right mix of opportunity, assets and leadership. Good timing and luck help too. With that mix in mind, we turn to the case of RTP as a model of one of the first and most successful research parks.

RTP TODAY

What is RTP?

Before recounting RTP's history, success factors and lessons learned, it is useful first to get an overview of what RTP is today. This will help show how much RTP has changed internally, as well as impacted its environment, over time.

RTP is a public/private planned research park, created in 1959 by leaders from business, academia and industry (RTF 2006). As measured by the number of employees that work there and the geographic area it encompasses, RTP is the largest research park in the United States. RTP is operated by the Research Triangle Foundation of North Carolina, a private, not-for-profit organization that owns and develops the Park. The Foundation is responsible for building and maintaining the

physical aspects of RTP, attracting and retaining companies to RTP, and enhancing the competitive position of RTP and its region (RTF 2006).

The vision of the Foundation is to create "a better life for all North Carolinians through sustainable knowledge and technology-based development that effectively balances human needs and humanities with economic opportunities". And its mission is "to promote university, academic, industry and government collaborations leading to the establishment and maintenance of research, scientific and technology-based facilities within the Triangle and North Carolina, creating quality jobs and opportunities for its citizens" (RTF 2006). As described in more detail below, the Foundation has managed RTP from its inception, and it has played a critical role in the Park's success.

Where is RTP?

Located on the East coast of the United States, midway between New York City in the North and Atlanta in the South, RTP is located in the heart of the state of

Figure 1. *Location of Research Triangle Park within United States*[3]*. Graphic Courtesy of North Carolina Department of Commerce*

North Carolina (Figures 1 and 2). As one of the original 13 British colonies in North America in the late 18th century, North Carolina was primarily an agricultural state throughout most of its early U.S. history; its economy depended heavily on crops such as tobacco and cotton. In the 21st century, however, it transformed from a predominantly agricultural state to a major industrial centre, and currently about 17 percent of its workforce is employed in manufacturing, most notably textiles and furniture. With a current population of slightly more than eight million people, North Carolina is the eleventh-most-populous state in the United States, and it ranks eighth largest in the United States in terms of manufacturing base.

Within the state, RTP is located almost equidistant between the cities of Raleigh, Durham and Chapel Hill (Figure 3). As discussed in more detail below, this location in the state is by no means an accident; each city is home to a world-class research university, and several other favourable assets exist in RTP's immediate environment.

At the eastern point of the Research Triangle, Raleigh, the state capital, has a population approaching 300,000 and is home to North Carolina State University (NC State). Founded in 1887, NC State is a large public land-grant research university with approximately 30,000 students and 1,800 full-time and part-time faculty[4]. A nationally recognized leader in science and technology, NC State has historic strengths in agriculture and engineering. Its 10 colleges – Agriculture and Life Sciences, Design, Education, Engineering, Humanities & Social Sciences, Management, Natural Resources, Physical & Mathematical Sciences, Textiles, Veterinary Medicine – offer degrees at the baccalaureate, master's, intermediate, first professional, and doctoral levels in 125 fields of study (NCSU 2006).

Approximately 45 kilometres to the northwest, at the upper point of the triangle, is Durham, a city of approximately 200,000 people, which serves as the home of Duke University, founded in 1924[5]. A medium-sized private university with approximately 12,000 students (approximately half of which are graduate and professional students) and 2,500 faculty[6], Duke has nine colleges and schools –

Figure 2. *Location of Research Triangle Park within North Carolina[7]. Graphic Courtesy of North Carolina Department of Commerce*

College of Arts & Sciences, School of Law, Divinity School, Graduate School, School of Medicine, School of Nursing, School of Environment and Earth Sciences, School of Engineering, School of Business. Its most prominent asset is its medical centre, established in 1930, which includes a hospital and a wide variety of clinical, training and research programs. In addition, Duke has particular strengths in the biomedical sciences and engineering (Duke University 2006).

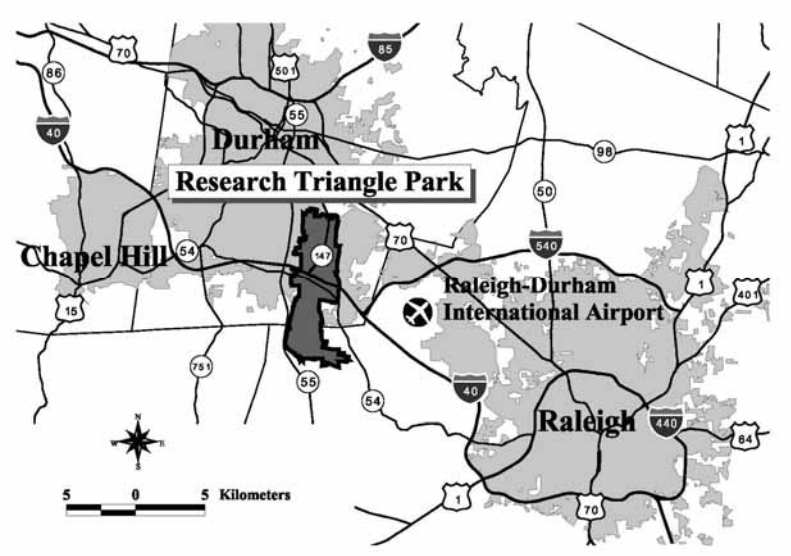

Figure 3. *Location of Research Triangle Park between Cities. Graphic Courtesy of North Carolina Department of Commerce*

At the southwest point of the triangle lies Chapel Hill, which has a population of approximately 50,000 and is 18 kilometres from Durham and 51 kilometres from Raleigh. It is the home of the University of North Carolina (UNC) at Chapel Hill, the state's first public university, chartered in 1789. UNC–Chapel Hill currently has approximately 27,000 students and more than 3,100 full-time and part-time faculty. With the exception of engineering and agriculture, it is the state's principal centre of graduate education and research at the doctoral levels. Its instructional programs are offered through two divisions. The Division of Academic Affairs consists of eight colleges and schools – College of Arts & Sciences, School of Business, School of Government, School of Journalism & Mass Communication, School of Education, School of Information and Library Science, School of Law, School of Social Work. The Division of Health Affairs includes five schools – School of Dentistry, School of Medicine, School of Nursing, School of Pharmacy, School of Public Health. Its degree offerings include 71 bachelor's, 110 master's and 77 doctorate programs. UNC–Chapel Hill is particularly notable for its biomedical research and computer-science strengths (University of North Carolina 2006).

