Battelle
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Assessing the Greater Oklahoma City Region's Competitive Position in the Biosciences:

A BENCHMARKING ANALYSIS

PREPARED FOR:
Greater Oklahoma City Chamber

PREPARED BY:
Battelle
Technology Partnership Practice

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Executive Summary

The Greater Oklahoma City Chamber is supporting the development of a strategy designed to grow a bioscience corridor that will extend from Stillwater to Ardmore.[1] The strategy will build on the region's considerable bioscience assets, which include the University of Oklahoma and its Health Science Center, the Oklahoma Medical Research Foundation, Oklahoma State University and The Samuel Roberts Noble Foundation. The strategy will set out a vision for the region's bioscience future and chart a set of actions to achieve it. The project is designed to answer the following questions:

- Where does the region stand today in the biosciences?
- Where does the region need to go in terms of vision and focus?
- What needs to be done to achieve this vision—particularly in the short-term, i.e., five years?

The Chamber has engaged the Battelle Technology Partnership Practice to assist in formulating the strategy. Battelle is recognized worldwide for technology-based economic development, management, commercialization and the development of industry/government/academic partnerships. Battelle's 7,500 scientists, technologists and specialists conduct more than 5,700 projects each year.

The Benchmarks

- Birmingham
- Dallas
- Kansas City
- Louisville
- St. Louis
- Saskatoon

To answer the question of where the region stands in the biosciences, Battelle benchmarked the region against other regions that have either an established or emerging bioscience sector or that are trying to develop a bioscience sector. Battelle benchmarked the Greater Oklahoma City region against the following six metro areas: Birmingham, AL; Dallas, TX; Kansas City, KS and MO; Louisville, KY; St. Louis, MO and IL; and Saskatoon, Saskatchewan, Canada. This report presents the findings of the benchmarking analysis.

KEY FINDINGS

The region has many of the key programs in place found in the benchmarks. To grow their bioscience economies the benchmarks have invested in building R&D capabilities, undertaken various initiatives to encourage investment in bioscience-focused venture capital funds, provided support for university-industry research partnerships, developed research parks and incubators, and provided support to entrepreneurs and start-up companies. The Greater Oklahoma City region compares favorably to the benchmarks in the range of programs and services provided by

[1] For the purposes of this initiative, the Greater Oklahoma City region includes not only the Oklahoma City metropolitan area with its large biomedical base, but extends south from Stillwater along the I-35 corridor to Ardmore. This definition was used because the regions' leaders wanted to understand and capture fully the entire breadth of the bioscience sector in the region.

OCAST, i2E, Meridian Technology Center for Business Development and the Presbyterian Health Foundation (PHF).

The priorities of the benchmarks are very similar to the priority needs being addressed in the Greater Oklahoma City region. They include addressing the need for pre-seed, seed and venture capital, attracting and retaining entrepreneurial and management talent, and the transfer and commercialization of technology. In addition to addressing these needs, the region also needs to build its bioscience research base; this issue also faces Louisville and Kansas City. Growing the R&D base is less of an issue for Birmingham, St. Louis and Dallas that have well developed bioscience R&D bases.

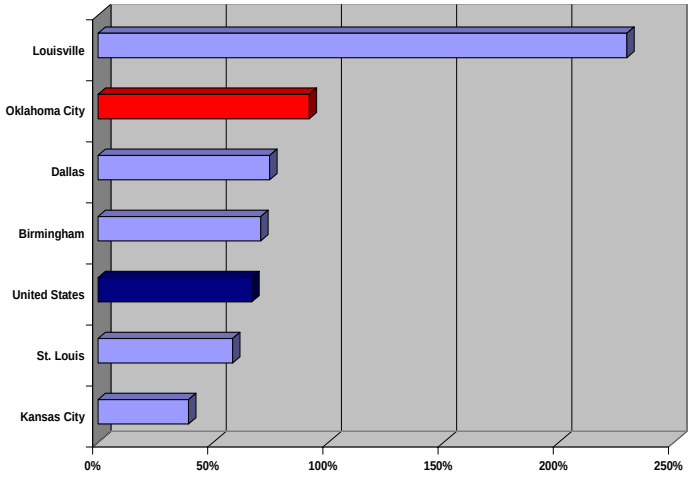
***The benchmarks recognize the need for collaboration between and among research institutions and are working to promote a greater level of partnering*.** This is a key element of Kansas City's strategy to increase their R&D base and they have created a mechanism, the Kansas City Area Life Science Institute (KCALSI) to encourage, facilitate and support collaboration. There is a good deal of collaboration between researchers at institutions in the Greater Oklahoma City region but no formal mechanism exists for encouraging collaborations.

Academic Life Science R&D 2002 (millions of dollars)

St. Louis	414.2
Dallas	276.2
Birmingham	241.2
Oklahoma City	129.6
Louisville	64.1
Kansas City	20.9

The region has experienced a significant increase in NIH funding in recent years but still significantly lags St. Louis, Birmingham and Dallas in bioscience R&D funding. Total academic life science R&D funding in the region totaled $129 million in FY 2002.[2] St. Louis received more than five times this amount and Birmingham and Dallas received more than three times this amount. NIH awards to the Greater Oklahoma City region almost doubled between FY 1999 and FY 2003, growing to $72.6 million. Despite this large increase, the region significantly lags St. Louis, Birmingham, and Dallas, which received $442 million, $280 million, and $194 million in NIH awards respectively in 2003. On a per capita basis, however, the region's life science R&D base ranks third among the benchmarks, lagging only Birmingham and St. Louis.

Figure ES-1: Percentage Change in NIH Awards, FY 1999–FY 2003



Source: NIH

***All of the benchmarks recognize the importance of investing in research facilities and faculty in order to maintain and build a bioscience research base*.** Since 1999, the University of Alabama-Birmingham (UAB) has raised $388.7 million that has been used to support 56 endowed chairs, 126 endowed scholarships and fellowships, and for construction and

[2] Academic life science R&D includes agricultural, biological, medical and other life science R&D awards made to colleges and universities. These data are reported by the National Science Foundation (NSF). NIH awards include all awards made by NIH to any research institutions, individuals or firms in the region.

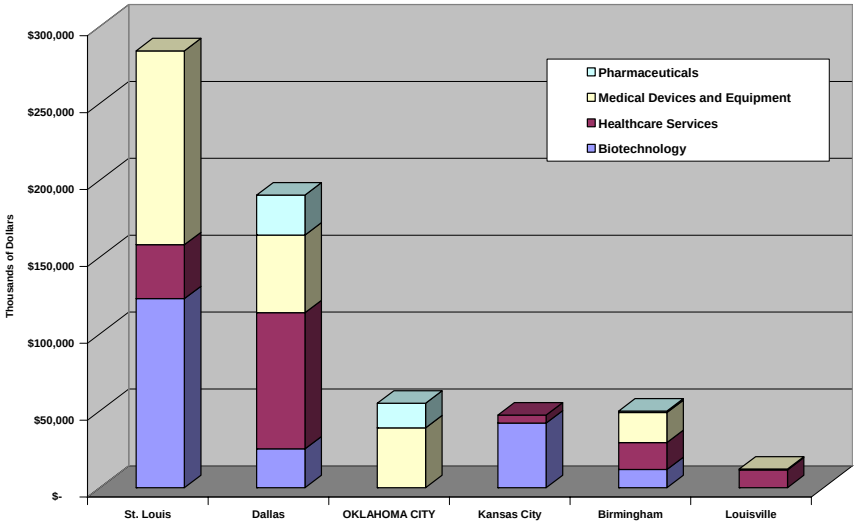
renovation of buildings and labs. UAB recently built two major new research buildings and a complete new main hospital building. Louisville received $100 million to develop recruitment packages to attract highly productive research "stars." The Oklahoma City region's research institutions have made recent investments and a number of pending proposals would greatly increase the funding available to build facilities and attract additional researchers. OUHSC, OMRF, and OSU have committed to adding a significant number of research positions. OMRF, OUHSC, PHF Park and Noble Foundation have new buildings that have recently been completed or are under construction. The Dean McGee Eye Institute is midway in a campaign to raise funding for a new building. Last year the state legislature provided funding to the Board of Regents to allow them to clear out a backlog of Eminent Scholar positions that were awaiting state matching funds.

The legislature recently approved a $500 million bond issue that would be used to fund capital projects at Oklahoma's universities. A request by the Governor to allocate $100 million to create a Research Endowment was not enacted in 2005. If the Research Endowment is created in the future, these investments could help to put Oklahoma and the region at a competitive advantage to some of the benchmarks.

The benchmarks are strategically targeting their bioscience investments at the technology platform or end-market level. Kansas City, for example, is targeting personalized medicine, animal health, drug discovery, oncology, cardiovascular, neuroscience, and medical transaction IT. Saskatoon is targeting agbiotech, nutraceuticals, biofibers and fuels, vaccines, and structural biomedicine. The Oklahoma City region has not targeted specific areas previously, although individual research institutions have specific focus areas. The core competency being conducted as part of this strategy development project will identify potential areas for focus in this region.

All of the benchmarks are continuing to struggle with the issue of seeking to encourage the commercialization of IP generated by regional research institutions. St. Louis has been most aggressive in seeking to address this issue. The region's research institutions have created a nonprofit, the Biogenerator, to provide seed funding and help commercialize technology. Washington University (Wash U) and St. Louis University (SLU) have created internal commercialization funds to support proof of concept activities.

Figure ES-2: Biotechnology Venture capital by Metro Areas, FY 1999–FY 2004



Source: PwC Moneytree data, Battelle calculations

All but one of the benchmarks have formed pre-seed and or seed funds to support the development of new start-up companies. Most of these funds are in the $5 to $10 million range and make investments of up to $250,000. The Business Technology Finance (BTF) Program

operated by i2E for OCAST provides pre-seed funding of up to $125,000. A proposal is pending in the Oklahoma legislature to create a $10 million seed fund ($5 million in state funding to be matched by $5 million in private dollars). The seed fund would make investments in the range of $250,000–$500,000.

Venture capital investment in biotechnology companies is increasing although it is not yet at the level of St. Louis or Dallas. Between FY 1999 and FY 2004, venture capital funds invested $54.9 million in bioscience firms in the Oklahoma City metro area.[3] This level of investment is similar to that of Kansas City and Birmingham but significantly less than St. Louis and Dallas. However, biotechnology venture capital investments increased nearly nine-fold in the Oklahoma City MSA between the 1996–2000 time period and the 2001–2004 time period.

The Greater Oklahoma City region has a gap in later stage venture capital in comparison to the benchmarks. Most of the benchmarks have taken steps to attract venture capital companies willing to make 2nd and 3rd round investments in bioscience companies. In St. Louis, a $60 million privately managed "fund of funds" has been created to build syndication with funds in other regions. Saskatoon has access to a $45 million Western Life Sciences Venture Fund, which is privately managed but was subsidized by a provincial tax credit. Several years ago, Oklahoma raised a Life Science Fund that invested in five companies, but attempts to raise a Life Sciences II Fund have thus far not succeeded.

