Research Triangle Park: Evolution and Renaissance

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Executive Summary

The Research Triangle Park (RTP) is one of the largest and oldest examples of how strategic investments in education, infrastructure, and business climate can positively impact an economy. RTP's success was built around its first-mover status in the field of science parks; its ability to build a critical mass of technology companies and knowledge workers; and the Park's linkages to the region's universities' research and development strengths. RTP's future success will depend on its ability to marshal these assets and to reinvent itself to better address coming global and technology trends.

This paper is divided into five parts:

1. Overview and History
2. Impacts of the Park
3. Turning Point (Challenges and trends confronting RTP)
4. Preparing for the Next 50 Years (Strategies and programs to evolve RTP)
5. Summary and Conclusions

A. Overview and History

The Research Triangle Park (RTP) was founded by a committee of government, university, and business leaders as a model for research, innovation, and economic development. By establishing a place where educators, researchers, and businesses come together as collaborative partners, the founders of the Park hoped to change the economic composition of the region and state, thereby increasing the opportunities for the citizens of North Carolina.

RTP is at the center of the dynamic Raleigh-Durham region with a population of 1.3 million within the defined metropolitan area and nearly 3 million within a 60-mile radius of the Park. The "Triangle" from which RTP was named is formed by the geographic location of the region's three highly regarded educational, medical, and research universities—the University of North Carolina at Chapel Hill, Duke University, and North Carolina State University. In addition, RTP draws on the intellectual capacity of a host of other community colleges and higher education institutes. Together, these institutes create knowledge assets and provide a steady supply of trained scientists, engineers, managers, and technicians to the region's workforce.

In addition to this academic and research capacity, the region possesses an established network and infrastructure to support a diverse range of companies. Ranging from the Council of Entrepreneurial Development to the North Carolina Biotechnology Center to the RTI International, a host of organizations and networks exist to complement and catalyze activities around a number of cluster industries. These institutions and companies work together with Park companies and the universities, reflecting a spirit of cooperation and learning within the scientific and technological community.

Since it was established, the Park has witnessed a steady and stable increase in the number of companies and employees. Currently, there are 136 research and development facilities in RTP. More than 37,600 people work in RTP with combined annual salaries of over $2.7 billion. The average salary in the Park is $56,000 annually, nearly 45 percent larger than the regional and national average.[i]

Companies represented in RTP include IBM, Nortel Networks, GlaxoSmithKline, Cisco Systems, Ericsson, BASF, Eisai, Biogen IDEC, Credit Suisse, and Syngenta. In addition, a number of U.S. Federal agencies have a presence in the Park, including the U.S. Environmental Protection Agency, the National Institute of Environmental Health Sciences, and the U.S. Forestry Service. (For a full list of current RTP companies, see Appendix A)

More than a location and an engine for the economic growth, RTP has been a center of innovation. It is home to winners of the Nobel and the Pulitzer prizes, as well as recipients of the U.S. Presidential Award and National Foundation Awards. Just as important, it is the workplace of technical, chemical, and biomedical scientists and patent holders whose discoveries have impacted the lives of all citizens in this country and around the world. Some of the most profound discoveries of the 20th century have been influenced by scientists and researchers working in RTP, including the invention of the Universal Product Code, 3D ultrasound technology, and Astroturf. Among the most significant of RTP accomplishments was the discovery of Taxol, hailed by the National Cancer Institute as the most important new anti-cancer drug of the past 15 years, and AZT, a drug used to fight HIV-AIDS.

The Park is managed by the Research Triangle Foundation of North Carolina, a non-profit organization founded in 1959. The Foundation is responsible for the overall management of the Park as well as ensuring that the regulations developed by the Park's founders to protect the natural environment and aesthetics of RTP are preserved. Under the development regulations governing the Park, a certain percentage of the total

area is devoted to green space. In addition, companies in RTP must obey stringent setbacks and land coverage regulations to maintain the natural environment of the Park and its surroundings.

Forming RTP

The idea for RTP stemmed from the need to reverse a number of negative economic trends facing the North Carolina economy. In the mid-1950s, North Carolina's per capita income was one of the lowest in the nation. In 1952, per capita income in North Carolina was $1,049, compared to $1,121 for the eleven state Southeast region, and $1,639 for the continental United States.[ii] In addition the state's economy was dominated by low-wage manufacturing industries such as furniture, textiles, forestry, and small-scale agriculture. The state was facing a serious "brain drain" as graduates in the state were leaving in search of better jobs, and those attending college outside the state were not returning.

Given the expected consequences, leadership within the state sought to reverse these trends. Upon the urging of some private sector leaders such as Robert Hanes, the president of Wachovia Bank and Trust Company, and Romeo Guest, a Greensboro building contractor, and with the help and support of North Carolina State Chancellor Carey Bostian, Governor Luther Hodges commissioned a concept report on the idea of the establishment of a research park to diversify the state's economic base. By the end of 1956, the University of North Carolina and Duke University joined the effort and the Research Triangle Development Council was formed. The vision was to attract research companies from around the nation to locate in a parcel of land surrounded by the state's research universities. The resulting "Research Triangle Park" would be a place where companies could take advantage of the region's intellectual assets in individual campus settings that provided a ready physical infrastructure.

During the next year, various subcommittees were formed. The groups decided that the Research Triangle project idea was a valid concept and should be undertaken as a private effort with engagement of the three flagship universities rather than a state/government sponsored effort. In particular, the Park would be set up to "encourage and promote the establishment of industrial research laboratories and other facilities in North Carolina primarily in, but not limited to, the 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." The Park would also "promote the use of research facilities" at the universities and "cooperation between the three institutions and industrial research agencies." The end goal was to "increase opportunities of the citizens of this state for employment and to increase the per capita income of the citizens of the state."[iii]

Early Obstacles

While support for the establishment of RTP was growing, the project had several obstacles to overcome. The first was the image of the South in mid-20th century America. In part due to problems of segregation, the region did not have the most progressive reputation. North Carolina—and the U.S. South in general—was not known for innovation or entrepreneurial activity. In addition, companies at that time tended to maintain their research facilities near their manufacturing sites which were predominantly located in the northeast and mid-western parts of the country. The Triangle region did not posses any manufacturing facilities for the types of "new-line" industries the Park was targeting. Finally, the committee needed to raise the funds to acquire, promote and develop the parcel of land that was to become RTP.