Figure 4. *Research Triangle Park. Graphic courtesy of Research Triangle Foundation*

In addition to these three major research universities, the Raleigh–Durham–Chapel Hill region includes several other colleges and universities, both public and

private[8]. In total, the region includes more than 111,000 university students. And in terms of total population, the region includes more than 1.3 million residents. Linking all these people is an extensive network of interstate highways and statehighways and roads, as well as mass transit such as bus and train service. Also of importance is Raleigh–Durham International Airport, which in 2000 ranked as the second fastest growing major airport in the U.S. In 2005, the airport averaged 25,000 passengers a day, for a total of 9.4 million passengers for the entire year. At the end of 2005, RDU offered 212 daily departures to 36 cities, servicing eight major airlines and 16 regional airlines (RDU 2006). Together, these resources and infrastructure are key components in RTP's success.

How is RTP organized and managed?

RTP itself is 13 kilometres long (North to South) and 3.2 kilometres wide (East to West). It is more than 2,800 hectares in total size and currently has 1.9 million metres in developed space. By design, and consistent with its name, RTP maintains a park-like setting; strict zoning regulations limit the building density and create considerable green space (Figure 4). The Park spans Durham and Wake counties which, in terms of population, rank sixth and second, respectively, out of North Carolina's 100 counties (U.S. Census Bureau 2006).

The northern three-fourths of RTP lies in Durham County, which designates special Science Research Park (SRP) zoning for RTP. This special zoning provides an area for business and scientific R&D, for training, and for production of prototype products, plans or designs in a low-density, open, campus-like setting. The district is intended to house research facilities, pilot plants, prototype production facilities and other manufacturing operations that require the continual or recurrent application of research knowledge and activity as an integral part of the manufacturing process. Offices and support services are also allowed. Within this district, no more than 15 percent of each lot can be devoted to buildings, and buildings taller than 120 feet are not allowed, except with special approval ("Why RTP? Zoning", RTF 2006).

The southern one-fourth of the Park lies in Wake County, which designates a special Research Application District (RAD) zoning for RTP. Like Durham's zoning for RTP, the RAD is intended to accommodate research and research-applications activities such as related manufacturing, business and science activities. The district is intended to accommodate research facilities, pilot plants, prototype production facilities and other manufacturing operations that require the continual or recurrent application of research knowledge and activity as an integral part of the manufacturing process. Unlike Durham's portion of RTP, however, there is no limit on building height except in special cases. Not more than 30 percent of the total area of a lot can be covered by buildings, driveways, parking areas and loading areas ("Why RTP? Zoning", RTF 2006).

As noted above, the non-profit Research Triangle Foundation owns and operates RTP. The Foundation, staffed by 14 full-time employees, has responsibility for building and maintaining the physical aspects of the Park overall and for attracting

and retaining Park companies[9]. It sells lots to organizations that wish to locate in the Park, and it finances its operations with revenue from the sale of land. Although there are no direct government subsidies to RTP, state and local governments do assist the Park by providing services such as sharing in the cost of the Park's roads, providing water and sewer services, and providing police protection. In addition, North Carolina's Department of Commerce assists with attracting and recruiting businesses to the Park.

The state government did, however, make a key decision in 1985 to pass legislation that prevents the cities of Durham and Raleigh from annexing any portion of the Park (State Law 1985-435: An Act to Authorize Counties to Establish Research and Production Service Districts). This law effectively means that, unlike landowners in annexed areas, the Park's property owners pay property taxes only to the county government, not to the city government. Thus, by decreasing the overall tax burden facing RTP landowners, the law makes RTP a more attractive place for companies to conduct their R&D.

By and large, the organizations residing in the Park have most of the responsibility for providing buildings and services such as eating facilities, grounds maintenance, and waste and garbage disposal (Luger and Goldstein 1991, Chapter 5). While the bulk of RTP's available space has been developed, 654 hectares remain to be developed, and most or the Park's existing industries have room to expand.

What is notable about RTP?

On the Park's 40th anniversary in 1998, the Research Triangle Foundation commissioned a comprehensive assessment of what has been achieved in the Park, in the region, and in the state[10]. Based on that evaluation and additional information supplied by the Research Triangle Foundation, RTP can point to several notable measures and achievements, which are summarized here in terms of employers, employees, relationships and economic impacts.

Employers and employees

As a hub of R&D activity for the region, RTP is home to over 145 companies, most of which are in high-tech industries (Table 1). In terms of number of companies, the Pharmaceuticals/Health Services/Medical Devices sector represents the largest industry in RTP, with more than 35 companies (e.g., GlaxoSmithKline, BD Technologies, United Therapeutics Corporation) employing nearly 7,000 people. This high concentration reflects the R&D strengths of area universities such as Duke and UNC–Chapel Hill, both of which have hospitals, schools of medicine, schools of nursing, and highly-ranked biomedical and biomedical-related research programs.

The second-highest industry concentration is in the IT/Pervasive Computing/Telecommunications sector, with more than 25 companies (e.g., IBM, Nortel Networks, Cisco Systems) employing over 20,000 people. The engineering schools at NC State University and Duke, as well as the computer-science department at UNC–Chapel Hill, are strong magnets for companies in this industry.