The region has a wealth of talent in the graduates of its universities but a smaller bioscience workforce than Dallas, St. Louis, and Kansas City. The region's educational institutions awarded approximately 2,500 bioscience degrees in 2002. Among the benchmarks, only St. Louis with 4,500 bioscience degrees awarded in 2002 produced more bioscience graduates than the Greater Oklahoma City region.

The benchmarks are similar to the Greater Oklahoma City region in that it is often difficult to attract entrepreneurial and management talent with experience in starting up bioscience companies, but some of the benchmark regions are developing creative ways to address this issue. St. Louis' two bioscience incubators house a CEO in Residence that mentors new start-ups with the expectation that he or she will eventually leave to launch a new company. Other regions are using students in their entrepreneurship programs to assist start-up companies. i2E has a corps of mentors that can help with early stage companies and serve as interim CEOs, but attracting CEOs to the Greater Oklahoma City region is still a challenge.

Oklahoma's PHF Park, as well as the Oklahoma Technology and Research Park in Stillwater and the OU Research Campus in Norman, gives the region a competitive advantage over most of the benchmarks in terms of space and facilities. With the exception of Saskatoon and Birmingham, the rest of the benchmarks are playing catch up in trying to develop a research park in proximity to their medical district. St. Louis and Louisville are seeking to do this but they are developing on an in-fill basis in an already heavily developed area. The proximity of PHF Park to the region's biomedical institutions and the availability of space for companies relocating or expanding in the Greater Oklahoma City region as well as for start-ups is an advantage that should be exploited.

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[3] These data are for the Oklahoma City MSA as defined by the US Bureau of the Census. The MSA includes Norman but does not include Stillwater or Ardmore.

SUMMARY AND CONCLUSIONS

The Greater Oklahoma City region compares favorably to the benchmarks in terms of the infrastructure that is available to support the start-up and growth of bioscience companies. The programs operated by OCAST and i2E are similar to the best practice examples from the benchmarks. One area is which the region has a competitive advantage is in space and facilities. The region has a well developed research park located in close proximity to its medical center, another research park under development in Stillwater and a research campus in Norman that contains two multi-tenant buildings. Incubator facilities are available at PHF and in the Meridian Technology Center for Business Development. Research parks in most of the benchmarks are only in the early stages of development and are being developed on an in-fill basis.

Encouraging and facilitating the commercialization of university developed technologies is a challenge for the benchmark regions as it is for the Greater Oklahoma City region. The benchmarks also continue to struggle to build local venture capital markets and to ensure an availability of pre-seed and seed capital. The one area in which the region lags several of the benchmarks is in the size of the bioscience R&D base. The Greater Oklahoma City region's R&D base is significantly smaller than St. Louis, Dallas, and Birmingham. The good news is that the region's NIH funding almost doubled between 1999 and 2003. Table ES-1 summarizes the findings from the benchmarks and assesses the region's competitive position.

Table ES-1: Summary of Benchmark Findings and Assessment of the Region's Situation

Key Issue Area	Benchmark findings	Situation in Greater OKC Region
Leadership	Bioscience cluster organizations are widely in place, serving to steer strategy and providing opportunity for networking	No single voice for the bioscience sector
Bioscience focus	Several regions are targeting bioscience at the technology platform or end-market level Several are also targeting ag/plant biotech	Core competency assessment will identify analogous areas but it is clear that there is competition in ag/plant biosciences
R&D base	Of the benchmarks, only Texas and Kentucky have made significant investments in R&D capacity, but Kansas seems poised to follow	$500 million bonding for higher education
Tech transfer/ commercialization	Not an area of great success among the benchmarks, but several are moving aggressively, including especially St. Louis	Greater OKC faces issues very similar to other regions Tech Transfer Alliance may help address
Pre-seed/seed and venture capital	With exception of Birmingham, all the regions have active pre-seed funds of some kind /All still having trouble building local capacity for later-stage funding, despite range of tactics	Lack of seed fund Lack of local venture funds despite OCIB and tax credits provided to investors
Talent	University entrepreneurial centers are moving from research into practice – flowing students into business planning for research partners and university's own licensing projects	Opportunities exist to link OU and OSU MBA students to assist start-up companies

Space and facilities	Best in class research park is Innovation Place/ Wet lab incubator capacity led by St. Louis, with significant space in Birmingham and Saskatoon	Greater OKC has competitive advantage with PHF Research Park and its space for startup companies
Business environment	Seed capital credits have been poorly utilized/Saskatoon integrates generous R&D credits with large matching funds	Oklahoma has one of the earliest “fund of funds” backed by contingent tax credits that is now being adopted in many other states.

Introduction

As the Greater Oklahoma City region develops its bioscience strategy, it is critical to understand approaches undertaken and lessons learned in comparable communities. This report presents the results of a benchmarking analysis of six regions selected by a project steering committee appointed by the Greater Oklahoma City Chamber, which is the sponsor of this project.

Purpose of benchmarking

Benchmarking, which is commonly undertaken in the corporate and financial communities as a way of improving efficiency and calibrating performance, is just as important in planning for technology-led economic development. Benchmarks allow one to identify, analyze and draw useful lessons from the practices of other regions that are comparable along relevant strategic dimensions. Benchmarking can help in:

Identifying the competition. Benchmarking forces a community to identify clearly the kind of region against which it competes for business investment in the targeted sectors. Benchmarking forces planners to examine in a broad, qualitative way who is pursuing similar strategies and how they are succeeding or failing. This may yield important insights into how the competitive landscape looks to those in business who make decisions on locational investment.

Isolate the strategic issues. To design a regional strategy for technology-led economic development, any region must understand what its key choices are and how various potential uses of resources trade against each other. Examining how competing regions have positioned themselves can give insight into what strategic choices must be made in view of the home region's strengths and weaknesses, and the opportunities and threats posed by the broader marketplace.

Figure out what works. There is no point in reinventing the wheel. Strategies and initiatives that work in other regions facing similar challenges can often be adapted to local conditions, avoiding the risks of investing in entirely untried approaches.

How the benchmarks were selected

For benchmarks to be useful, they must share at least some common features. Although no community will be like the Greater Oklahoma City region[4] in all respects, a balanced representation can be achieved across the entire set. In early discussions with members and staff of the Greater Oklahoma City Chamber of Commerce and the project steering committee, Battelle identified several factors it considered important and which were used to construct the benchmark

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set. So we looked for candidates that shared as many of the following characteristics as possible:

- Multi-institutional downtown medical district with an adjoining research park;
- Metro area of moderate size, if possible based in or close to the South Central region;
- State level science and technology program that can be levered by the region;
- Dispersed bioscience research base with multiple institutions;
- Important role played by foundations;
- Potential relevance of agricultural bioscience; and
- Interesting or novel experiments in venture capital formation.

These criteria resulted in identification of a universe of 11 possibilities, from which the following set of six was selected: **Birmingham, Dallas, Kansas City, Louisville, Saskatoon** and **St. Louis.**

KEY FINDINGS

The Greater Oklahoma City region has many of the key programs in place found in the benchmarks. To grow their bioscience economies the benchmarks have invested in building R&D capabilities, undertaken various initiatives to encourage investment in bioscience focused venture capital funds, provided support for university industry research partnerships, developed research parks and incubators, and provided support to entrepreneurs and start-up companies. Oklahoma compares favorably to the benchmarks in the range of programs and services provided by OCAST, i2E, Meridian Technology Center for Business Development and the Presbyterian Health Foundation (PHF).

The priorities of the benchmarks are very similar to the priority needs being addressed in the Greater Oklahoma City region. They include addressing the need for pre-seed, seed and venture capital, attracting and retaining entrepreneurial and management talent, and the transfer and commercialization of technology. In addition to addressing these needs, the Greater Oklahoma City region also needs to build its bioscience research base; an issue that faces Louisville and Kansas City as well. Growing the R&D base is less of an issue for Birmingham, St. Louis and Dallas that have well developed bioscience R&D bases.

The benchmarks recognize the need for collaboration between and among research institutions and are working to promote a greater level of partnering. This is a key element of Kansas City's strategy to increase their R&D base and they have created a mechanism, the Kansas City Area Life Science Institute (KCALSI) to encourage, facilitate and support collaboration. There is a good deal of collaboration between researchers at institutions in the Greater Oklahoma City region but no formal mechanism exists for encouraging collaborations.

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research institutions have made recent investments and a number of pending proposals would greatly increase the funding available to build facilities and attract additional researchers. Both OUHSC and OMRF have committed to adding a significant number of research positions. OMRF, OUHSC, PHF and Noble Foundation have new buildings that have recently been completed or are under construction. The Dean McGee Eye Institute is midway in a campaign to raise funding for a new building. Last year the state legislature provided funding to the Board of Regents to allow them to clear out a back log of Eminent Scholar positions that were awaiting state matching funds.

In 2005, the Legislature approved a $500 million bond issue that will be used to fund capital projects at Oklahoma's universities. A request by the Governor that $100 million be allocated to create a Research Endowment to build R&D capacity was not enacted this year. If the endowment is created in the future, these investments would help to put Oklahoma and the region at a competitive advantage to some of the benchmarks.

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All of the benchmarks are continuing to struggle with the issue of seeking to encourage the commercialization of university developed IP within the region. St. Louis has been most aggressive in seeking to address this issue. The region's research institutions have created a nonprofit, the Biogenerator, to provide seed funding and help commercialize technology. Washington University (Wash U) and St. Louis University (SLU) have created internal commercialization funds to support proof of concept activities.

All but one of the benchmarks have formed pre-seed and or seed funds to support the development of new start-up companies. Most of these funds are in the $5 to $10 million range and make investments of up to $250,000. The Business Technology Finance (BTF) Program operated by i2E for OCAST provides pre-seed funding of up to $125,000. A proposal to create a $10 million seed fund ($5 million in state funding to be matched by $5 million in private dollars) was not enacted in the 2005 legislative session.

The Greater Oklahoma City region has a gap in later stage venture capital in comparison to the benchmarks. Most of the benchmarks have taken steps to attract venture capital companies willing to make 2nd and 3rd round investments in bioscience companies. In St. Louis, a $60 million privately managed "fund of funds" has been created to build syndication with funds in other regions. Saskatoon has access to a $45 million Western Life Sciences Venture Fund, which is privately managed but was subsidized by a provincial tax credit. Several years ago, Oklahoma raised a Life Science Fund that invested in five companies, but attempts to raise a Life Sciences II fund have thus far not succeeded.

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Below is a summary of the benchmark findings for each individual region.