To address the latter obstacle, the Committee began to assemble parcels of land to make up the Park. An effort led by Romeo Guest optioned 3,430 of the identified 4,000 acres under the name "Pinelands, Inc." For its part, the State of North Carolina played an important role as organizer—both for political support and support and engagement from the universities.

Initial attempts to sell stock in the Pinelands locally proved difficult. In August 1958, Archibald Davis, an executive with Wachovia Bank and Trust, was enlisted to support the effort. Davis recognized that it would

be much easier to raise money from corporations and institutions that were interested in serving the state rather than trying to find private investors. As such, Davis began a fundraising campaign on December 1, 1958, and by January 1959 had raised nearly $1.5 million to purchase the first parcels of land. Contributions came from across the entire state.

Research Triangle Foundation and the Research Triangle Institute
With the contributions secured, on January 9, 1959, the Research Triangle Committee reorganized as the non-profit Research Triangle Foundation of North Carolina and was charged with developing and managing the Park.

In addition to forming the Research Triangle Foundation, the founders set aside $500,000 to establish the Research Triangle Institute (RTI)[iv]. The purpose of the Institute was to do contract research for business, industry and government.[v] It was intended to keep university faculty interested in the Park concept, as well as signal to the corporate community that the Research Triangle leaders had enough faith in the concept to establish the first organization at the Park. RTI sought to provide "industry in North Carolina and the South with research services not available; to encourage the use of research in the state and regional industry; and to extend the Research Triangle's position as a research center."[vi]

Early Park Development
RTP was established as a magnet for research and development in order to transform the region and state's economy. As such, the guidelines for the Park mandated that "eligible occupants of the Research Park be design, research and related operations…or in more general terms, uses that require a high degree of scientific input and which can benefit from a location relationship with the academic community." While it was decided initially that "no manufacturing or processing enterprises" could be conducted within RTP, the decision was later amended to allow for certain manufacturing.[vii]

An important element of the planning of the Park was the commitment to sacrifice the total amount of building space that could be accommodated in order to preserve the natural balance and integrity of the land. The early planners of the Park used the topography, drainage patterns, and vegetation of the land to create an environment with the highest possible physical quality for the researchers' work experience. The zoning provisions in the Northern (Durham County) section of the Park dictate that "no more than fifteen percent of the total area of a tract shall be covered with buildings."[viii] The provisions are similar in the Southern (Wake County) portion, allowing for up to thirty percent of coverage for buildings, infrastructure and parking surfaces. In addition, development standards and an architectural review board were created to ensure the integrity of the covenants.[ix]

Historical Growth—Chronological timeline
The first five years of the Park's existence were relatively slow. While Chemstrand, a company jointly owned by Monsanto Corporation and America Viscose, announced its decision to come to the Park in 1960, it was not until 1965 that growth in the Park took off. In 1965, IBM announced that it would locate a 400 acre, 600,00 square foot research facility in the Park. Also that year, the U.S. Department of Health, Education, and Welfare decided to locate its new $70 million National Environmental Health Science Center at the Park. With the location of a substantial government presence and private sector company, the Park gained credibility as a place for research and development.

Due in part to the existence and extension of road, water, and sewer infrastructure in Durham County, the early growth of the Park was in its Northern section. In addition, major highway improvements, including the building of North Carolina route 147 to connect Duke University and downtown Durham to the Park (1973), the construction of Interstate 40 from the Park to Chapel Hill (1985), and improvements to the region's Raleigh-Durham International Airport helped to improve the Park's competitive position.

In the following 40 years, growth in the park has averaged six new companies and an addition of roughly 1,800 employees per year.[x] The original parcel of land that made up RTP in 1959 consisted of 4,400 acres. Through the years, the Foundation acquired more land, surpassing 5,500 acres by 1979 and totaling 6,971 acres presently. In the same period, the Park's developed space has increased from only 200,000 square feet in 1960 to more than 20 million square feet in 2005.

Figure A: Distribution of RTP Companies
(by number of employees)

# of Employees	# of Companies
>10,000	1
5,000 - 10,000	1
1,000 - 5,000	6
500 - 1,000	5
250 - 500	8
<250	115
Total Employees = 37,600	Total Companies = 136

Mirroring the information communications technology boom in the late 1990s, the Park reached a peak employment level of 45,000 in 2001. Although the number of employees declined slightly in the ensuing recession, the number of companies in RTP has increased steadily.

Large companies continue to make up the majority of the Park's employment numbers. The guiding assumption behind the initial recruitment strategy for the Park was to attract larger, more established companies that would build a culture in which smaller, start-up industries could thrive. The theory has proven accurate, as a number of smaller, spin-off companies have emerged. As illustrated in Figure A, the profile of companies in the Park is transitioning to one of smaller companies with fewer employees. The trend is further reflected within a close proximity to the Park and near the university labs.

TUCASI

The Park was established with the three flagship universities as the anchor. In 1974 when the Park became solvent, under Archie Davis' direction, the Triangle Universities Center for Advanced Studies, Inc. (TUCASI) was established. The mission of TUCASI is to ensure the continued presence of the institutions in the Park. In particular, TUCASI's purpose is "to assist in and facilitate the planning and execution of non-profit research and educational programs that utilize and enhance the productivity of the intellectual and physical resources of the University of North Carolina at Chapel Hill, Duke University, and North Carolina State University at Raleigh."[xi] In addition, TUCASI is the body that proposes how the Foundation's assets are distributed to the universities and projects of their choice. It has become the "manifestation of university cooperation toward a common end."[xii]

The Foundation set aside a 120-acre campus for TUCASI to house organizations that could bring together faculty from the three universities and Park scientists. Today, the TUCASI campus is home to the National Humanities Center, MCNC – initially established as the Microelectronics Center of North Carolina, the North Carolina Biotechnology Center, the National Institute of Statistical Sciences, and the Burroughs Wellcome Fund.[xiii] These groups reflect the universities' core values of innovation and collaboration for a common good.[xiv]

Owners and Tenants Association

The Research Triangle Owners and Tenants Association (O&T) was established within the restrictive covenants of the Park to represent the companies within RTP. In addition to serving as the consensus voice of the Park community, the O&T addresses common issues of concern and maintains Park amenities such as jogging trails, playing fields, and beautification efforts. The O&T hosts a number of committees and activities including SmartCommute@RTP and the Environment@RTP.[xv] There are currently more than 75 corporate members of O&T, representing roughly 90 percent of Park company employees.