***Table 1**. RTP companies by industry, 2006*

Industry	*Companies*	*Employees*
IT/Pervasive Computing/Telecommunications	25	20,525
Pharmaceutical/Health services/ Medical devices	35	6,893
Non-profit organizations/Associations	13	2,864
Environmental science	9	2,766
Biotechnology/Biological agents	14	1,998
Electronics/Nanotechnologies	10	843
Other	6	758
Professional/Business services	16	521
Chemicals	4	240
Materials science	2	77
Total	134*	37,485

Source: Research Triangle Foundation.

** The number of companies listed here is lower than the number mentioned in the introduction (145) because a small number of companies, particularly start-up companies, operate in RTP for less than a year and thus choose not to include themselves in the Research Triangle Foundation's industry listing.*

***Table 2**. Largest employers in RTP, 2006*

Company	*Employees*
IBM	10,800
GlaxoSmithKline	5,000
Cisco Systems	3,400
Nortel Networks	2,800
RTI International	2,500
US Environmental Protection Agency	1,500
National Institute of Environmental Health Sciences	1,000
Diosynth Biotechnology	900
Sony Ericsson	750
Bayer CropScience	500
Biogen IDEC	500
BASF Corporation Agricultural Product Center	500
Total	30,150

Source: Research Triangle Foundation.

Other industries and sectors, such as environmental science (e.g., U.S. Environmental Protection Agency) and biotechnology/biological agents (e.g., Bayer Crop Science) also have a significant presence in RTP, and their decisions to locate in the Park strongly reflect the strengths of the region's universities in these fields[11].

Table 3. *Occupation types, RTP, 1998*

Occupation type	*Mean percentage*
Scientists or engineers	46%
Managers or administrators	17%
Skilled technicians	22%
Clerical workers	9%
Semi- or low-skilled production workers	5%
Other	1%
Total	100%

Source: Hammer, Siler, George Associates.

It should be noted, however, that RTP's top-12 largest companies in 2006 employed 30,150 people (Table 2), meaning the remaining 7,335 people are spread across 133 relatively small companies. In fact, nearly 42 percent of RTP's companies have fewer than 10 employees, and the vast majority of the other companies in RTP are classified as small businesses. Among the large organizations, the majority are branch plants of large corporations, most of which do not have their headquarters in North Carolina. As discussed in more detail below, this reflects North Carolina's and RTP's historical emphasis on attracting branch plants of large corporations rather than fostering new, small start-up businesses (Luger and Goldstein 1991). Among all the companies, however, a large majority (85 percent) of the employees typically have post-graduate, college or technical school education (Table 3). This, in part, explains RTP's above average salaries, and it results from the Park's relationship with area universities.

Relationships

RTP generates numerous synergistic benefits from its relationships with its surrounding region and state, particularly with universities[12]. Overall, nearly 90 percent of RTP companies reported that they have formal or informal relationships with universities in the region (Table 4). For example, more than 80 percent of RTP companies viewed access to university graduates as employees as very or moderately important. Moreover, more than 70 percent of the companies viewed courses and training for their employees as very or moderately important. Several other types of company-university relationships – cultural, social and recreational

amenities; opportunities to subcontract; and use of faculty for consulting – were also viewed as very or moderately important by a majority of the companies.

Table 4. *Importance of university relationships to RTP Companies, 1998*

	Importance		
Relationship	*Very/Moderate*	*Minor*	*Not*
Access to university graduates as employees	82%	9%	9%
Courses and training for employees	73%	27%	0%
Cultural, social, recreational amenities	59%	27%	14%
Opportunities to (sub)contract	55%	32%	14%
Use of faculty for consulting	54%	27%	18%
Use of university facilities and laboratories	36%	14%	50%
Faculty appointments for scientists and engineers	28%	27%	45%

Source: Hammer, Siler, George Associates.

Table 5. *Chancellors' stated impact of RTP on their institutions, 1998*

Impact	*Response**
Jobs	85%
Internships/Professional training	68%
Visiting faculty/Lectures	60%
Endowment support	52%
Research funding	51%
Demand for continuing education/degree	34%
Consultant assignments	34%

Source: Hammer, Siler, George Associates.

**Percentages are approximations based on a graph presented in the report. Percentages should be accurate within plus or minus two percentage points.*

The universities, in turn, consider their relationships with RTP to be very important, and for virtually the same reasons as do the companies.[13] More than 85 percent of university chancellors viewed RTP as an important source of jobs for their graduates, and nearly 70 percent viewed RTP as an important source of internships for their students and professional training for their faculty (Table 4). And more than half of the chancellors viewed RTP as an important source of visiting faculty/lectures, endowment support, and research funding (Table 5).

Economic impacts

RTP's synergistic benefits have yielded significant and broad-ranging economic impacts for North Carolina. The Park's most significant and direct impact has been its ability to attract companies to the region (Table 6). As revealed in the 1998 assessment, among RTP companies representing 84 percent of the Park's

Table 6. *RTP impact on company location, 1998*

Would you have located in the region had it not been for the RTP?	*Response**
Very unlikely	52%
Unlikely	45%
Other	3%
Total	100%

Source: Hammer, Siler, George Associates.

**Percentages in terms of share of employment.*

employees, over half indicated that is was 'very unlikely' they would have located in the region had it not been for RTP. An additional 45 percent said it was 'unlikely' they would have located in the region were it not for the Park. Thus, only three percent indicated the Park did not have an impact on their decision to locate in the region.

The Park also has had a significant direct economic impact through the payroll of its companies, totalling over $2.7 billion (Table 7). This payroll provides a strong market for other providers in the state and region, such as real estate, retail goods,

Table 7. *Estimated annual RTP payroll and N.C. purchases, 1998*

	Spending	*Employees*	*Avg/emp.*	*Total in RTP*
Payroll	$394,771,562	7,289	$54,145	$2,707,240,787
N.C. purchases	$275,508,097	6,469	$42,589	$2,129,448,887

Source: Hammer, Siler, George Associates.

food and entertainment, education, and other amenities. The companies themselves are large consumers of in-state goods and services, purchasing more than $2.1 billion from other North Carolina businesses. For example, a large majority of RTP companies have subcontract relationships with other RTP companies; about half hire other RTP company personnel and consultants, and more than one-third purchase equipment and supplies from other RTP companies.