SUMMARY OF FINDINGS BY COMMUNITY

Birmingham

- This steel making town is trying to reinvent itself as a bioscience hub while the state still focuses on attracting auto plants
- Success was driven by rapid growth in research budgets at UAB which was able to occur because of prior investments in buildings and facilities, and visibility provided by then-vigorous HealthSouth
- UAB hit wall several years ago and recent spin-offs have been from the loosely affiliated Southern Research Institute
- The UAB research park anchors the redevelopment of the former steel property and is not downtown—this is now acknowledged as a probable error
- A small incubator has served 80 companies, graduated 40 and one has gone public
- Some early creative work in pre-seed funding has stalled
- A multi-sector technology council backed by the Chamber is turning attention to building entrepreneurial culture
- Some ongoing tension exists with similar efforts in Huntsville and Auburn and there are no state resources for coordination

Dallas

- In Dallas technology has traditionally meant the Telecom Corridor, with bioscience emerging only in the last decade as a target for growth
- UT Southwestern Medical Center, the region's consolation for losing Baylor college of Medicine to Houston in 1943, grew explosively after two faculty won Nobel Prizes in 1985
- The Medical Center's strategic importance at the center of a huge downtown medical district was first recognized by regional planning exercises in the late 1990s
- UT reorganized its licensing unit to add a three person venture-development staff, tripled revenue, and started generating spin-offs, most small to date
- Hidden in the large high-tech sector was a strong medical-device manufacturing component—recognized in regional planning process
- UT began convening biotech breakfasts in 2003. The Dallas and Fort Worth Chambers and a local Health Council helped create the BioDFW cluster organization
- The region has several small dry and wet-lab incubators but is planning a large research park adjacent to the Southwestern Medical District, with a major incubator
- State investments have been episodic, but large new Emerging Technology Fund is on the horizon
- Dallas may share with the Greater Oklahoma City region the problem of being a "best kept secret" in biosciences, often still overshadowed by Houston

Kansas City

- The region started with a fragmented research base and modest state programs in Kansas, none in Missouri
- The Kansas Technology Enterprise Corp. (KTEC) had equipped University of Kansas Medical Center (KUMC) with a pre-seed fund ("Precede"), which was generating some spin-offs
- But the region was really pursuing telecom services when the Stowers family (American Century Funds) changed everything
- A $1.1 billion endowment (now $2 billion) set up the Stowers Institute for Medical Research, intended to free investigators from grant-seeking
- This gift catalyzed the Kansas City Area Life Science Institute (KCALSI), a community-wide initiative to raise the bioscience R&D base from $86 million to $500 million over a decade (at least measurement, $219 million)
- With inspiration from the Midwest Research Institute, which already had several collaborations, KCALSI developed a project approach to capacity building
- Higher visibility led to creation of the $500 million Kansas Bioscience Authority, and cemented an alliance with St. Louis that led to a plan to invest a portion of Missouri's tobacco settlement funds in bioscience R&D

- The region still has no research park, and only one modest wet-lab incubator
- Now KCALSI is turning attention to the existing animal health sub-sector, exploiting presence of Bayer Animal Health, Aventis and Boehringer-Ingelheim

Louisville

- A visioning exercise led by Greater Louisville in the late 1990s identified "health enterprises" as high potential, based on the fact that the city is headquarters to several major hospital chains (Humana, Vencor)
- But it also highlighted significant weaknesses in research capacity and a significant lack: no culture of entrepreneurship
- This project coincided with major state-level investment in "bucks for brains" professorships, allowing the University of Louisville (U of L) to accelerate its growth
- This was followed by an explicit strategy creating a New Economy Office (NEO) with grant-making power, a fund of funds, and new programs for industry collaboration at the Kentucky Science and Technology Corp.
- At the same time, the city was redeveloping the waterfront and determined to lever the downtown medical district with an in-fill research park
- One outcome of state funding was Enterprise Corp., a networking and mentoring organization, a bioscience incubator, and several equivalents of a pre-seed fund
- Faculty recruitments have created several spin-offs in which local investors participated—and some have stayed after being acquired
- But the region still has trouble accommodating later stages of growth, and ties to University of Kentucky (UK) in Lexington are still weak

St. Louis

- A large Midtown medical district and an enormous research engine at Washington University (Wash U) were ignored for years in favor of manufacturing sector (Boeing, Emerson)
- But Monsanto's near-death experience in the late 1990s galvanized civic community led by Danforth Foundation (led by the retired Chancellor of Wash U)
- The foundation made major investments in "plant and life sciences" at Wash U and in a separate Plant Science Center—leading to creation of region's second wet-lab incubator
- More importantly, the foundation paid to staff a Plant and Life Sciences Coalition that mobilized in task forces on research, facilities, and capital formation
- Results: more than $200 million in capital formation in first two years, followed by new internal and external pre-seed funds, a new $80 million fund of funds initiative, and state commitments to research and beginnings of a research park
- One incubator tenant has gone public to date, others poised, and major inward investments from large firms like Pfizer and J&J/Centocor, joining existing regional players like Bunge and Sigma-Aldrich

Saskatoon

- This is a small sized prairie city with solid university programs, including steadily accreted expertise in hybrid oilseed crops, and a niche in veterinary infectious disease
- With a major federal agriculture lab on campus since the 1940s, the agriculture school was primed to transition from traditional plant breeding to genetically modified techniques in the 1980s
- The university and province skillfully matched federal funds across multiple programs to add faculty and physical capacity, including shared wet-lab facilities and quasi-incubators
- This coincided with a provincial initiative to build the Innovation Place Research Park, which became a Canadian outpost for many major multinational agrichemical firms
- By default, Saskatoon became the designated center of agbiotech in the federal governments' developing biotechnology strategy, with a federally sponsored Plant Biotech Institute industry collaborative
- This culminated in reinvention of the veterinary institute as a vaccine center, and recruitment of major VC-backed startup from Illinois (Pyxis)
- Now, by attracting Canadian Light Source—largest big science project in some time in Canada—region is billing itself as a Science City of the Prairie and integrating its agbiotech with biomedicine

Detailed profiles of each of the benchmark regions are found at the end of this report.

Benchmarking the Greater Oklahoma City Region's Bioscience Base Against Peer and Competitor Regions

The bioscience sector is a rapidly growing global industry. Countries around the world are seeking to attract and grow bioscience companies because they bring with them highly paid, highly skilled jobs and the potential to develop products that will dramatically improve human health and well-being. Recognizing the potential of this industry and its present geographic concentration in particular regions of the United States, states and regions are developing initiatives designed to foster an environment in which bioscience companies can succeed and grow. It is important that the Greater Oklahoma City region consider how other regions are positioning themselves to become leading bioscience centers in determining what activities should be undertaken to strengthen the region's position in the biosciences.

To assess the Greater Oklahoma City region's competitive position vis-à-vis other peer or competitor regions, Battelle benchmarked the region against Birmingham, AL; Dallas, TX; Kansas City, MO and KS; Louisville, KY; St. Louis, MO; and Saskatoon, Saskatchewan, Canada. Birmingham, Dallas, Louisville and St. Louis were chosen, in part, because they all have large downtown medical complexes similar to Oklahoma City's. Birmingham is a similar size to the region and has successfully grown its bioscience R&D base with support from its university and local government. Dallas was included because it is a nearby competitor. Kansas City and Louisville have both received strong state support and are regions that are at an earlier stage of development. St. Louis, in addition to having shown considerable success in implementing its plant and life science strategy during the last five years, has a focus on plant sciences as does Saskatoon, Saskatchewan, an area of importance in the region due to the presence of OSU and the Noble Foundation.

Overview of the Benchmark Regions

The approaches undertaken by each of these regions to grow their bioscience base have both similarities and differences. These approaches are described below.

Leadership and Strategy Ownership

Each of the benchmark regions features at least one entity that has taken leadership of the bioscience strategy. In most cases, this is a public/private partnership that enjoys some support both from city government and regional business leadership. Typically, state S&T agencies and bioscience trade associations take a secondary but supportive role. Table 1 lists these leadership entities.

Table 1: Entities Responsible for Strategy Development and Implementation in the Benchmarks[5]

Region	Primary strategy owner	Secondary leader
Birmingham	**Tech Birmingham,** a multi-sector technology council and the spin-off of the Birmingham Regional Chamber of Commerce	**UAB** and the **Biotech Association of Alabama**
Dallas	**BioDFW,** a cluster organization spun off by the Greater Dallas Chamber of Commerce and other business organizations	**UT Southwestern** and, if the Emerging Technology Fund passes, **State of Texas**
Kansas City	**KCALSI,** a collaborative of eight local research organizations, backed by the Civic Council of KC (a CEO leadership group)	State of Kansas through **KTEC** and the new **Bioscience Authority**
Louisville	The **Mayor** and **Enterprise Corp.,** a commercialization center that is a spin-off of Greater Louisville	State of Kentucky through **KSTC and ONE;** also **Louisville Health Enterprise Network** and **UL** itself
St. Louis	**Plant and Life Sciences Coalition**, an activity of the St. Louis Regional Commerce and Growth Association, backed by Civic Progress, the CEO leadership group	**MoBIO** (recently formed)
Saskatoon	**AgWest Bio,** a multi-cluster organization backed by the Provincial agriculture and revitalization agency	Multiple federal agencies, especially **Western Diversification**

Strategy Content and Focus

There is a range of strategy types in the benchmark set, from broadly targeted to very finely differentiated strategies focusing on particular research or clinical strengths. Several strategies include both agricultural (plant or animal) bioscience in addition to biomedicine, and at least two target convergence with IT sectors. Building an entrepreneurial culture and enhancing seed-stage financing are common themes as well. See Table 2.

[5] Details on the initiatives listed in this and the following tables can be found in the individual benchmarking profiles that appear later in this report.

Table 2: Strategy Content and Focus of the Benchmarks

Region	Sub-sectors targeted	Other priorities
Birmingham	Drug development; drug delivery; biodefense; genomics/proteomics; and devices	Tech transfer infrastructure at UAB; downtown research park; new seed funds; inter-regional ties
Dallas	State level: nanotechnology, vaccines; molecular sciences; biomedical engineering; animal and plant modeling; convergence with wireless/IT	Create downtown research park; prepare other "bio-ready" building sites; focus on VC and entrepreneurship
Kansas City	Personalized medicine; animal health; drug discovery; oncology; cardiovascular; neuroscience; medical transaction IT	State level: recruitment; matching federal awards; new facilities bonding; vouchers; TIF districts
Louisville	Little specification, but by inference from past investments, cardiovascular disease and cancer	State level: tech commercialization; early stage finance; incubators
St. Louis	Plant and life sciences broadly	Entrepreneurial culture; early-stage finance; incubators
Saskatoon	Agbiotech; nutraceuticals; bio-fibers and fuels; vaccines; structural biomedicine	Creating the "science city of the prairie" brand

BUILDING INSTITUTIONAL COLLABORATION

Building collaboration across the various universities, nonprofit research institutions, and academic medical centers and hospitals remains a challenge for most regions, but is the core of the strategy in Kansas City, where critical mass can only be attained by aggregating the work of as many as eight separate institutions. Both Kansas City and Birmingham feature independent research institutes that have been reasonably good research partners to the major universities, and possibly more entrepreneurial because of their heritage in industrial research. Regions with a single, dominant bioscience player such as Dallas have less incentive to worry about collaboration. In both Kansas City and St. Louis there are explicit attempts to link institutions with strength in biomedicine to those whose forte is agricultural research. Table 3 shows the type of institutional collaboration underway within the benchmarks.