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Beginning with the first planning session in 1956, North Carolina's leadership took deliberate and rather ambitious steps to make a positive change in the state's economy. In the fifty years that have elapsed, the vision and commitment of that group has been carried forward and has resulted in the development of a unique parcel of land that is home to one of the greatest critical masses of knowledge workers and intellectual activity. With RTP as its driver, the Triangle region has emerged as one of the top five high technology regions worldwide.

B. Impacts of the Park

With widespread national appeal and significance due to its positive impact to society, RTP has been and continues to be a model for innovation, education, and economic development that has been applied around the world. The research conducted by institutes and universities has directly shaped policies and funding for research on education, substance abuse, air quality, infectious disease, and health care.

Of the several hundred research and science parks operating in the United States today, RTP is the only one that ranks among the largest and successfully growing parks along a number of leading indicators, including the total size of the park, number of employees, buildings/square footage available, employee and company growth.[xvi] Similarly, RTP ranks at the top of several indicators when compared to science parks around the world. (See Appendix B)

As noted below, the effect of the Park over the last 47 years has worked to transform the region and the state. This impact has resulted in a change in the composition of the region's industries, an upgrading of the capacities at the three flagship universities—as well as throughout all institutes of education throughout the region and state, and a global brand that has built the reputation of the region and state as one of the leading areas for high-technology innovation.

In addition to the quantitative results of the Park, RTP has succeeded in raising the level of involvement of the corporate, political, and academic communities in the region and state as they work together toward a common cause. In the words of former University of North Carolina president, William Friday, "Research Triangle Park is the most significant economic and political manifestation of will in the state in the last century."[xvii]

Changing an Economy

Recent scholarly analysis has suggested that research/science parks have no positive effect on regional economic development overall. The works suggest that there is little empirical evidence that public policy to spur the growth of clusters from scratch is effective. RTP is highlighted as the exception to the rule. Though it took more than 30 years to see evidence of the cluster development attributed to the Park, the development of RTP has been able to change the economic make up of the region.[xviii]

For example, before the Park was established, fewer than 15 percent of the businesses in the three counties surrounding the Park—Orange, Wake, and Durham—were in what was defined as "New-line" industries. This included businesses involved in chemicals, electronics, communications, business services, educational services, and engineering and management services.[xix] As more companies came to the Park and created other benefits, the share of new-line industries increased. By 1966, nearly 30 percent of businesses in the three counties were in new-line industries, by 1995, nearly 47 percent were new-line and by 2005, the percentage had reached 51 percent.[xx]As Figure B suggests, this change has had a significant impact on the state and region, especially when compared to the national growth in employment in these industries over time.

Figure B: National Percent Share of Technology Employment

	1956	1966	1976	1986	1996	2003
National Index	100	100	100	100	100	100
North Carolina	45.4	55.9	66.2	71.3	81.0	89.3
Research Triangle Region	57.3	87.2	103.8	115.3	115.5	125.3

Source: US Census, 2003

In addition to transforming the economic base of the economy, the Park has had a number of direct and indirect impacts on the counties surrounding it. Direct impacts include construction, real estate tax yields, sales tax yields and income tax yields. Indirect impacts include spin-off companies and off-site businesses in addition to multiple expenditures of corporate and personal incomes.[xxi] An ongoing study to inventory the number of spin-off companies created by the university and Park company activity in the region suggests that more than 1,500 such enterprises have been stimulated by activity in the Park and the universities since 1970.[xxii]

Beyond the boundaries of the Park, a core area of similar industries and office parks has developed; including the country's largest privately held software firm and the world's largest pharmaceutical contract research organization. In many cases, these businesses partner with Park tenants to provide services or manufacturing facilities.

As the region has grown, a host of amenities has developed around RTP. As RTP prepares to enter its next 50 years, major initiatives are underway to re-develop older Park properties and encourage retail and residential development in parcels directly surrounding the Park.

Within a 4-mile radius of the boundaries of the Park, there are 13 million square feet of built space and 15,000 acres under development for office, commercial, retail, and industrial uses. In the same area, there are more than 40,550 housing units, offering executive housing, single-family homes, townhouses, and apartment units. Thanks to the region's growing transportation infrastructure, a number of significant retail and entertainment areas are within easy reach of RTP. The developments around RTP have contributed to a unique urban landmass that has a tremendous impact on the economic vitality and dynamism of the region and state. No other campus location in the Triangle region has comparable access to such a broad mix of housing and retail opportunities.

Beyond the immediate area of the Park, RTP has influenced the innovation culture of the region and state. This phenomenon is best exemplified by the organizations and other research parks/innovation centers that have developed. These include the North Carolina Board of Sciences and Technology, the Triangle Universities Computation Center, MCNC, the North Carolina Biotechnology Center, and the First Flight Venture Center (see Appendix C for descriptions of these efforts).

Another outgrowth of RTP's success is the spread of university infrastructure to catalyze innovation and economic growth. In 1984, Centennial Campus was established on the grounds of North Carolina State University to provide a place where university, industry, and government partners can interact in multidisciplinary programs directed toward the solution of contemporary problems. Consisting of 1,334 acres, the campus provides office and lab space for more than 1600 corporate and government employees. To date, more than $620 million has been invested to create 2.7 million square feet of space in 25 major buildings. Centennial is touted as one of the leading examples of urban, "green door" research park developments.

Building on the successful translation of the RTP model to Centennial, in 2000, the North Carolina State General Assembly enacted the Millennial Campus Act. The Act authorized the UNC Board of Governors to designate real property held by, or to be acquired by, one of the university campuses to be developed to encourage university/government/industry collaborations in research and development. The campuses will capitalize on North Carolina's considerable research strengths and history of investment to spark high-quality economic development. Two Millennial campuses have been formed under the act, with several more planned to be online in the next 3-5 years.

Success Factors

Given the aforementioned analysis on the effectiveness of research parks and RTP's legacy of success in transforming the region, the Park has long been studied as a model for economic development and change. Especially as other countries have joined the movement to create science cities and centers, many have looked to the experience of RTP to identify potential, replicable success factors.