Other direct economic impacts include construction, real estate and property tax yields, retail sales tax yields, and state and local retail sales tax yields (Table 8). For example, real and personal property in RTP is valued at more than $1.9 billion annually, and these properties yield more than $17 billion to the Park's home counties ($16 million to Durham County and $1.4 million to Wake County). RTP's employees also prove significant economic impact to the region, spending an estimated $87 million annually on items such as lunches, apparel and accessories. These expenditures yield more than $5 million in state and local taxes annually.

Table 8. *Selected direct economic impacts, RTP, 1998*

Factor	*Value*
Real and personal property valuation	$1,921,973,818
Real and property tax yield	$17,384,604
Job-based retail sales	$87,097,500
Annual state and local retail sales tax yield	$5,225,852

Source: Hammer, Siler, George Associates.

Less directly, RTP has had positive impacts on its region by strengthening the community identity and quality of life. Many of the RTP companies are engaged in community-building activities, such as supporting educational initiatives, donating computers and other equipment, contributing to major civic projects, and encouraging their employees to become involved in their communities and the central-city problems. Outside its region, the Park has also had substantial impacts by leading to the development of manufacturing facilities related to the research activity of RTP companies. During the 1990's alone, an estimated $300 million in private investment occurred in the 10 counties surrounding the Triangle region. Examples of RTP-related investments throughout the state include IBM in Charlotte, Siemens Medical Systems in Greensboro and Cary, and Merck Manufacturing in Wilson. In addition, since 1970 at least 225 technology firms started in RTP, representing nearly 14,000 jobs. Approximately 30 percent of these companies are still located in the Park, and another 17 percent are located in the immediate vicinity (Hammer Siler George Associates 1999, p. 22).

All of this activity has substantially enhanced – nationally and internationally – the image of North Carolina overall and the Research Triangle region specifically. A 1997 national survey of senior broadcast journalists, for example, revealed that 91 percent rated the Research Triangle region as an excellent business climate, while 68 percent had that view of North Carolina overall. And in recent years the Research

Triangle region and state have garnered an impressive collection of accolades on several fronts. The following list provides a sample:

- *#1 High Tech Region in US (Research Triangle Region)* – "Projections 2006 – Daring to Compete: A Region-to-Region Reality Check", Silicon Valley Leadership Group, August 2005
- *#1 Preferred State for Location and Expansion (NC)* – Plants Sites and Parks, October 2004
- *#2 Best Place for Business & Careers (Raleigh–Durham)* – Forbes, May 5, 2005
- *#3 Hot Cities for Entrepreneurs (Raleigh–Durham)* – Entrepreneur Magazine, September, 2005
- *#3 U.S. Metro Area for Biotech/Life Sciences (Raleigh–Durham–CH)* – Milken Institute, June 2004
- *#5 Most Entrepreneurial City in the United States (Raleigh)* – Visa's New Innovation Index, October 2004
- *# 4 Up and Coming State (North Carolina) in the World of Biotechnology* – Ernst & Young, Outlook, May/June 2003

As noted in the introduction, accolades such as these were virtually unimaginable when RTP was first envisioned nearly 50 years ago. A review of the genesis of RTP and its evolution will show just how far the Park has come in less than half a century.

RTP HISTORY

The genesis and early years

For most of its economic history since the 1600s, North Carolina's was not a high-technology state. In fact, during most of that time the state's primary competitive advantage derived from its plentiful natural resources, a long and productive agricultural season, and cheap, abundant labour. Though these assets served the state well throughout much of its history, by the mid 1950s North Carolina's economy found itself heavily concentrated in just three industries – tobacco, textiles and furniture – each of which employed primarily low-skill workers. Moreover, each of the industries was on the decline in the state; the furniture industry was expanding to the northeastern United States; the level of tobacco manufacturing was shrinking (due largely to growing health concerns); and the textile industry was beginning to move its manufacturing operations overseas (Link 1995, p. 3). As a result, North Carolina's per capita income was virtually the lowest in the nation, ranking 45th out of the 50 U.S states in 1950, and 48th in 1952. Moreover, because the state had three strong research universities (Duke, NC State and UNC–Chapel Hill) but very little comparable industrial R&D activity, a significant share of its population, particularly the high-skilled portion, saw few economic opportunities within the state. By the mid 20th century, North Carolina was experiencing serious 'brain drain', with many of its college graduates moving to other states in search of employment.

Recognizing the need to diversify and expand North Carolina's economy, a group of the state's educational, industrial and government leaders began to push the

idea that the region's three research universities could act as magnets to attract companies, particularly R&D companies. In response, North Carolina Governor Luther Hodges formed a committee in late 1954 to investigate and perform an objective assessment of the idea of encouraging R&D organizations to locate near the universities. Composed of a small group of business and academic leaders, the commission produced a 10-page report in January 1955 stating that

> "The State of North Carolina today has unique and undeveloped advantages that can attract research organizations to the State and that can lead to the development of an important research center of the United States. The growth of research organizations within the State can, in turn, lead to the attraction of existing industries to the State and the development of new industries within the State"[14].

It also stated that "Specific plans should be made for the development of an area between Raleigh, Durham and Chapel Hill and near the Raleigh–Durham Airport, as a center for industrial research".