Table 3: Institutional Collaboration within the Benchmarks

Region	Within the University	With other entities	Across regions/universities
Birmingham	N/A—one comprehensive campus	SRI is now a UAB affiliate with interlocking boards	None with other UA institutions or Auburn
Dallas	Minimal collaboration with other UT units or the other 2 HSCs	N/A	Rotates breakfast series with UNT HSC in Fort Worth; no inter-regional collaboration
Kansas City	KUMC and UK Lawrence are both founding members of KCALSI	MRI has strong record of forming R&D alliances with other KCALSI members	KCALSI now trying to integrate KSU Manhattan and UM Columbia (especially plant/animal science)
Louisville	N/A—one comprehensive campus	State supported cardiovascular institute joint with Jewish Hospital	Minimal with UK Lexington except in natural products consortium
St. Louis	Both Hilltop and Med Center Wash U campuses are well integrated into BioMed21 capacity initiative	CORTEX research park will bind Wash U, SLU, UMSL, and Botanic Garden; Monsanto has its own incubator (not downtown)	Independent Danforth Plant Science Center involves Wash U, UM Columbia, UIUC and Purdue
Saskatoon	Saskatoon and Regina campuses linked through Innovation Place Research Park	Strong connections to federal institutes: Plant Biotechnology Institute and Ag Canada Research Centre	Money for Pyxis recruitment came through Alberta-based satellite of National Genome Initiative and involves UBC

ASSESSING THE REGION'S COMPETITIVE POSITION

To create an environment in which bioscience firms can grow and flourish, states and regions are undertaking initiatives that seek to address the specific needs of bioscience companies. These include:

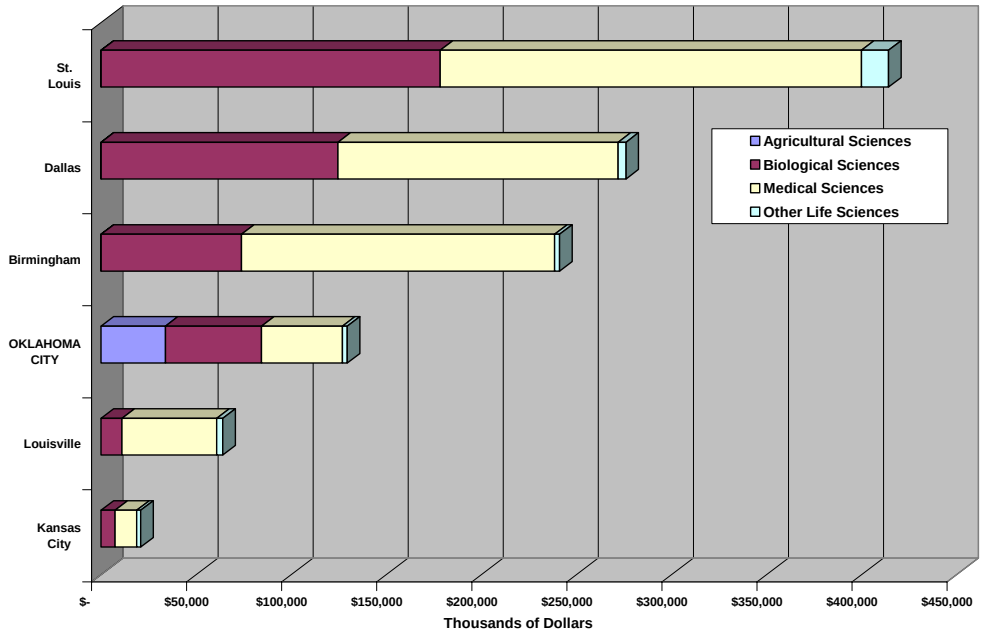
- Strong academic research institutions conducting basic research in the biosciences;
- Mechanisms for successful transfer of basic research for product commercialization;
- Access to early-stage risk capital;
- A supply of highly skilled workers with training in the biosciences;
- Specialized facilities, including wet-laboratory space and specialized equipment; and
- Stable and supportive tax and regulatory policies.

Battelle's analysis compares the Greater Oklahoma City region's current infrastructure in each of these areas to those of the benchmark regions and then describes the initiatives undertaken in the benchmark states to build or improve their infrastructure in each area.

Bioscience R&D Base[6]

The region's bioscience R&D base is significantly smaller than St. Louis, Dallas and Birmingham but larger than Louisville and Kansas City.[7] Total academic life science R&D[8] was $129 million in 2002. See Figure 1.

Figure 1: Academic Life Science R&D by Discipline and metro Area, FY 2002



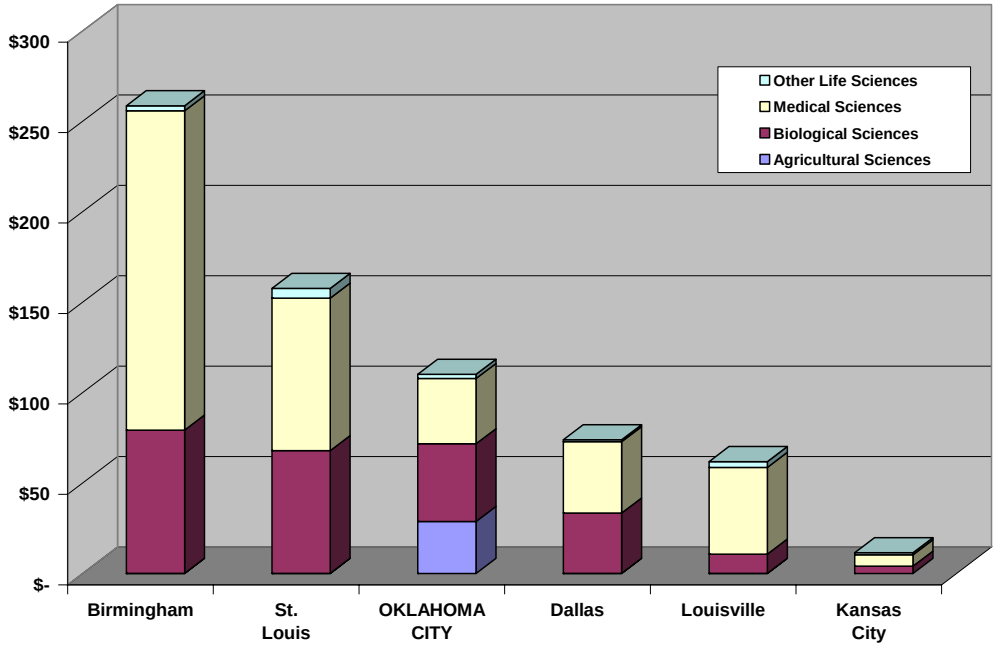
On a per capita basis, the region's life science R&D base ranks third among the benchmark regions lagging only Birmingham and St. Louis. See Figure 2.

[6] Saskatoon is not included in the analysis of each region's bioscience R&D base because comparable data are not available.

[7] The data for the Oklahoma City metro area was adjusted to include OSU, which is included in the Greater Oklahoma City region as defined by the project steering committee.

[8] Academic life science R&D includes agricultural, biological, medical and other life science R&D flowing to the region's universities. These data are reported by the National Science Foundation (NSF). The data, therefore, do not include OMRF or Noble Foundation.

Figure 2: Academic R&D Per Capita by Life Science Discipline



The Greater Oklahoma City region is the only region among the benchmarks with a significant R&D base in agricultural sciences. This is due, however, to the inclusion of OSU in the data. No land grant universities are found within the other metro areas. In the Greater Oklahoma City region, as in Dallas and St. Louis, life science R&D is focused on both biological sciences and medical sciences whereas in Birmingham and Louisville medical sciences accounts for 68.3 percent and 77.5 percent of total life science R&D. See Table 4.

Table 4: Academic Life Science R&D by Discipline as a Percent of Total

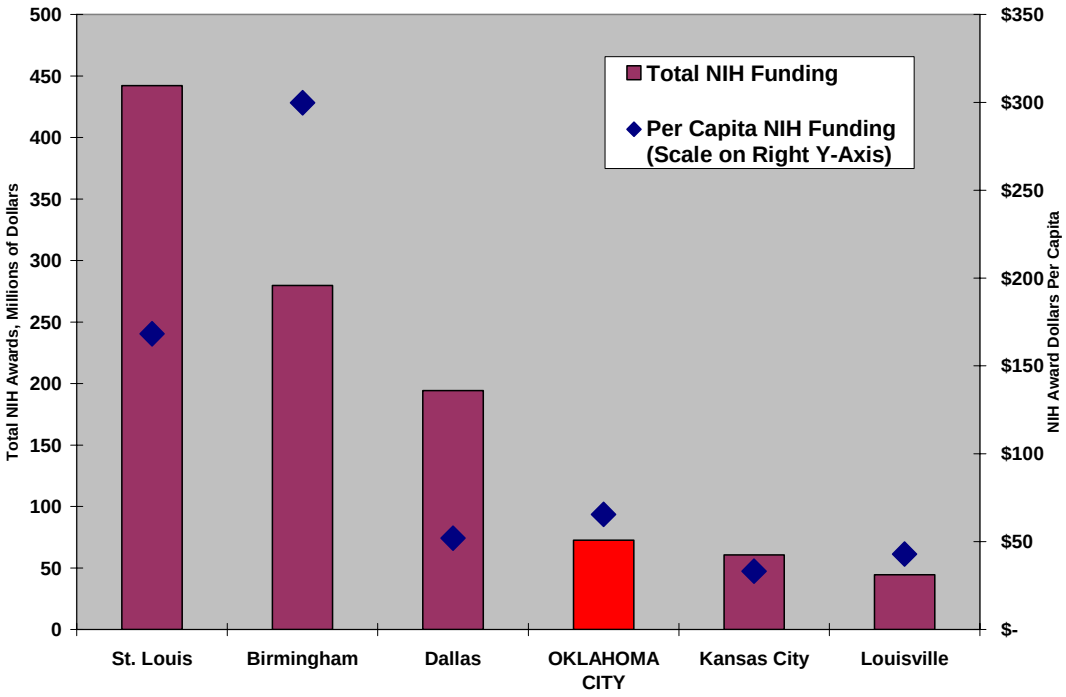
	Birmingham	Dallas	Kansas City	Louisville	Greater OKC*	St. Louis
Agricultural Sciences	0.0%	0.0%	0.0%	0.0%	**5.3%**	0.0%
Biological Sciences	30.6%	45.1%	35.3%	17.3%	**41.2%**	43.0%
Medical Sciences	68.3%	53.4%	54.6%	77.5%	**50.5%**	53.5%
Other Life Sciences	1.1%	1.5%	10.1%	5.2%	**3.0%**	3.4%
Total	100.0%	100.0%	100.0%	100.0%	**100.0%**	100.0%

*Includes Stillwater and Norman.
Source: National Science Foundation, FY 2002.