Unlike the organic successes in developing and nurturing clusters of industry in California and Massachusetts, the genesis and growth of RTP was the result of a well-formed planned vision and strategy. Led by the active long-term commitment given to RTP by the state and region's business, government, and academic communities, a number of factors have been critical to the Park's success.

Timing. The idea for the Research Triangle came at an opportune time for U.S. business interest. Following the end of World War II, the American government and business community placed an increased importance of the role of research and development and technology. In the shadow of Route 128's development in Massachusetts and the Stanford Research Institute in California, the idea of being in a location in close proximity to three strong research universities appealed to may companies.[xxiii] The ability to develop isolated, stand-alone campuses nestled within the environmental beauty of central North Carolina was also a strong draw to industries at the time.

Connection to universities. In addition to its good-timing, the Park was able to draw upon the strength and cache of three prominent universities—Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill. These universities and the other universities, colleges, and community colleges within the region provide a steady supply of trained scientists, engineers, and technicians to the region. In turn, the universities and community colleges have been substantially strengthened by the environment and interactions with the industrial and governmental research activities. Moreover, the ability of the universities to attract high levels of Federal funding further strengthens the region's innovative capacity.

Critical mass. A third factor of the Park's success is the critical mass of companies and knowledge workers it has been able to build. The critical mass affords the Park and the region a sought-after labor pool that is both broad and deep. This enables the region to draw more high-quality employers and companies that not only provide jobs but also increase the sophistication and expertise of the region's workforce through their research, use of technology, investment in employees and high standards. It also provides an environment in which company researchers, knowledge workers, and university professors can interact around ideas, creativity and entrepreneurship, thereby creating more knowledge, more innovation, and economic growth.

Long-term commitment. A final, and less quantifiable, factor contributing to the Park's success has been the long-term commitment of leadership at all levels. When the Park's founders established the Park, they recognized that the benefits of their investment could take decades to come to fruition. They also recognized that the many of the investments they made would spur secondary and tertiary effects that would also strengthen the state and region. Throughout its existence, the Park's leadership, local elected

leadership, and populace as a whole, have understood that the vision of the Park's success was a long-term one. Especially in the fast pace of change of today's global market, few localities have RTP's luxury of a long-term implementation horizon.

C. Turning Point

Despite the success of RTP thus far, the leadership of the Foundation recognized that the Park could not sit on its laurels. As the world changed around it and as the companies comprising the Park evolved to react to those changes, the Park, likewise needed to adapt. As companies and individuals demand different amenities in and around the workplace, they recognized that the Foundation must also look to a new business model that will allow it to address these needs and create a self-sustaining and self-perpetuating entity to continue to generate the returns necessary to sustain the Park.

RTP is at a critical juncture. As one of the "first-movers" in the research park industry, RTP set the model for how such park developments are structured around an individual campus setting. As industry needs changed, however, newer models have developed to better address specific needs.[xxiv] RTP's leadership recognized that the life span of it current business model needs to be revisited.

A New Vision

In January 2005, the Foundation set forth a new framework, known as the Vision 2020 Strategy, to re-focus the mission and vision of the organization and to ensure that RTP continues to provide a high-quality and value-priced operating platform from which R&D and technology companies can develop and maintain world-class competitor status in their industry.

In particular, the Foundation board approved updated vision and mission statements to better focus the organization's efforts to respond to changing trends. As illustrated below, the two are much in keeping with the original principles of the Park, but take into consideration the technological and global changes that have taken place in the intervening years.

> *RTP Vision*
> A better life for all North Carolinians through sustainable knowledge and technology-based development that effectively balances human needs and humanities with economic opportunities.
>
> *RTP Mission*
> 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.

Finally, to place the new vision and mission in more concrete terms, the Foundation set for the goal that by 2020, RTP and the Triangle region will become the world's leading regional center of innovation, technology commercialization and quality job creation.

Benchmarking and Positioning

Over the past 12 months, the Foundation has laid the groundwork for being able to achieve such an ambitious goal. The Foundation partnered with IBM Business Consulting Services to develop a better understanding of the current competition to attract globally recognized research and development talent and to understand what needs to be done to continue to be one of the leading locations to do so.

Known as the, "Triangle Innovation Project," the benchmarking exercise provided RTP a framework through which to prepare for the Park's next 50 years. It highlights the importance of building upon

existing strengths, as well as positioning RTP, the region, and the state for the next technology wave. In addition, the project suggested ways that the Park can work more effectively with partners from around the state to ensure that the economic impacts flowing into and from the Park are maximized.[xxv]

Assumptions
The Innovation Project was built upon the assumption that successful locations are those that possess a package of assets and characteristics that, in combination, lead to economic success. All four ingredients are required for sustained success. These include:

- *Attractiveness to Companies*. This enables a region to draw high-quality employers and companies that not only provide jobs but also increase the sophistication and expertise of the region's workforce through their research, use of technology, investment in employees, and high standards of performance.

- *Attractiveness to Individuals*. This enables a region to attract the high-skill knowledge workers that top companies need to prosper and grow.

- *Reputation/Brand*. This generates the awareness among companies and individuals of all that the region has to offer. For example, a strong brand leads to greater exposure in the media and in academic research, alerting more people to the area's strengths.

- *Intellectual Interaction*. This shapes what arises out of the combination of companies and individuals the region attracts. When top-notch companies and individuals are present, and they interact around ideas, creativity and entrepreneurship, the region creates more knowledge, more innovation, and more companies.

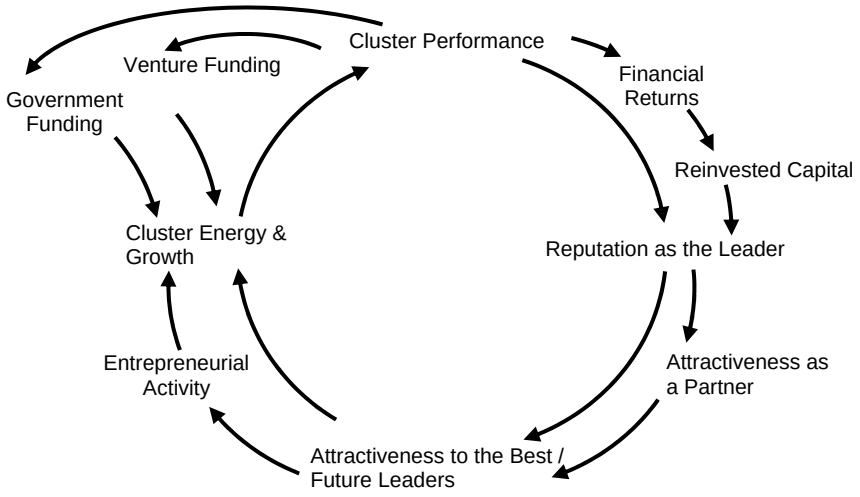
Summary of Findings
As noted in Appendix D, the Innovation Project identified a number of areas in which the Park has achieved "best practice" status in the characteristics listed above. In particular, the Park does well in terms of its reputation and attractiveness to companies. The Park falls behind some of the top ranked regions in terms of its intellectual interaction and providing networks to spark spin-offs and to connect individuals both formally and informally. The Project also suggests that the region needs to strengthen its entrepreneurial capacity, as this group appears to be a critical ingredient to transforming knowledge investments into economic growth.[xxvi]