After several months of discussions and deliberations surrounding the report, in September 1956 Governor Hodges announced the establishment of the Research Triangle Committee, Inc. The Committee's certificate of incorporation outlined its intent:

> "The objects and purposes for which the corporation is formed are to encourage and promote the establishment of industrial research laboratories and other facilities in North Carolina primarily in, but not limited to, that geographical area or triangle formed by the University of North Carolina at Chapel Hill, North Carolina State College of Agriculture and Engineering of the University of North Carolina at Raleigh, and Duke University at Durham. It is the intent and purpose of the corporation to promote the use of the research facilities of the three above-named institutions through cooperation between the three institutions and cooperation between the institutions and industrial research agencies, to bring to the attention of industry throughout the country the unique and undeveloped advantages of this State and thereby attract industrial research laboratories and other facilities to this State. It is the purpose through such activity not only to attract industrial research laboratories and facilities but to attract the establishment of industries and thereby to increase opportunities of citizens of this State for employment, and to increase the per capita income of the citizens of the State (Link 2002, p. 1)".

In October 1956, George Simpson, professor of Sociology at the University of North Carolina at Chapel Hill, was appointed as director of the corporation. For the next several months Simpson, with the help of his assistant, Elizabeth Aycock, worked tirelessly to develop the RTP 'story' and market it to research companies throughout the United States. Simpson focused his efforts primarily on developing printed material (e.g., brochures and fact sheets) to provide information about RTP to companies. The material provided key information about the RTP concept, the resources and amenities of the region, the strengths of the area's universities, and the Research Triangle Committee.

Simpson then developed a two-part strategy for translating the RTP dream into a reality. The first part involved direct marketing, or making the resources of RTP known to appropriate people in industry and government. This involved distributing printed material to companies throughout the United States as well as making numerous (more than 200) site visits – with the help of the Governor, academics and

business leaders and personal contacts – to companies' research directors and executives throughout the country. The second part involved activities requiring more local initiatives, such as local financing of laboratories, building laboratory buildings, establishing cooperative laboratories involving industries already in the state, establishing commercial research laboratories, and establishing a research institute (Link 1995, p. 41). The direct marketing approach took first priority, followed by the local initiatives as time and opportunity permitted. It should be noted that Simpson also had to carry out a considerable amount of in-state marketing of RTP, particularly to the university faculty, who were wary about being too tightly involved with industry.

While working to sell the RTP idea outside and inside the state, Simpson, with the assistance of others such as Governor Hodges and the Research Triangle Committee, also worked to make RTP tangible, namely by acquiring land for the Park. It was agreed that developing the land would be on a for-profit basis. That is, investors would purchase the land, develop it with laboratory buildings and facilities, and then make a profit as additional laboratories co-locate and increase the value of the land. In September 1957, Governor Hodges recruited Karl Robbins, a retired industrialist with ties to North Carolina, to provide funds to acquire options on land. By the end of 1957, nearly 1,700 hectares of land (primarily farmland) had been optioned or purchased at a price of approximately $700,000. The land was officially acquired by the newly-formed Pinelands Corporation, whose sole stockholder was Karl Robbins.

By mid 1958, however, it became clear that the Research Triangle Committee could not rely solely on Robbins for the financial capital needed to acquire all the land needed for the Park. Thus, Governor Hodges recruited Archie Davis, an executive of Wachovia Bank, to help attract North Carolinians to invest in the land for the Park by investing in the Pinelands Corporation. Davis agreed, but under two conditions: that he would raise the needed money by soliciting contributions for RTP rather than selling stock for Pinelands, and that the funds would be used to purchase the Pinelands Corporation and pay off its debts. These two conditions proved to be pivotal, since in a matter of two months Davis travelled throughout the state raising more than $1.4 million in private donations through one-on-one conversations with wealthy, established North Carolinians. The key to Davis's success was the argument that RTP was designed for public service rather than for private gain. According to Davis, "... if this indeed was designed for public service, then it would be much easier to raise money form corporations and institutions and the like, who were interested in serving the State of North Carolina, by making a contribution" (Link 1995, p. 68).

In January 1959, Governor Hodges announced that Davis had, single-handedly, raised $1.425 million from more than 850 donors across the state. These funds would be used for three purposes: to acquire the land assembled by Karl Robbins and pass control of his venture (Pinelands) to the newly formed non-profit Research Triangle Foundation; to establish the Research Triangle Institute to do contract research for business, industry and government; and to construct a new building to house the Institute and the Foundation in the centre of the Park (Link 1995, p. 73). The Research Triangle Institute (now called RTI International) was the Park's first

tenant and served as a focal point for companies interested in the Park. Four months later, Chemstrand Corporation announced its decision to locate in RTP, becoming the Park's first major industrial tenant. It is important to note, though, that RTP was not on Chemstrand's original list of 20 potential locations. RTP came to its attention only after representatives from the three universities met with Chemstrand officials and sold them on the Park's potential.

A slow start, then decades of growth

Realizing the Park's potential did not come quickly or easily. During its first six years, 1959 to 1965, RTP grew very little. During that time, the Research Triangle Foundation worked hard, with little success, to advertise the Park to U.S. research corporations. Only a handful of organizations – the U.S. Forest Service, the American Association of Textile Chemists and Colorists, Technitrol, Inc., the North Carolina Science & Technology Research Center – established operations in the Park. Although these were trying times for the RTP's founders and management, they never lost faith in the project.

That faith paid began to pay off in 1965, when at the start of the year it was announced that the U.S. Department of Health, Education, and Welfare (now called

Figure 5*. IBM opens Research Triangle Park Facility in 1965. Graphic courtesy of Research Triangle Foundation*

the Department of Health and Human Services) had selected RTP for its $70 million Environmental Health Sciences Center (now called the National Institute of Environmental Health Sciences). Months later, in April, it was announced that IBM would located a 56,000-square metre research facility on 160 hectares in RTP; this site is still the largest single-owner piece of property in the Park. RTP representatives, under the leadership of Governor Terry Sanford, had courted the Environmental Health Science Center for three years and IBM for seven years. These two moves validated the mission of RTP and made the Foundation free of debt.