The Greater Oklahoma City region received $72.6 million in NIH awards, considered the "gold standard" of bioscience funding, in 2003. This reflects a near doubling of NIH awards since 1999 when the region received $37.9 million. Only Louisville experienced a larger percentage increase in NIH awards during this time period and this was due in part to the fact that Louisville started from such a small base. Despite this large increase in NIH awards, the Greater Oklahoma City

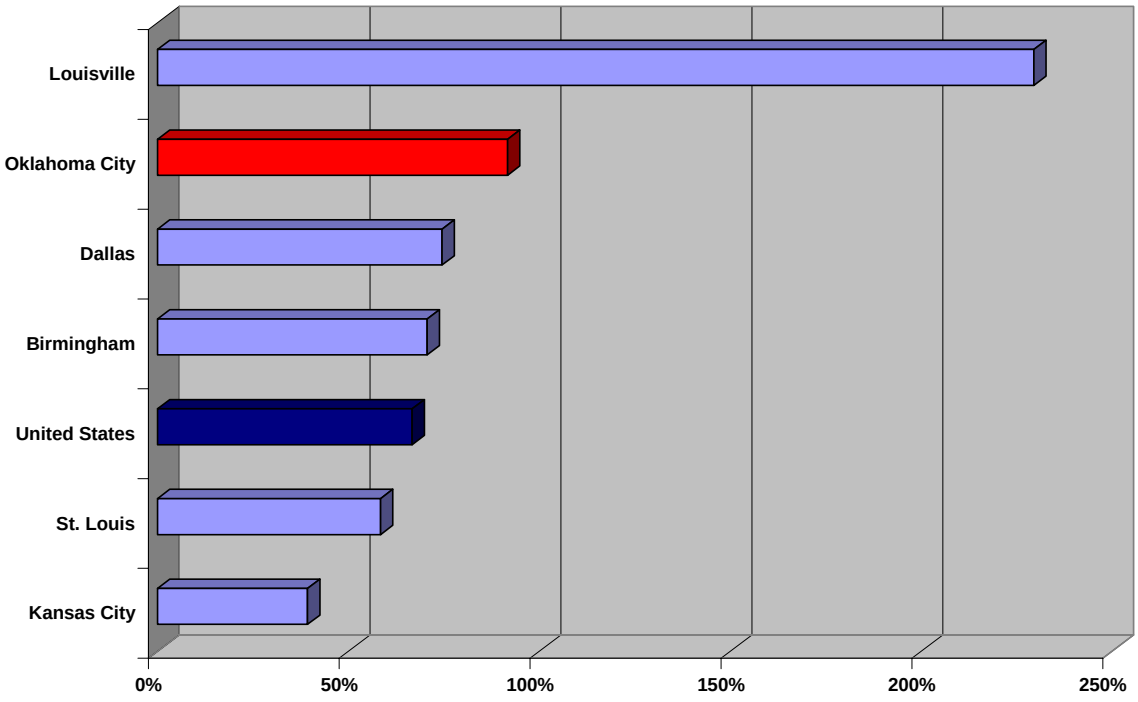
region significantly lags St. Louis, Birmingham and Dallas, which received $442 million, $280 million, and $194 million, respectively in 2003. On a per capita basis, the Greater Oklahoma City region at $65.51 moves ahead of Dallas but still lags Birmingham and St. Louis. See Figures 3 and 4, and Table 5.

Figure 3: Total and Per Capita NIH funding in, FY 2003



Source: National Institutes of Health, FY 2003, Census, Battelle calculations

Figure 4: Percentage Change in NIH Awards, FY 1999–FY 2003



Source: National Institutes of Health, FY 2003, Battelle Calculations

Table 5: NIH Awards, FY 1999 and FY 2003 by Metro Area

Region	FY 1999 (millions)	FY 2003 (millions)	% Change FY 1999–2003	Per Capita FY 2003
Birmingham	$163.9	$279.7	71%	$299.82
Dallas	$111.3	$194.2	75%	$51.97
Kansas City	$43.6	$60.7	39%	$33.23
Louisville	$13.5	$44.5	229%	$42.88
Greater OKC	$37.9	$72.6	92%	$61.61
St. Louis	$279.1	$442.1	58%	$168.23
United States	$12,192.3	$20,321.1	67%	$69.88

Building the Region's Bioscience R&D Base

Approaches to capacity building in the benchmarks depend heavily on university capital campaigns with participation from regional corporate and philanthropic leadership; although some major state-level initiatives are emerging.

The Kansas City Area Life Sciences Initiative is an instructive example. Created to boost annual life science funding to $500 million within the decade, it was conceived initially as an unrestricted kitty to which regional corporations would contribute. Instead it has migrated to project-based fund raising and has successfully grown the base from $86 million to $219 million. Its success was part of the impetus for passage of the Kansas Economic Growth Act, which contemplates dedicating $500 million in incremental tax revenue from the bioscience sector over the next decade to a new Authority with ability to invest directly in bioscience lab space and faculty recruitment.

In Louisville, it was the state that drove the process by creating the "Bucks for Brains" Challenge Grant that invested $100 million (matched 1:1) in the endowments that the University of Louisville (UL) used for recruitment of 55 new endowed chairs in a range of disciplines, but favoring the biosciences. The state's Office of the New Economy also invested directly in new research buildings, and a new "Kentucky Science and Engineering Foundation" (KSEF) was created to provide small grants for exploratory research in areas likely to attract federal or industrial support.

In Oklahoma, OCAST provides funding through the Oklahoma Health Research Program to prepare researchers to compete for federal funding. OHRP grants range from $10,000 to $45,000 for one to three years. An Endowed Chairs program is available through the State Regents and legislation was passed in the 2005 session to authorize a $500 million bond issue that would fund capital projects at the state's universities. Table 6 lists the initiatives underway in the benchmarks to build R&D capacity in the biosciences.

Table 6: R&D Capacity Building Initiatives in the Benchmarks

Region	Facilities	Faculty/projects
Birmingham	$350m UAB Capital Campaign; Federal earmarks for new biomedical research buildings	UAB capital campaign supported a bioscience share of 56 endowed chairs raised
Dallas	Sporadic legislative line items; revenue-bonding authority; gifts from Perot and other local philanthropists	Texas Excellence Fund through UT regents and privately raised $60 million endowed scholars program
Kansas City	Revenue bonding for both KUMC and Stowers; state funds for UMKC	
Louisville	State (ONE) grants for research towers, cardiovascular institute, and incubators in the research park	Bucks for Brains program levered by private fund raising for UL; also KSEF grants for exploration.
Greater OKC	$500 million bond issue under consideration in legislature, OMRF and Eye Institute capital campaigns, proposed $1 billion Research Endowment	Funding provided by legislature in 2004 for Regent's Endowed Chairs $500 million Bond approved for Higher Education Capital Investments
St. Louis	Danforth Foundation, Monsanto and state tax credits built the Plant Science Center	Endowments from Danforth and McDonnell families major driver of Wash U BioMed21 capital campaign; Coming state support through tobacco settlement
Saskatoon	Federal programs	Federal programs

Technology Transfer and Commercialization

In addition to having a strong bioscience research base, regions with strong bioscience sectors have established mechanisms that promote the transfer of knowledge from universities and laboratories to industry. Much of Silicon Valley's success, for example, is attributable not only to the world-class research conducted at Stanford University, but also to Stanford's policy of encouraging its faculty and students to commercialize research that they developed. Measuring a region's capacity to realize commercialization benefits from research findings is difficult, if not impossible. However, a number of data points can be used as indicators of the vitality of a state's technology transfer activity. These include

- Inventions disclosed;
- Patent applications filed;
- Patents issued;
- Licenses executed; and
- Start-up companies formed.

OMRF and OU perform well in terms of number of start-up companies generated per license executed ranking in the top quartile of research institutions and universities, respectively. OMRF also ranks in the top quartile in terms of start-ups per $10 million of R&D. OSU ranks at the median for start-ups per license executed but below the median in start-ups per $10 million of R&D. OMRF performs very well in terms of patents issued per $10 million of R&D; its rate of 3.16 greatly exceed the top quartile of hospital and research institutes which on average generate 1.85 patents per $10 million of R&D. All three institutions, however, have lower disclosures per R&D dollar. OMRF generates one invention disclosure for every $3 million in R&D, compared to one disclosure for every $1.8 million for the top quartile of hospitals and research institutions. OSU generated one disclosure for every $2.9 million of R&D and OU generates one disclosure per $2.4 million of R&D. The key to increasing technology transfer and commercialization from the Greater Oklahoma City region's research institutions lies in 1) increasing the size of their R&D budgets and 2) increasing the number of disclosures.

Table 7: Oklahoma Research Institutions Technology Transfer Activities: FY 2000–FY2002

Tech Transfer Indicators FY 2000–FY 2002	OMRF	Top Quartile of Hospital/Research Institutions	Median for Hospital/Research Institutions
Total R&D (millions $)	91.7	364.3	303.3
Disclosures	30	198	59
Licenses Executed	14	59	34
Patents Issued	29	53	28
Start-ups	4	5	2
Licenses per $10 M R&D	1.53	2.31	1.35
Start-ups per $10 M R&D	.44	.14	.03
Gross License Income (millions of $)	3.141	18.627	4.770
Start-ups per license executed	.29	.09	.04

Tech Transfer Indicators FY 2000–FY 2002	OSU	OU	Top Quartile of Universities	Median for U.S. Universities
Total R&D (millions$)	282.2	351.3	751.3	430.7
Disclosures	97	130	322	138
Licenses Executed	13	18	82	32
Patents Issued	11	44	86	38
Start-ups	2	6	11	4
Licenses per $10 M R&D	.46	.51	1.57	1.01
Start-ups per $10 M R&D	.07	.17	.21	.12
Gross License Income (millions of $)	.931	7.754	16.581	4.038
Start-ups per license executed	.15	.33	.23	.12

Source: Association of University Technology Managers, Annual Survey, 2003.

Promoting Collaboration with Industry

One approach to encouraging the commercialization of technology developed in a region's research institutions is to encourage and facilitate partnerships and collaboration of academic

researchers and firms. The most common, and thought by many in the field to be the most effective, means of fostering greater university and industry interaction is to provide matching grants for research partnerships. Among the benchmarks, Kansas City and Louisville have access to state-supported university-industry matching grant programs. Saskatoon also provides support for academic-industrial collaboration.

The Kansas and Kentucky programs are of modest size and generally comparable to those available currently through OCAST. In Saskatoon, the matching grant has been elevated to the level of a locational incentive. The Genome Canada program offered such significant cost sharing for a university research project that it affected the decision of Pyxis Genomics to relocate from Illinois to Saskatoon, where it will collaborate with the University of Saskatchewan as well as partners in British Columbia.

Table 8: Industry-University Matching Grants Programs in the Benchmarks

Region	Program levered by the region	Scale and scope
Birmingham	None—Alabama Research Alliance is inactive	
Dallas	None—Texas Advanced Technology Program cancelled	
Kansas City	KTEC Applied Research Matching Fund in Kansas, nothing in Missouri	Grants up to $125,000 matched 1.5:1 and repayable from royalties
Louisville	KSTC Innovation Group programs: Commercialization fund and R&D voucher fund.	Up to $225,000 over 3 years, repayable; up to $200,000 over 2 years. Total available less than $2 million
Greater OKC	OCAST's Oklahoma Applied Research Support (OARS) Program	OARS provides proof of concept funding of $45,000 a year for 2 years and up to $300,000 for applied research projects ; requires 1:1 match
St. Louis	None	
Saskatoon	Multiple federal programs	Genome Prairie by far the largest—$13m match to Pyxis project. Others in mid-five figures

Programs to Promote Technology Commercialization

Once research yields a new discovery, a great deal of work remains to be done before the technology can be incorporated into a new product or process and introduced into the marketplace. States, regions and universities are increasingly focusing their efforts on creating mechanisms to assist faculty, entrepreneurs, and companies through the commercialization process. Among the benchmarks, St. Louis has been the most aggressive in launching efforts to promote commercialization of the region's IP. In St. Louis, Washington University (Wash U), St. Louis University (SLU) and the region's two wet lab incubators, the Center for Emerging Technologies (CET) and NIDUS came together to form the Biogenerator, a new not-for-profit entity that provides proof of concept funding and expertise to identify and commercialize

promising technologies. The Biogenerator is designed to bridge the gap between research universities and venture capital funds, thereby assuring the transfer of new technologies to the marketplace. In addition, both Wash U and SLU created internal commercialization funds to provide support to faculty for pre-commercialization work. Kansas City and Louisville also have funding available for proof of concept, pre-commercialization activities.