Despite the Park's strong position, however, its ability to compete in the global environment is at risk. Regions around the globe have recognized the importance of specialization and building knowledge assets and have made substantial investments to do so. For example, regions like Philadelphia, PA; Phoenix, AZ; and Chicago, IL in the United States have made focused investments in the biotechnology/life-sciences clusters to try to better their competitive position in this area. Similarly, governments in Asia and Europe are expending substantial resources to build "science cities" to jump-start innovative and entrepreneurial activity. These initiatives and investments have helped these regions close the gap on the Park's lead.

Simultaneously, other regions have built upon their own strengths and are creating a new set of standards against which regions and their success are based. For example, Silicon Valley and Boston have built a strong leadership position in life sciences and information communications technology and are building upon a cycle of success to further strengthen their leadership position in these areas. By attracting the talent and venture capital and in encouraging spin-offs and gazelle companies to continue to grow those clusters' presence in their region, they have perpetuated and strengthen their growth trajectory. Because of this "success cycle," regions like this are widening their lead over the Park and making the prospect of gaining a pre-eminent leadership role in one of these sectors almost impossible (Figure C).

Figure C: Success Cycle

The ultimate result of such a system is that dominant players become increasingly entrenched in the niches in which they are dominant.



Given this fast pace of change and competition, merely improving the Park incrementally is not enough if the region is to become the leading region for innovation, technology, and high-quality job creation. Rather, just as the founders of the Park set forth an ambitious vision and made the investments needed to execute it, the Foundation has developed an "out-of-the-box" goal strategy that will help it "leap frog" competitors and gain leadership in one of the next emerging technology waves.

D. Preparing for the Next 50 Years

RTP is committed to remaining a place where companies and academic talent can come together. Given the findings of the Triangle Innovation Project, the Foundation has set forth on a two-pronged approach to maintain its current lead and to leap frog to a new position of pre-eminence in the coming years. The approach involves strengthening current efforts and building new programs to increase the innovative capacity of the region and state.

- **Implement Best Practices and Strengthen Park Assets:** These include efforts to strengthen connectivity between the Park companies, government, and academia, as well as developing systems to constantly scan the global market to ensure the Park is correctly positioning itself to take advantage of the next technology wave. Such programs will fine-tune the physical amenities and opportunities for interaction within the Park and strengthen engagement with the flagship universities given the increasing importance of university-business relationships in innovation and start-up company generation.

  These forward plans also include ways to better engage with existing and emerging science parks throughout the world through a global partnering network. As communication technology and changing investment flows necessitate that science parks build their own internal capacity to interact seamlessly on a global level, this network will enable RTP to serve as an international portal to North Carolina and the rest of the United States, as well as provide a mechanism through which in can share best practices with its peer organizations.

In addition, RTP is taking steps to meet its statewide mandate by partnering with other economic development organizations and institutes of higher education around North Carolina. Whether by sharing best practices or joining as a consensus voice on issues that impact economic growth and knowledge creation throughout the state, the Park will use its influence and global brand to further improve innovative capacity.

- **Out-of-the-Box Actions to Establish Leadership:** This effort is a long-term play by the Park to position itself favorably for the next emerging technology wave. As noted above, the leadership positions in the current waves (viz., biotechnology and information technology) have already been won. Thus, the Park's forward strategy is to leverage existing strengths and to ensure that core capabilities and economic foundations in the state and region are in place to allow the Park to accomplish first-mover advantage in one of the below areas to catch and exploit the next wave. This will include efforts to:

    1. Leverage existing strengths to secure leadership in a next-generation sector (e.g., nanomaterials and nanorobotics, genomics/computational medicine, sustainable systems - clean technology, or biodefense);

    2. Establish leadership with a cross cutting technique to become an "open innovation" hotbed and horizontal cluster;

    3. Create a "plug and play" internationalization platform with other parks and regions; and/or

    4. Strengthen regional computing collaboration to bring an added capability to the region.

To accomplish the above, the Foundation has adopted a new business model, taking on additional roles above its traditional land development/landlord ones. The new core functions will allow RTP to continue to build and develop the types of physical amenities that are demanded/required by high-technology companies; to serve as a thought leader, facilitator and catalyst for strengthening and building the types of knowledge assets that will better the Park's position; and to serve as a convener and facilitator to better connect the Park community among itself and with key regions and science parks globally to spark greater levels of innovation and entrepreneurialism. To most effectively execute this shift, the new business model must also generate the returns sustain the effort.

Adapting to a New Paradigm

The above changes in the Foundation's roles and core functions represent a paradigm shift in the way the Park and the Foundation function and contribute to economic development efforts. The shift represents a recognition that economic development is changing as the world globalizes and job growth opportunities shift. Whereas traditional economic development focused on growth of jobs in industrial enterprises (e.g., manufacturing, distribution, and transportation) was sensitive to transportation opportunities, site selection, labor, and was more reliant on government assistance in terms of zoning, hard infrastructure and tax concessions, a new, more collaborative model is taking shape. This model focuses on intellectual capital driven industries and is sensitive to access to ideas, collaboration, venture capital, culture of innovation, and entrepreneurship. The new model is less susceptible to globalization and flight to lower-production cost areas. In this model, government assists with value networks to promote collaboration and access to critical services. Innovation will play a vital role in creating new economy jobs even where it has not been vital in the past.

The new RTP business model was structured to thrive in this new paradigm. Recognizing the trends shaping the environment in which research parks operate, the business model going forward focuses on the

"softer" side of innovation and technology commercialization. It focuses on the intangible assets a park can provide such as networking opportunities within the Park and around the globe.