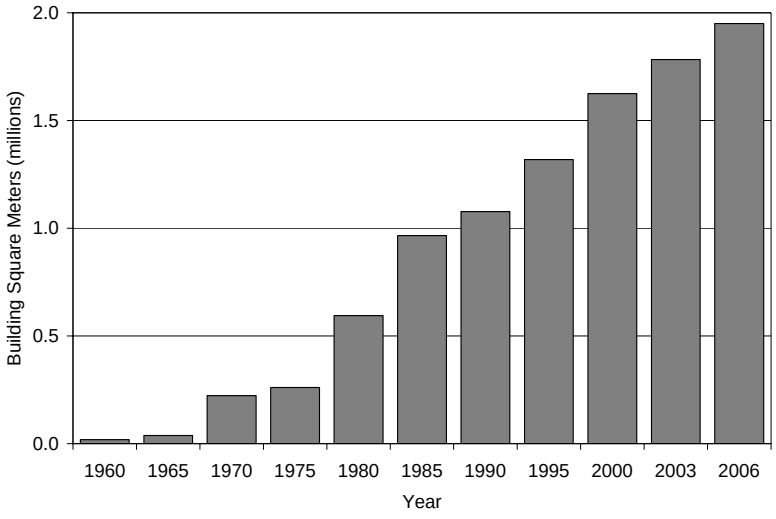

Figure 6. *Developed building square metres in RTP, 1960-2006. Source: Research Triangle Foundation*

The Park's rate of growth increased rapidly after 1965, with a total of 21 organizations locating there in by 1969. Key examples include the National Center for Health Statistics and the Triangle Universities Computation Center in 1966. Between 1970 and 1979, an additional 17 organizations located in RTP. Major additions in that time period include the U.S. Environmental Protection Agency in 1971, Burroughs Wellcome in 1973, and the National Humanities Center in 1978. By 1989, 28 more companies located there, including the Microelectronics Center of North Carolina (now MCNC) in 1980, the North Carolina Biotechnology Center in 1984, and BASF Corporation Agricultural Products in 1986. In the 1990s, 42 new R&D companies established operations located there. Most notable are Cisco Systems in 1994 and Biogen in 1995. Overall, in the more than 40 years since 1965, the Park has averaged six new companies and approximately 1,800 new employees per year[15].

These changes are reflected in the large increase in the number of RTP employees since 1960 as well as by the impressive increase in building square

footage during that time (Figures 6 and 7). The growth in square footage stems from at least three factors: the size of RTP increased over time to accommodate growth, existing organizations expanded their facilities, and new organizations located there

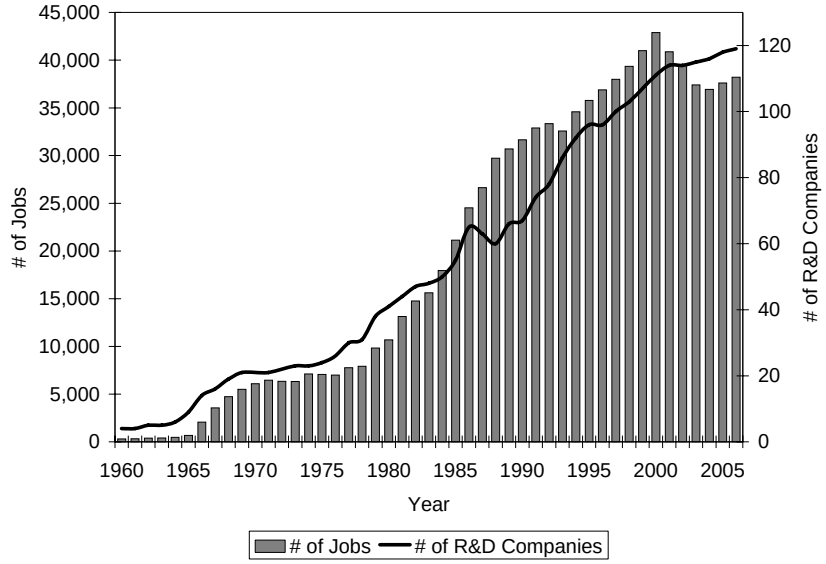

Figure 7. *Jobs and R&D companies in RTP, 1960-2005. Source: Research Triangle Foundation.*

over time. While the increase in number of companies and employees has begun to slow in recent years, the amount of building square footage has continued to increase steadily. Currently, the Research Triangle Foundation and other interested groups are implementing several strategic steps to ensure the Park continues to grow and thrive.

RTP SUCCESS FACTORS AND LESSONS LEARNED

Success factors

After reviewing RTP's achievements and its nearly 50-year history of growth, one could easily assume that its success was a forgone conclusion. In reality, though, several factors were stacked against it. For example, at the time of RTP's founding, the region was not a large metropolitan area, it lacked a strong base of high-tech manufacturing, it had a low-skilled and relatively low-education level, and it had little tradition of entrepreneurial activity. Fortunately the region also had several assets in its favour, and those assets came together in a way that tipped the balance in favour of RTP. In particular, three factors were most important for bringing about

RTP's success: the universities, the leaders and people of North Carolina, and timing. While none of these factors alone was sufficient, each was necessary[16].

Clearly, the RTP region's strongest asset is its three research universities. Few places in the United States or the world have a conglomeration of faculty and facilities comparable to that found in the Raleigh–Durham–Chapel Hill region. Indeed, from the beginning the universities served as the region's primary selling point, as evidenced by their prominent positioning in the marketing materials originally developed to sell the idea to companies throughout the United States[17]. But these education and research assets, by themselves and working independent of one another, were not enough to generate RTP. The universities needed to, and in fact did, recognize that they had to act as a unified research community, cooperating for the common good.