In Oklahoma, OCAST's Oklahoma Applied Research Support (OARS) program has been used to provide support for commercialization activities and i2E provides services similar to St. Louis' Biogenerator. OMRF can use internal funds to support commercialization activities. No funds have been created within the universities to provide support for proof of concept activities. Table 9 lists the commercialization and tech transfer initiatives found in the benchmark regions.

Table 9: Tech Transfer and Commercialization Initiatives

Region	Internal university tools/programs	Other
Birmingham	None—former Emerging Technology Partners company formation fund inactive	
Dallas	Targeted venture-development staffing of 3 in UT Southwestern licensing office	Lost tech transfer set-aside from the former state Advanced Technology Program
Kansas City	KUMC tech transfer office is embedded in a nonprofit KUMC Research Institute, which is recognized as a KTEC "incubator"/seed fund	
Louisville	KSTC Voucher Fund can be used for commercialization research	
Greater OKC	Newly formed Innovation Network Group comprised of tech transfer directors; OMRF and OUHSC can provide commercialization funding	OCAST OARS program can be used for commercialization research; i2E provides commercialization support
St. Louis	Wash U internal Bear Cub Fund for commercialization research (5 grants a year up to $50,000 each); similar program at Saint Louis University (grants of $15,000–$20,000)	Standalone nonprofit BioGenerator serves all regional institutions – in first year reviewed 47 technologies, did due diligence on 30, invested in 5
Saskatoon	U of S recently took in-house a formerly stand-alone patent/licensing agent	

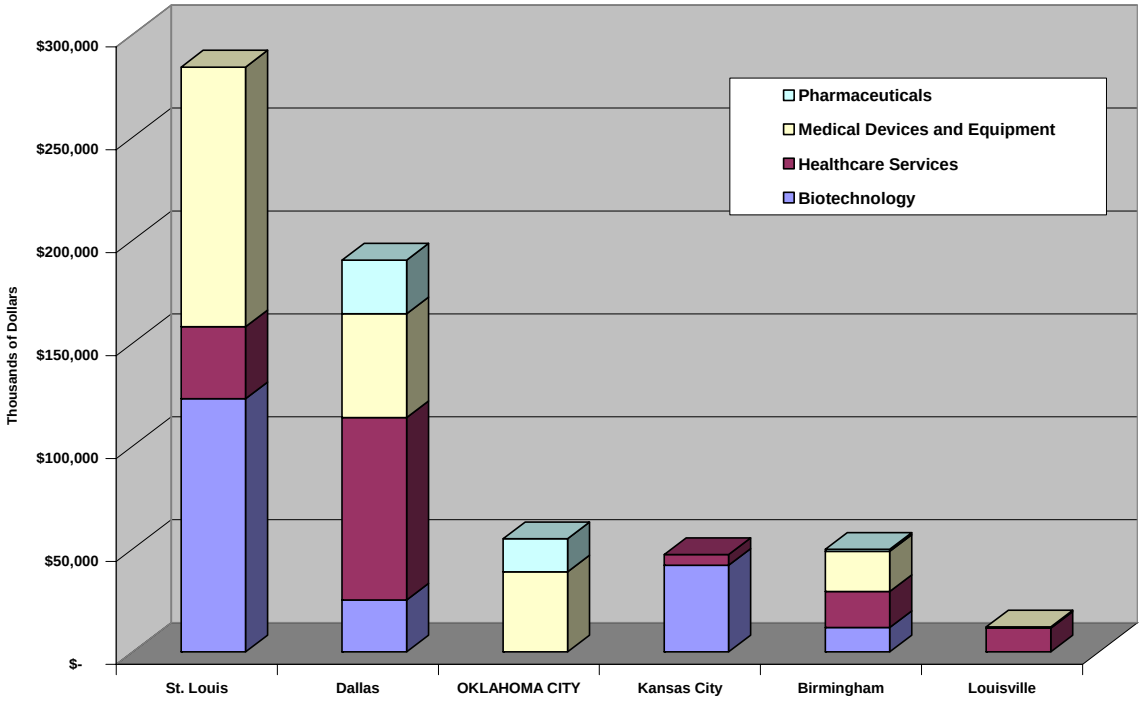
Risk Capital

Between 1999 and 2004, venture capital funds invested $54.9 million in bioscience firms in the Oklahoma City metro region.[9] This level of investment is similar to that of Kansas City and Birmingham which each received approximately $50 million in bioscience venture capital investment during this time period. Significantly more dollars were invested in St. Louis and Dallas. See Figure 5. Of the $54.9 million invested, $38.9 million was invested in medical

[9] These data include only the Oklahoma City MSA as defined by the U.S. Bureau of the Census. The Oklahoma City metro area includes Norman but does not include Stillwater or Ardmore.

devices and equipment companies and $16.0 million in pharmaceuticals companies. No investments were made in biotechnology or healthcare services firms in the region during this time period.

Figure 5: Biotechnology Venture Capital by Metro Areas, FY 1999–2004



Source: PwC Moneytree data, Battelle calculations

A comparison of biotechnology venture capital investment between the Tech Boom years of 1996–2000 and the Tech Bust years of 2001–2004 shows that while most of the benchmarks experienced a significant decline in biotechnology venture capital investment, Oklahoma City and St. Louis experienced a significant increase. Biotechnology venture capital investments increased nearly nine-fold in the Oklahoma City metro area between these two time periods. See Table 10.

Table 10: Amount of Biotechnology Venture Capital Investments by Stage of Financing

Metro Area	Tech Boom Years (1996-2000)					
	Seed/Start-Up Stage	Early Stage	Expansion Stage	Later Stage	Not Categorized	Boom Total
Birmingham	$27,300,000	$17,300,000	$13,150,000			$59,198,000
Dallas	$62,619,000	$45,218,955	$23,899,000		$3,335,000	$138,721,955
Kansas City			$14,575,000	$12,000,000	$3,500,000	$54,962,000
Louisville	$6,250,000	$4,500,000	$5,406,000		$5,000,000	$23,883,000
Oklahoma City	$6,500,000					$6,500,000
St. Louis	$31,908,000	$31,850,000		$25,500,000		$90,258,000
	Tech Bust Years (1996-2000)					
	Seed/Start-Up Stage	Early Stage	Expansion Stage	Later Stage	Not Categorized	Bust Total
Birmingham		$1,800,000	$20,286,000	$7,750,000		$29,836,000
Dallas	$3,000,000	$32,450,000	$50,438,000	$25,000,000	1,200,000	$110,888,000
Kansas City			$17,000,200	$5,000,000		$22,000,000
Louisville				$535,000		$535,000
Oklahoma City		$16,000,000	$33,800,000	$5,100,000		$54,900,000
St. Louis	$19,479,000	$25,100,000		$132,620,000	$850,000	$236,624,000

Source: PwC Moneytree and Battelle calculations.

Additional important sources of seed capital are the federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. These programs provide more than $2 billion annually, making them the largest source of early-stage financing for start-up companies. Data are not available on a metro basis to compare the performance of the Greater Oklahoma City region with that of the benchmark regions but the state of Oklahoma received 19 SBIR awards in 2004, seven of which were from NIH and three from NSF. In addition, Oklahoma received six Phase II awards, two of which were from NIH and one of which was from NSF. OCAST provides small grants to researchers that can be used to prepare SBIR proposals and provides bridge funding between Phase I and II. The Meridian Technology Center for Business Development in Stillwater also offers an SBIR Assistance Program.

Providing Pre-Seed/Seed Stage Finance

The line between commercialization research and pre-seed funding can be vague, especially in programs such as the BioGenerator which seem to do both at once. However, each benchmark region is struggling with the need to increase seed-stage capital. There are few government-driven initiatives. In most regions, the private sector (both for-profit and non-profit) has patched together at least small programs intended to develop ventures to the point where they are of interest to the formal venture-capital community.

Table 11: Pre-seed and Seed Capital Programs in the Benchmark Regions

Region	Program	Scale/scope
Birmingham	None—Paradigm Venture Partners inactive	
Dallas	STARTEch Early Ventures, a fund assembled by a for-profit accelerator; state funds for this purpose never went active	Total of $36 million under management; separate med-tech pre-seed fund targeting $10 million
Kansas City	KTEC Seed Fund; "Precede" Fund at KUMC; and captive funds at Stowers and MRI; KCALSI fund yet to be launched	KTEC up to $250,000; Precede same level; Stowers fund capitalized at $60 million but will invest outside KC if that is necessary
Louisville	U of L captive Minerva Ventures; Enterprise Corp. Vogt Invention Fund; R&D voucher used also	Vogt funded by earnings on $5 million endowment, makes awards up to $250,000
Greater OKC	i2E administers OCAST's Technology Business Finance (TBF) Program which provides pre-seed funding. Proposal pending for creation of $10 million seed fund ($5 million public to be matched by $5 million private)	TBF can provide up to $150,000; approx. $1.4 million currently available
St. Louis	BioGenerator	Funded by $6 million in commitments from leading companies, foundations; 5 investments/year up to $250,000
Saskatoon	Ag West, a nonprofit intermediary charged with developing several clusters including agbiotech can make investments in early stage companies	Investments in the range of $50,000–$300,000

Initiatives Designed to Attract Later Stage Venture Capital

Even St. Louis, the region that attracted the largest pool of early-stage capital ($400 million), still lacks the later stage funds that can hold companies in the region. In several of the benchmark regions, states have created CAPCO programs, but these seem unlikely to address this problem effectively because CAPCOs are usually risk-averse. In St. Louis, civic leaders pooled institutional investment (including labor-sponsored pension funds) in a privately managed "fund of funds" intended to attract new, later-stage funds to St. Louis or at least to create syndications that bring outside capital to St. Louis companies on terms that do not include relocation.

Several years ago, Oklahoma raised a Life Science Fund, which has been fully invested in five companies. Investors in the Fund included PHF, Noble Foundation, OMRF and private investors. Efforts to raise a second life science fund have not succeeded to date. The Oklahoma Capital Investment Board (OCIB) was created in 1991 to support the growth of the venture capital industry in the state. It is a fund of funds backed by contingent tax credits. OCIB has $100 million in authority and it has invested in 11 funds including Emergent Technologies' ET-OK fund,

which has invested in several OMRF spin-out companies. Table 12 lists the initiatives in the benchmarks that are seeking to attract later stage venture capital.