E. Summary and Conclusions

To position itself to take on this next phase in its evolution, RTP has set forth on an ambitious approach to not only maintain its current lead as one of the top region's for technology innovation, but also to secure a new position of pre-eminence in the coming years. RTP is committed to remaining a place where companies and academic talent can come together; it recognizes that the need to evolve is not optional.

Just as it seized "first-mover" advantage at the beginning of the science park industry's development, RTP will take a leadership position in forging a new, "next generation" model. This renaissance will consist of leveraging existing strengths and reaching out to partners around the globe to exploit technology trends and shifting growth opportunities. It will seek ways to better network science parks internationally to interact seamlessly and better serve their tenant companies and leverage their strengths. The network will allow parks with aligned strategies and similar missions to share best practices and connect their assets.

In addition to providing a global portal to Park companies, RTP's new business model will look inward to develop the types of physical amenities that are demanded/required by high-technology companies. By working to secure a leading position in the next technology wave, RTP will serve as a thought leader and catalyst throughout the state to strengthen and build the types of knowledge assets that will better the Park's competitive position in the 21st century.

RTP has evolved from a mere vision for changing a region's economic base to the manifestation of the how strategic investments in education, infrastructure, and business climate can positively impact an economy. With a critical mass of technology companies and knowledge workers and linkages to three world-class universities' research and development strengths, RTP's future success will depend on its ability to marshal these assets and reinvent itself to better address coming global and technology trends.

Appendix A: RTP Companies

Accurate Electronics, Inc.
Advanced Liquid Logic, Inc.
Aerie Pharmaceuticals, Inc.
Alion Science and Technology
AlphaVax, Inc.
A.M. Pappas Associates, LLC
American Assn of Textile Chemists & Colorists
ATEN, Inc.
Bank of America
BASF Corporation Agricultural Product Center
Bayer CropScience
BD Technologies
Bekaert Corporation
Bekaert Flex Circuits
BioAbility, LLC
Biogen IDEC
BOC Edwards
BrandPort, Inc.
Brown Computer Company
Burroughs Wellcome Fund
CPKD Solutions, LLC
Carolina Group Insurance Services, Inc.
Caspian Networks
Chorus Systems
CIIT Centers for Health Research
Cisco Systems, Inc.
Clean Design, Inc.
Clinical Diagnostics (Formerly Icoria, Inc.)
Clinication, Inc.
Cognosci, Inc.
Collaborative Studios, Inc.
Comprehensive Accounting Services, Inc.
CopperRoad Corporation
Craig Davis Properties
Credit Suisse
Cree, Inc.
Cromoz, Inc.
Delta Products Corporation
Diosynth Biotechnology
Duke Mass Spectrometry Facility
DuPont Electronic Technologies
EMC Corporation
Eisai Inc.
Endacea, Inc.
The Enrichment Center by Bright Horizons
Ericsson
First Citizens Bank
First Flight Venture Center
General Engineering and Environmental of NC, Inc.
GlaxoSmithKline
Governor's Institute on Alcohol & Substance Abuse, Inc.
GretagMacbeth, LLC
Howard Associates, LLC
Humacyte
i5, Inc.
IBM
International Union of Pure and Applied Chemistry (IUPAC)
Instrumentation Association
The Instrumentation Systems and Automation Society (ISA)
Invitrox
JMC (USA), Inc.
Learning Machines, Inc.
Lenovo
Liggett Vector Brands, Inc.
Lineberry Research Associates
MCNC
Mechanical Specialties
Medicor Pharmaceuticals, Inc.
Melmotte, Inc.
Mi-Co
MEMA
Mycosol, Inc.
National Humanities Center
National Institute of Environmental Health Sciences
National Institute of Statistical Sciences
National Toxicology Program
Network Appliance
Network Development Group
Norcarex Bio Corporation
Nortel Networks
North Carolina Biotechnology Center
North Carolina GlaxoSmithKline Foundation
North Carolina Healthcare Information and Communications Alliance
North Carolina Medical Device Organization
North Carolina State Education Assistance
North Carolina Technological Development Authority, Inc. (NCTDA)
Nufarm Americas, Inc.
Parrish Brian Partners, Inc.
PocketScience, Inc.

Practical Management, Inc.
Qualyst, Inc.
RadarFind Corporation
Radisson at RTP
Reichhold, Inc.
RTI International
Sigma Xi, The Scientific Research Society
Snowfin, LLC
Software Development Europe, Inc.
Sony Ericsson Mobile Communications, Inc.
Statistical and Applied Mathematical Sciences Institute
Sumitomo Electric Lightwave Corporation
Syngenta Biotechnology, Inc.
Synthon Pharmaceuticals, Inc.
Talecris Biotherapeutics
Teer Associates
Teotten Diagnostics
Tetra Tech, Inc.
Triangle Life Science Center (TLS Center)
Triangle Research Collaborative
Triangle Service Center, Inc.
Triangle Transit Authority (TTA)
Triangle Universities Center for Advanced Studies, Inc
Triumph Health Care, Inc.
Troxler Electronic Laboratories, Inc.
UAI Technology, Inc.
Underwriters Laboratories, Inc.
United States Environmental Protection Agency
USDA-Forest Service-Southern Research Station
United States Postal Service
United Therapeutics Corporation
The University of North Carolina Center for Public Television
Wachovia Bank
Wesinco, Inc.
Xsira Pharmaceuticals (Formerly Norak Biosciences Inc.)
Zen-Bio

Appendix B: Comparison of RTP and other Science Parks

Science park	Year Est.	Area (acres)	# of Tenants	Main Industries
Kansai Science City	1986	37,070	72	Cultural creation and exchange, promotion of academic researches
Zhongguancun Science Park	1988	24,710	4400	Biological and medical projects, electronic information, new energy
Zhengzhou High and New Technology Industries Development Zone	1988	16,010	1003	Electronics, ICT, medical sciences, biotechnology
Europole Mediterraneen de l'Arbois	1995	11,120	33	Environmental enterprises, research, training, technology transfer
Multimedia Development Corporation	1996	7,141	250	ICT, biotechnology, telecommunications.
Research Triangle Park	1959	7,000	136	Biotechnology, electronics, environmental science, ICT, pharmaceuticals
Tri Cities Science & Technology Park	1990	4,000	120	Environmental cleanup and restoration, medical technology, energy, advanced materials, and life sciences
Cummings Research Park	1962	3,843	225	Aerospace, technology-based precision manufacturing
Kulim Technology Park Corporation	1996	3,600	33	High technology manufacturing and R&D activities
Nanjing New & High Technology Industry Development Zone	1988	3,257	2000	ICT, biotechnology, new materials, aeronautic industry resources, modern materials, and photo electricity

Source: IASP Members Director, AURP Membership Directory

Appendix C: North Carolina Innovation Infrastructure

- **North Carolina Board of Sciences and Technology (1965).** The first of its kind in the United States, the Board was created by the North Carolina General Assembly to strengthen the science and engineering base across the state through research grants to private and public institutions. The Board encouraged inter-institutional collaborations to create inter-institutional research facilities.