What helped in this regard was the leadership of at least two of two of the state's governors – Governor Luther Hodges (1954-1961) and Governor Terry Sanford (1961-1965) – in the Park's early years. Governor Hodges played a critical role as an agenda setter and convener of common interests, and he provided the original impetus for the universities to inventory their in-house resources in an effort to assess their ability to attract research-based companies to the region. Once the RTP idea was off the ground, Governor Sanford played a key role in recruiting some of the initial big organizations, such as the National Institute of Environmental Health Sciences, to locate in the Park. Several other key individuals, including George Simpson, Archie Davis, and others not mentioned here, played crucial leadership roles in the Park's development[18].

Importantly, though, this leadership took place, against the larger backdrop of what some have called North Carolina's 'generosity of spirit'. The people of North Carolina, as in many southern states in the post-U.S. Civil War period, had a strong tradition of commitment and cooperation for the common good of the state. In the words of Archie Davis,

> "I am convinced that it is the love of this state that was the motivation for the Research Triangle idea. Motivation derives from dedication and dedication derives from the knowledge of high expectations ... Research Triangle is a manifestation of what North Carolina is all about (Link 1995, p. 6)".

The region's strong universities, combined with its committed leaders and public-minded citizens, came together at an opportune time for the development of a research park. For example, in response to the important role that technologies had played in World War II, many business leaders were eager to exploit the benefits of technology in their products' manufacturing processes. Moreover, the Soviet launch of the Sputnik satellite in 1957 set off the 'space race', which put a premium on R&D and made the U.S. government direct much larger competitor with industry for researchers. And finally, very few research parks existed when RTP was first envisioned and began its operations. The two best-known research regions were the Stanford Research Park in California and the Route-28 region around Boston in Massachusetts, and word of their successes was spreading. In the late 1950s, there was ample opportunity for other regions, such as the Research Triangle, to replicate those successes.

While the role played by the universities, leaders and citizens, and timing was central to RTP's success, other factors also played a role. For example, the RTP region is well-noted for excellent quality of life. In fact, representatives of companies moving to RTP often cite this as a key factor in their decision to locate there. It is also clear that a key factor enabling RTP's development was the decision to use donations rather than for-profit investments or state moneys to generate the funding needed to purchase land for the Park. Before that decision, fundraising efforts for the Park struggled for nearly a year; after that decision, fundraising efforts succeeded in a matter of months. While it is possible that the fundraising success resulted more from the personality and connections of its champion, Archie Davis, than from the means of fundraising, it is clear that the original strategy of relying on private investments wasn't working. Additionally, it is no accident that RTP is located close (less than 10 kilometres) to an international airport, that it is in a central geographic location to serve the Southeast and Mid-Atlantic region, and that its first and currently fifth-largest occupant is RTI International, one of the premier research institutes in the world. The airport is a critical transportation hub for people and materials (particularly on the East coast) travelling to and from the Park. And RTI International has been the Park's physical and intellectual cornerstone from the start, bringing considerable international recognition to the Park and acting as an important bridge for the diverse commercial, industrial and academic endeavours of the region and nation.

All these factors combined, in the right ways and at the right time, to help make RTP what is it today. But what the Park is today is not what it will be tomorrow. In an increasingly dynamic world, the RTP Foundation is taking proactive steps to ensure the Park's continued growth and success in the 21st century economy. In 2005, the Foundation updated its mission and vision statements to take into account the technological and global changes that have occurred since it founding. It also set the goal of becoming the world's leading regional centre of innovation, technology commercialization and quality-job creation by the year 2020.

Toward that end, it has undertaken the 'Triangle Innovation Project', a benchmarking exercise designed to develop a better understanding of the current competition and to develop strategies for meeting it. Those strategies include implementing a set of best practices (e.g., strengthening connectivity between the Park's tenants), strengthening the Park's assets (e.g., enhancing the Park's physical amenities), engaging with existing and emerging science parks (e.g. creating a global partnering network), leveraging existing technology strengths to ensure leadership in the next-generation sectors (e.g., nanomaterials, clean technology, genomics/computational medicine), and establishing leadership with a cross-cutting approach (e.g., moving toward an 'open innovation' hotbed and horizontal-cluster model).

These changes represent a paradigm shift for the Foundation, and the Park's future success will depend on its ability to adapt to an ever-changing technology-economy environment that emphasizes intellectual-capital-driven industries and is sensitive to access to ideas, collaboration, venture capital, culture of innovation and entrepreneurship. If done right, the changes will help make the Park less susceptible

to trends such as globalization and the flight to lower-cost production areas (Weddle et al. 2006).

Lessons learned

For regions wishing to learn from the RTP experience and develop their own research parks, several lessons deserve mention. First and foremost, it is important for regions to know their assets, particularly their university-based R&D strengths. It also helps to have a large number of R&D assets that are complementary to one another and well aligned with the region's industrial sectors. In the development of RTP, the region's leaders devoted a considerable amount of time to inventorying their universities' resources and detailing how they could be used in mutually beneficial ways. These efforts are continuing even now, as the RTP region recently completed a comprehensive strategic plan and is actively working to implement a broad range of recommendations targeted at ensuring its prosperity into the future[19].

It is also important to have strong, committed leaders who are willing to champion a cause, take a risk, and remain persistent throughout the process, especially during the inevitable periods of controversy and pushback. While this should go without saying, its importance cannot be overemphasized. RTP would not have become a reality without the committed leadership of several people. In pushing for RTP, they faced numerous delays and redirections – some minor, others not; some accidental, others intentional. In the process they remained steadfast, and their leadership helped change the economic trajectory of the RTP region and its parent state, North Carolina.

The role of the leadership also highlights a third important lesson: In large endeavours such as this, it is important to engage all stakeholders early and often, to focus on the common good, and to have bridging institutions that help in that process. In the case of RTP, the initial Research Triangle Commission, later renamed to the Research Triangle Committee and then to the Research Triangle Foundation, played this role. By involving representatives from several sectors such as government, industry and academia, the organization provided the vision and cohesion needed to maximize the common good and minimize the differences among the various interests involved with a stake in the Research Triangle region's economic development. In the case of RTP, the universities were both the region's strongest asset as well as its most wary participant. The following statement, made by William Carmichael, a representative of the UNC System, to Romeo Guest, developer and contractor in 1956, represents well a common sentiment offered by university representatives early in the process:

> "Let me see, if I really understand what it is we are talking about here, you want the professors here and all of us to be the prostitutes and you're going to be the pimp (Link 1995, p. 29)".