Table 12: Initiatives to Attract Later-Stage Venture Capital

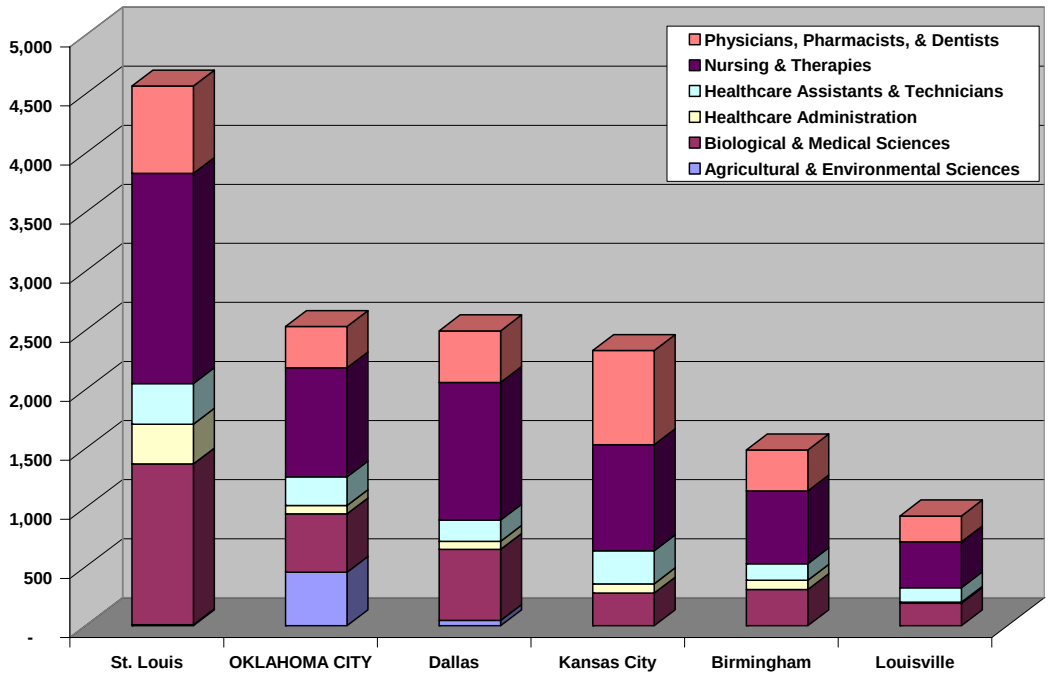
Region	Program	Scale/Scope	Other
Birmingham	State CAPCO program	$100 million in six funds each with local partners	Southeast VC Forum in association with Wayne Brown and other sectors
Dallas	UTIMCO[10] set-aside of its VC pool for investment in VC funds targeting UT spin-offs	$25 million invested by UTIMCO in a Houston based fund, out of a very large venture allocation	CAPCO program still under development
Kansas City	25% seed capital credit to be stepped up to 50% for angel investments	$20 million cap	
Louisville	Office of New Economy runs internal fund of funds (Commonwealth Investment)	$11 million invested in several funds, both large and small, all local	New Venture Club tied to Enterprise Corp. Affinity funds like Triathlon marketing in region
Greater OKC	Oklahoma Capital Investment Board (OCIB)	$100 million authority has invested approximately $50 million in 11 venture funds	Oklahoma Venture Forum
St. Louis	Tax credit stimulated investment by foundations, individuals and universities in Prolog	Region raised $400m in several early stage funds in five years	Vectis: a $60m privately managed fund of funds intended to build syndication with funds in other regions. Triathlon also active
Saskatoon	Western Life Sciences Venture Fund, privately managed but subsidized by provincial tax credit	$45m across several western provinces	Ontario-based Foragen targeting agbio and bioproducts

[10] Nonprofit created to manage the Permanent University Fund and other investment funds that support the public universities.

Workforce and Talent Pool

The Greater Oklahoma City region has a wealth of talent in the graduates of its universities. The region's educational institutions awarded approximately 2,500 bioscience degrees in 2002. This number was slightly down from the 2,660 degrees awarded in 1999. Among the benchmarks, only St. Louis with 4,500 bioscience degrees awarded in 2002 produced more bioscience graduates than the Greater Oklahoma City region. In terms of the type of bioscience degrees awarded, the region produced significantly more agricultural and environmental science degrees than any of the benchmarks. This is likely due to the inclusion of OSU in the region. See Figure 6.

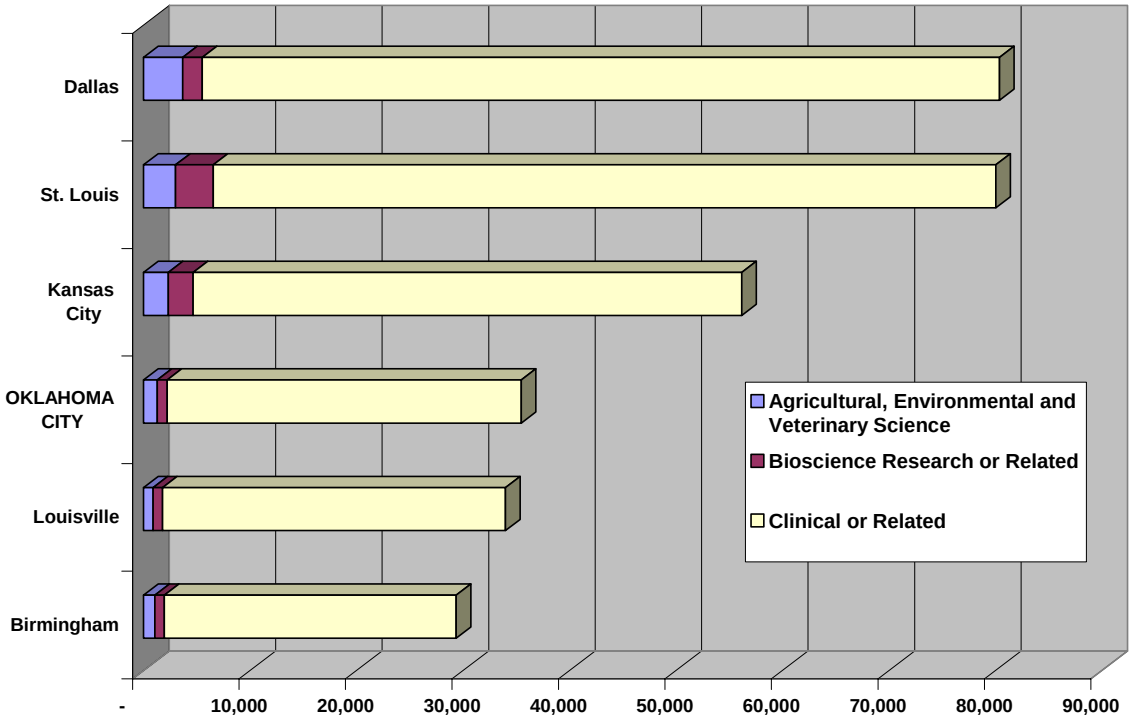
Figure 6: Bioscience Degrees Awarded, FY 2002



Source: National Center for Educational Statistics, IPED Survey and Battelle calculations, FY 1999–2002

More than 35,000 people were employed in biosciences occupations in the Greater Oklahoma City region in 2003, 94 percent of whom worked in clinical or related fields. Among the benchmarks, Dallas, St. Louis and Kansas City employ larger numbers of people in the biosciences. St. Louis and Kansas City also have a larger percentage of their employment in bioscience research or related occupations than does the Greater Oklahoma City region or the rest of the benchmarks. Only 2.5 percent of Oklahoma's employment is in the bioscience research category as compared to more than 4 percent in St. Louis and Kansas City. See Figure 7.

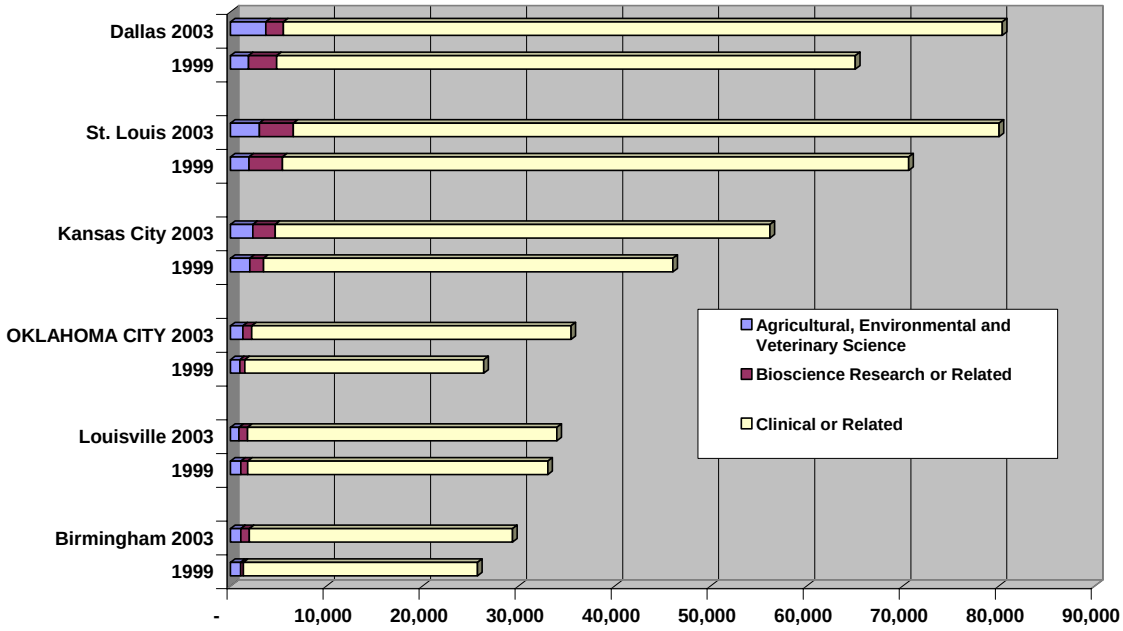
Figure 7: Occupational Employment in Bioscience Fields by Metro Area, FY 2003



Source: Occupational Employment Statistics, Bureau of Labor Statistics, 2003.

The Greater Oklahoma City region experienced the greatest growth in the number of people employed in the biosciences between FY 1999 and FY 2003, growing by 34 percent. See Figure 8.

Figure 8: Occupational Employment in Bioscience Fields, FY 1999 and FY 2003



Source: Occupational Employment Statistics, Bureau of Labor Statistics, Battelle Calculations

Approaches to Attracting and Developing Talent

The need that most of the benchmarks are trying to address is for entrepreneurial and management talent with experience in the biosciences. One of the ways in which the benchmarks are trying to meld business and scientific expertise and support the start-up of new bioscience ventures is by using university entrepreneurial centers to track interested students either to industrial practicums or to service with the university licensing office in planning for spin-offs. A few institutions have also formally developed specialized MBA tracks that address the bioscience sector, or "professional masters" degrees that start with a scientific knowledge base but add on business orientation.

OCAST provides support to allow faculty and students to obtain industrial R&D experience though the Oklahoma Applied Research Support R&D Faculty and Student Internship Program. Support of $10,000 to $30,000 is provided for one to two years. A one to one match is required. PHF also supports a number of programs designed to develop bioscience talent in the region. Its Oklahoma School of Science and Mathematics (OSSM) Investigative Research Scholars program allows high school students to work with top scientists in their research laboratories. Similar experiences for undergraduates are provided through the Summer Undergraduate Research Experience (SURE) program at OUHSC.