- **Triangle Universities Computation Center (1965).** Developed with a grant from the North Carolina Board of Sciences and Technology, the Center provided mainframe computer services to the region's three research universities, the Research Triangle Institute, and tenants of the Park. As an outgrowth of the Center, an agency of the UNC System was created to extend the services to other colleges and technical institutes across the state. The Center was dissolved in 1990 as commercial entities emerged to provide such services.

- **MCNC (1980).** Created as the Microelectronics Center of North Carolina, MCNC began as a state-of-the-art design and computer chip production facility. It included a Class I clean room that networked the three universities and RTI. In its early years, MCNC worked to advance technology-led economic development and job creation through North Carolina. Within this role, MCNC operated the North Carolina Research and Education Network (NCREN) — one of the nation's first and most advanced statewide networks in the country that provides Internet, video, audio and data network services to the University of North Carolina's 16-campus system, Duke University, Wake Forest University other educational institutions. MCNC also operated the North Carolina Supercomputing Center, which was established in 1986. In addition, through its Grid Computing and Networking Services, it delivers advance communications statewide to more than 180 public and private institutions, including universities, community colleges, K-12 schools, libraries and state government.

- **North Carolina Biotechnology Center (1984).** The Center was created by North Carolina General Assembly in 1984 to provide long-term economic and societal benefits to the state through the support and growth of biotechnology research, business, and education throughout the state. Since its establishment, the Center has provided about $16 million in financial assistance to 92 early stage biotechnology companies and has invested more than $50 million in North Carolina universities to recruit 46 outstanding faculty members, purchase multi-user research equipment, and sponsor more than 450 research projects. Through its educational efforts, the Center has tripled enrollment in the biosciences at the state's six historically minority universities by granting $8 million in special appropriations to improve the institutions' biotechnology programs.

- **First Flight Venture Center (1990).** The First Flight Venture Center is a state-of-the-art business incubator managed by the North Carolina Technological Development Authority. The facility offers approximately 15,000 square feet of leasable office and laboratory space for technology companies and research-based entrepreneurs. Services offered range from networking tenants with appropriate contacts in the private and public sectors to the provision of conference rooms, business equipment, receptionist services, and secretarial support. These services are available to both tenant and non-tenant companies that meet criteria for the program.

Appendix D: Summary of Triangle Innovation Project Findings

	*How RTP/Triangle region Rank**	*How Other Regions Rank*
Attractiveness to companies	• High education level (five percent of the Park's employees hold a Ph.D.) • Strong university and community college systems	• Top competitor regions have comparably talented workforces, but often face a shortage of technical workers
	• Excellent business climate for large and medium-sized companies. However, climate for smaller, start-up companies is not as strong; comparably difficult to attract financing for early stage companies • Infrastructure and zoning are in place for medium and large companies	• Top competitor regions do a better job of addressing the needs of smaller-startup companies, especially in terms of tax and fiscal environments • Other regions have more space for small/gazelle companies and are able to setup new business locates more rapidly
	• The Triangle is ranked #41 for economic dynamism in the Metropolitan New Economy Index	• San Francisco, San Diego, and Boston are ranked #1, 6, and 26, respectively, in the Metropolitan New Economy Index
Attractiveness to Individuals	• Quality of life is a strength of the region, as is its cost of living. The region does not rank well in terms of diversity	• Top competitor regions trail the Triangle in terms of quality of life, in large part due to higher costs of living and greater congestion problems
	• The region has consistently ranked among the top in terms of K-12 education	• Top competitor regions also rank high in K-12 education
	• The region does not rank as well in terms of social interaction	• Top competitor regions offer more opportunities—both formally and informally—for interaction, much of which has arisen out of market forces
Reputation	• RTP is one of the most recognized research/science parks in the world	• Top competitor regions have more name recognition than RTP among broader audiences
Intellectual Interaction	• The research universities in the Triangle region lag other top competitor regions in terms of technology spin-offs	• Top competitor regions do a better job of providing networking and awareness mechanisms to spark spin-offs

* Rankings are based on comparisons with the Best Practice-Case Study regions and top innovation regions in the United States including Boston/Cambridge, MA, Silicon Valley, CA and San Diego, CA.

End Notes

[i] *"Regional"* in this instance refers to the Raleigh-Durham-Chapel Hill Metropolitan Statistical Area as defined by the US Census Bureau. Data is for 2004.

[ii] Albert Link. *A Generosity of Spirit: The Early History of Research Triangle Park.* Research Triangle Park, NC: Research Triangle Foundation of North Carolina, 1995, p. 10.

[iii] Ibid, p. 34. Excerpts from the Certificate of Incorporation, Governor's Research Triangle Council (September 25, 1956).

[iv] The Research Triangle Institute later changed its name to "RTI International."

[v] Albert Link and John T. Scott. 2003. "The Growth of Research Triangle Park." *Small Business Economics, 20,* pp. 167-175.

[vi] Link, Generosity of Spirit, p. 47.

[vii] Ibid, p. 80-81. The amendment to the original guidelines allowed for the acceptance of IBM, Nortel Networks and other companies into the Park.

[viii] Link, Generosity of Spirit, p. 81.

[ix] Hammer Siler George Associates. The Research Triangle Park: The First Forty Years. Silver Spring, MD: Hammer Siler George Associates, 1999, p. 17.

[x] Based on Research Triangle Foundation of North Carolina employment and new company survey data since 1960.

[xi] Excerpted from the Triangle Universities Center for Advanced Studies, Inc. Articles of Incorporation, November 21, 1975.