That sentiment eventually faded, however, due largely to the hard work and forthright deliberations of the key players involved in RTP's development. George Simpson, founding director of the Research Triangle Committee, captured this sentiment well when reflecting on RTP 30 years after its conception:

> "Looking back now, it seems so obvious that all these groups had a lot to gain by working together. But back then, it wasn't so obvious ... What it took was the willingness of public-spirited leaders from various segments of the community to downplay their differences. There was a great generosity of spirit that dominated from the beginning, and this was what enabled people to look beyond their own narrow interests for the benefit of the entire project. From this generosity came first a basic agreement to work together. Once that was reached, the positive aspects of working together . . . took over and we were on our way (Link 1995, p. 93)".

This quote highlights the last, and perhaps most sobering lesson about starting and growing research parks: it is a long time from seed to harvest[20]. If the experience of RTP is any guide, it takes decades, not years, to grow a successful research park. The process involves numerous steps, each requiring considerable time: developing the regions assets, inventorying and appraising those assets, identifying the region's opportunities, constructing strategies for pursuing those opportunities, finding resources for executing those strategies, engaging relevant stakeholders (inside and outside the region), attracting the interest of researchers and companies (inside and outside the region), and following through with and catering to researchers and companies once attracted. In the case of RTP, it took more than 20 years to develop a large corporate R&D presence and to reach half of its current level of growth; it took another 20 years to reach its maximum level of growth[21]. This is no small amount of time.

Thus, the road to developing a successful research park is long and circuitous. Each park has its own challenges and, as a result, each has its own set of lessons. Those who wish to develop such a park in their own region are well advised to study in considerable detail the experiences of other parks in addition to that of RTP.

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NOTES

1 Data are current as of January 2006. If part-time contract employees are counted, the number of employees increases to more than 40,000.

2 In particular, the two most comprehensive and authoritative sources of information on the early history and growth of RTP are the following: *A Generosity of Spirit: The Early History of the Research Triangle Park* (1995) and *From Seed to Harvest: The Growth of the Research Triangle Park* (2002), by Link. The most recent comprehensive empirical assessment of RTP is *The Research Triangle Park: The First Forty Years (1999),* by Hammer, Siler, George Associates. An older but equally useful empirical assessment of RTP as well as research parks in general is *Technology in the Garden: Research Parks and Regional Economic Development* (1991), by Luger and Goldstein. The information in this chapter draws heavily on these sources and on information available on the Research Triangle Foundation website (http://www.rtp.org).

3 Only selected major cities appear on this map.

4 Land-grant universities are institutions of higher education in the United States designated by Congress to receive the benefits of the Morrill Acts of 1862 and 1890. The Morrill Acts funded educational institutions by granting federally-controlled land to the states. The mission of land-grant institutions, as set forth in the 1862 Act, is to teach agriculture, military tactics and the mechanic arts,

not to the exclusion of classical studies. As such, land-grant institutions typically focus on agricultural and technical education ("What is a Land Grant College", NASULGC 1999).

5 Duke began as Trinity College, which traced its roots to 1838 in nearby Randolph County. The school moved to Durham in 1892, and in 1924 was renamed Duke by James Buchanan Duke as a memorial to his father, Washington Duke. The Dukes were Durham family that built a worldwide financial empire in the manufacture of tobacco and developed electricity production in the Carolinas ("Quick Facts", Duke University).

6 The large faculty-to-student ratio results primarily from the fact that Duke has a hospital and medical school, which employ a large number of part-time faculty ("Quick Facts", Duke University).

7 Only cities with a population greater than 100,000 appear on this map.

8 Raleigh has the most academic institutions, with Meredith College, Peace College, Shaw University, St. Mary's College, St. Augustine's College and Wake Technical Community College. Durham has North Carolina Central University and Durham Technical Community College.

9 The Research Triangle Foundation has a 30-member Board composed of the Governor, the presidents of Duke University and the University of North Carolina system, and other high-level representatives of industry, academia and non-profit organizations in the region.

10 The assessment was conducted by Hammer, Siler, and George Associates.

11 Luger and Goldstein (1991, p. 85) found that, overall, the most important reason organizations cited for deciding to locate in RTP was proximity to the three research universities. The second reason was access to highly skilled labour, and the third was the quality of air service.

12 A total of 27 companies were surveyed. The companies represented 84 percent of RTP's employees and were selected jointly by the Research Triangle Foundation and Hammer, Siler, George Associates.

13 The surveyed universities included the 16 constituent institutions of the University of North Carolina. While three of those institutions are within the RTP region, the majority (13) are not.

14 The report was entitled "A Proposal for the Development of an Industrial Research Center in North Carolina".

15 The Park's initial growth was in the northern section, due in part to the existence of road, water and sewer infrastructure in Durham County. Growth has spread throughout the Park, however, as developments such as major highway creation and improvements, as well as upgrades to the Raleigh–Durham International Airport, have occurred.

16 The success factors outlined here are generally agreed upon by close observers of RTP's development and history; they draw most heavily on conclusions offered by Link, 1995, pages 4-7.

17 For examples of the promotional materials, see Link, 1995 and 2002.

18 For a more in-depth discussion of key individuals involved in the Park's development, see Link, 1995 and 2002.

19 See: http://www.researchtriangle.org/staying%20on%20top/index.php.

20 This phrase, "From Seed to Harvest", is the title of Link's 2002 account of the growth of RTP. The first person to apply the phrase to the growth of RTP was Elizabeth Aycock, assistant to George Simpson.

21 As measured by number of companies, number of employees, and building square footage.

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