[xii] Quoting Richard Daugherty, former State Executive for IBM in Albert Link. *From Seed to Harvest: The Growth of Research Triangle Park.* Research Triangle Park, NC: Research Triangle Foundation of North Carolina, 2002, p. 78.

[xiii] The National Humanities Center is the only major independent American institute for advanced study in all fields of the humanities. The Center provides a national focus for the best work in the liberal arts, seeking to insure the continuing strength of the liberal arts and to affirm the importance of the humanities in American life. The Center is located on the TUCASI campus in RTP.

MCNC is a non-profit organization committed to advancing education, innovation and economic development throughout North Carolina by delivering next-generation information technology services and by building partnerships among the academic, research, government and business communities. (see Appendix C). Since 1985, MCNC has operated the North Carolina Research and Education Network (NCREN) — one of the nation's first and most advanced statewide networks in the country. NCREN provides Internet, video, audio and data network services to the University of North Carolina's16-campus system, Duke University, Wake Forest University other educational institutions.

The National Institute of Statistical Sciences (NISS) conducts and facilitates collaborative research in statistical studies. Their principal activities are research projects in areas such as bioinformatics, data confidentiality, data integration, data quality, information technology, the environment, education statistics, large and complex databases, and computer model evaluation. The NISS also offers workshops, short courses and programs for Postdoctoral fellows and visitors.

The North Carolina Biotechnology Center is a private, non-profit corporation created by the state in 1984 and supported by the General Assembly. The Biotechnology Center's mission is to provide long-term economic and societal benefits to North Carolina through support of biotechnology research, business and education statewide. The Center serves the state with three core programs: Science and Technology Development; Business and Technology Development; and Education and Training. The Center has regional offices in Western North Carolina, the Piedmont Triad, Eastern North Carolina and Southeastern North Carolina.

Statistical and Applied Mathematical Sciences Institute conducts and facilitates collaborative research involving statistics and applied mathematics. Areas of activity include the environment, stochastic computation, inverse problems, modeling of Internet traffic, data mining and machine learning, along with multi-scale modeling and control design.

The Burroughs Wellcome Fund (BWF) is an independent private foundation dedicated to advancing the medical sciences by supporting research and other scientific and educational activities. Within this broad mandate, BWF's general strategy is to help scientists early in their careers develop as independent investigators. BWF also supports investigators who are working in or entering fields in the biomedical sciences that are poised for significant advancement but currently undervalued and underfunded.

[xiv] Link, Generosity of Spirit, p. 169.

[xv] SmartCommute@RTP provides assistance with travel management in and around the Park and joins the region's Triangle Transit Authority in undertaking a *SmartCommute Challenge*, during which commuters pledge to use at least one form of alternative commuting during a set period of time. The Environment@RTP committee works to address air, water, waste and wildlife habitat management issues in the Park. Throughout the year, Environment@RTP hosts *Electronics Recycling Days*, an opportunity for Park employees to discard unwanted electronic items and help the environment.

[xvi] Link, Seed to Harvest, p. 59.

[xvii] Ibid, p. 34.

[xviii] Scott Wallsten. 2004. "Do Science Parks Generate Regional Economic Growth? An Empirical Analysis of their Effects on Job Growth and Venture Capital" *AEI-Brookings Joint Center for Regulatory Studies, Working Paper*. Washington, DC. Also Bradley Braun and W. Warren McHone. 1992. "Science Parks as Economic Development Policy: A Case Study Approach." *Economic Development Quarterly 6, no. 2*: 135-147 and Harvey Goldstein and Michael Lugar. *Science/Technology Parks and Regional Development Prospects for the United States*. Edited by Ulrich Hilpert, *Regional Innovation and Decentralization: High Tech Industry and Government Policy*. London and New York: Rutledge, 1991a.

[xix] For the purposes of their analysis, Hammer Siler George Associates defined "New-Line" industries as those falling within the below SIC codes. Data was based on the corresponding year's U.S. Census Bureau data.

SIC Code	***SIC Code Description***
SIC 28	Chemicals and allied products
SIC 35	Industrial machinery and equipment
SIC 36	Electronic & other electric equipment
SIC 37	Transportation equipment
SIC 38	Instruments and related products
SIC 48	Communications
SIC 60	Depository institutions
SIC 61	Non-depository institutions
SIC 62	Security and commodity brokers
SIC 63	Insurance carriers
SIC 64	Insurance agents, brokers, & service
SIC 65	Real estate
SIC 67	Holding and other investment offices
SIC 73	Business services
SIC 80	Health services
SIC 81	Legal services
SIC 82	Educational services
SIC 87	Engineering & management services

[xx] Hammer Siler George Associates, Research Triangle Park, p. 2. Percentage for 2005 and translation of SIC codes to NAICS codes calculated by the Research Triangle Foundation.

[xxi] Ibid, p. 19.

[xxii] William Little. *An Emerging Dimension of the Research Triangle: Technology-based Start-ups and Spin-offs.* Presentation to the Triangle Area Research Directors Club, October 2005.

[xxiii] Link, Generosity of Spirit, p. 7.

[xxiv] For example, “green door” models such as Centennial Campus and the Piedmont Triad Research Park in Raleigh and Winston-Salem, NC, respectively, are more closely linked and located on university campuses to facilitate collaboration with university faculty and provide contemporary knowledge workers a more urban feel. Similarly, virtual parks are also being developed to share best practices and overcome geographical challenges.

[xxv] The Triangle Innovation Project was a partnership between IBM Business Consulting Services and the Research Triangle Foundation of North Carolina. Analysis was based on a series of global interviews conducted with executive staff from a number of science parks, Research Triangle Park stakeholders, and Triangle region business leaders; a literature review on research park success factors, analyses of the effect of research parks on regional economic development, and best practices; and applied business analysis, innovation-related expertise, and experience with international competition by the IBM team.

[xxvi] Zoltan J. Acs, David B. Audretsch, Pontus Braunerhjelm, and Bo Carlsson. "Growth and Entrepreneurship: An Empirical Assessment" (January 2006). *CEPR Discussion Paper No. 5409*. The importance of entrepreneurial activity is further studied by the London-based Centre for Economic Policy Research. The authors conclude that technology-based entrepreneurship serves as that reagent to stimulate spillovers of knowledge critical to sustaining growth.