Table 13: Initiatives to Attract and Develop Talent

Region	Managerial/Professional	Other
Birmingham	MBA/PhD. and VC Life Sciences Entrepreneurship program at UAB	
Dallas	Various entrepreneurship centers	
Kansas City	KU/MRI masters in biotechnology	
Louisville	U of L Institute for Entrepreneurial Research assigns students to incubators	Health Enterprise network has $3m DOL grant for healthcare workforce initiatives
Greater OKC	OUHSC and OMRF offers an MD/PhD program	OK School of Science and Mathematics; OCAST's OARS R&D Faculty and Student Internships
St. Louis	Wash U's Olin School has Center for Entrepreneurial Studies that assigns students to internships; SLU has similar program	St. Louis Community College offers an associates in applied science/biotech
Saskatoon	Biotechnology MBA and Center for Agricultural Entrepreneurship	"Virtual College" of biotech; various federal biotech job portals

Space and Facilities

Ensuring that the private marketplace offers the right amount and type of space suitable for the development and growth of bioscience firms has been a major challenge for emerging bioscience regions. This is an area in which the Greater Oklahoma City region holds an advantage in that it has the Presbyterian Health Foundation (PHF) Research Park which is within the region's medical district. The park offers both multi-tenant and incubator space for start-up and emerging companies. Space and facilities are also available at the Oklahoma Technology and Research Park in Stillwater, which includes incubator space in the Meridian Technology Center;the Research Campus in Norman; and at the Noble Foundation.

All the benchmark regions except Kansas City have existing or rapidly advancing plans for research parks, and of these all but Birmingham are downtown, integrated into a university or medical district. Birmingham, Louisville, and St. Louis all have significant-sized wet-lab incubators as part of their research parks (and St. Louis has an additional one at the suburban campus shared by Monsanto and the Danforth Plant Sciences Center). All three of these function not just as cheap spaces but as key business advisors, supplementing the work of standalone commercialization centers. In Oklahoma, iE2 operates as an incubator without walls offering similar services to start-up companies. Table 14 lists the various initiatives underway in the benchmarks to address bioscience companies' needs for space and facilities.

Table 14: Space and Facilities Initiatives

Region	Research Park	Incubator
Birmingham	100 acre UAB Research Park—not downtown but additional downtown district under consideration	67,000 sq. ft. wet lab (OADI)
Dallas	13 acre Biotechnology Corridor in the medical district on land acquired by UT Southwestern from City	Will include substantial wet-lab incubator. Three other wet and dry lab incubators in operation, focusing mainly on med-tech devices
Kansas City	None—plans considered on both Missouri (Hospital Hill) and Kansas (KUMC) sides of the border	6,000 sq. ft. Business Development Center at KUMC
Louisville	25 acre in-fill in Louisville Medical Center district, developed by nonprofit collaborative, 230,000 sq. ft. developed to date	Building 3 is a 48 sq. ft. incubator shared by IT and bio; MetaCyte bio incubator also functions "without walls" as an accelerator
Greater OKC	27 acre PHF Park, five buildings with a 6th under construction, 500,000 sq. ft. of lab and office space, room for 4 more buildings; Oklahoma Technology and Research Park in Stillwater; OU Research Campus includes 2 multi-tenant facilities; Noble Foundation has invested in new facilities and has plans for an agricultural/plant sciences field trials type research park	Meridian Technology Center for Business Development in Stillwater; Incubator space offered in PHF Park with services provided by i2E; eTec, business incubator, managed by the Norman Economic Development Coalition
St. Louis	1,000 acre CORTEX park envisioned, but only one multi-tenant structure under development to date, with consortial and tax credit funding	92,000 sq. ft. (2 buildings) CET downtown 40,000 sq. ft. Nidus Center at Monsanto 2 EDA grants for multi-tenant buildings at both sites
Saskatoon	60 acre Innovation Place adjacent to campus, including multi-tenant wet lab space	No park incubator, but PBI on campus has 74,000 sq. ft. "partnership" wing for participants in federal programs

Business Climate

Bioscience companies need a regulatory climate and environment that encourage and support the growth and development of their industry. Tax policies that recognize the long development cycle required to bring new bioscience discoveries to the market can provide additional capital for emerging companies as well as ensure an even playing field in state and local tax policies between older, traditional industries and emerging industries such as biosciences.

Texas trumps all the benchmark regions in the amount of discretionary funding available to close relocation deals, and Canada has made good use of generous R&D tax credits at both the federal

and provincial level. Aside from that, the benchmark set does not particularly excel at business climate initiatives. See Table 15. Several changes in tax incentives aimed at assisting technology companies were enacted by the Oklahoma legislature in 2005. SB 628 reinstituted the state's R&D tax credit that had sunset in 2004. SB 407 amended the Small Employer Quality Jobs Act to add more time for technology companies to create the number of jobs to qualify for the incentive. It also increases the time allowed to achieve 75 percent out-of-state sales and defines knowledge economy industries that qualify for this incentive.

Table 15: Business Climate Initiatives in the Benchmarks

Region	Initiatives
Birmingham	Pending suggestions for tax credits have not advanced at the state level
Dallas	Discussion of pre-permitting bioscience buildings; Relocation grants available through state level Texas Enterprise Fund
Kansas City	Existing $20 million, 25% seed capital tax credit to be stepped up to 50% targeted at angel investors
Louisville	State credit of 5% on facilities for R&D. Tax credits for investors in early-stage funds certified by KEDFA (but none granted so far)
Greater OKC	Proposed changes to the Small Employer Quality Jobs Act and proposed R&D tax credit
St. Louis	State programming relies heavily on ad hoc tax credits, but none currently for R&D
Saskatoon	Federal and provincial R&D credits extremely generous especially at lower tiers and additional personal credits for investment in labor-sponsored VC pools

SUMMARY AND CONCLUSIONS

The Greater Oklahoma City region compares favorably to the benchmarks in terms of the infrastructure that is available to support the start-up and growth of bioscience companies. The programs operated by OCAST and i2E are similar to the best practice examples from the benchmarks. One area in which the region has a competitive advantage is space and facilities. The region has a well developed research park located in close proximity to its medical center, another research park under development in Stillwater, a research campus in Norman, and plans for an a field trials type research park at Noble Foundation. Incubator facilities are available at PHF, in the Meridian Technology Center and at the emerging Technology entrepreneurial center (eTec) in Norman. Research parks in most of the benchmarks are only in the early stages of development and are being developed on an in-fill basis.

Encouraging and facilitating the commercialization of university developed technologies is a challenge for the benchmark regions as it is for the Greater Oklahoma City region. The benchmarks also continue to struggle to build local venture capital markets and to ensure an availability of pre-seed and seed capital. The one area in which the region lags several of the benchmarks is in the size of the bioscience R&D base. The Greater Oklahoma City region's R&D base is significantly smaller than St. Louis, Dallas, and Birmingham. The good news is that the region's NIH funding almost doubled between 1999 and 2003. Table 16 summarizes the findings

from the benchmarks and assesses the region's competitive position. Detailed individual profiles of each of the benchmark regions follow.

Table 16: Summary of Benchmark Findings and Assessment of the Region's Situation

Key Issue Area	Benchmark findings	Situation in Greater OKC Region
Leadership	Bioscience cluster organizations are widely in place, serving to steer strategy and providing opportunity for networking	No single voice for the bioscience sector
Bioscience focus	Several regions are targeting bioscience at the technology platform or end-market level Several are also targeting ag/plant biotech	Core competency assessment will identify analogous areas for OKc regiony The region faces clear competition in ag/plant biosciences
R&D base	Of the benchmarks, only Texas and Kentucky have made significant investments in R&D capacity, but Kansas seems poised to follow	$500 million bonding for higher education
Tech transfer/ commercialization	Not an area of great success among the benchmarks, but several are moving aggressively including especially St. Louis	OKc region faces issues very similar to other regions Tech Transfer Alliance may help address
Pre-seed/seed and venture capital	With exception of Birmingham, all the regions have active pre-seed funds of some kind All still having trouble building local capacity for later-stage funding, despite range of tactics	Lack of seed fund Lack of local venture funds despite OCIB and tax credits provided to investors
Talent	University entrepreneurial centers are moving from research into practice—flowing students into business planning for research partners and university's own licensing projects	Opportunities exist to link OU and OSU MBA students to assist start-up companies
Space and facilities	Best in class research park is Innovation Place Wet lab incubator capacity led by St. Louis, with significant space in Birmingham and Saskatoon	OKC region has competitive advantage with PHF Research Park and its space for startup companies
Business environment	Seed capital credits have been poorly utilized Saskatoon integrates generous R&D credits with large matching funds	Oklahoma has one of the earliest "fund of funds" backed by contingent tax credits that is now being adopted in many other states

Individual Benchmark Profiles

Birmingham, Alabama

THE STORY

Birmingham—a former steelmaking town in the midst of a major economic transition—has emerged as a promising center of bioscience development largely as a consequence of the rapid institutional growth of the **University of Alabama at Birmingham** (UAB). In 1945, the University of Alabama Medical School was moved from the main campus at Tuscaloosa[11] to Birmingham, in order to take advantage of the hospital cluster[12] in this much larger population center. As UA agglomerated other "extension" activities in Birmingham, the campus took on the character of a separate university, and was so recognized in 1969. Though its president reports to the UA system board and chancellor,[13] UAB now has a full lineup of undergraduate, graduate and professional schools—14 in all, including business, engineering and other programs.

The story of the UAB research enterprise is one of a building program that was well synchronized with growth in federal R&D budgets. Several years ago, a UAB official was quoted as saying, "We built infrastructure, we built buildings, before we had anyone to fill them." Sponsored research funding has doubled every decade since 1969, hitting $200 million in 1995 and now hovering just shy of $500 million, including the affiliated **Southern Research Institute**. UAB has had some success at commercialization not because of any exceptionally effective strategies, but largely because it was in the business early, with support from city government that included deeding the first acreage for the research park in Oxmoor. In the mid-1980s, UAB created a Research Foundation as its patent and licensing agent and gave the Foundation responsibility for co-developing with the city a UAB Research Park and associated wet-lab incubator in the Oxmoor redevelopment zone in the Jones Valley.

Since then, the UAB **OADI** incubator has served about 80 companies in multiple technology sectors, with about 26 in residence at any one time. Of its 40 graduates, a considerable fraction have been bioscience companies, but only one (**BioCryst Pharmaceuticals**, formed in 1985 by "alumni" of UAB and SRI) has gone public to date. A second high-profile startup **TransMolecular**, a neuroscience firm formed in 1996, maintains lab facilities in the incubator but has placed its own headquarters elsewhere in the city. There are currently about 80 bioscience companies in the region, accounting for about 2,000 jobs. Although some startups have been lost to acquisition, there has also been some consolidation that benefited the region (**Axcan Scandipharm**).

In the last two years, UAB's ambitions collided with its resources, and no bioscience startups were generated. In addition, an innovative pre-seed fund was shuttered as the priorities of the region's corporate leadership shifted. The latest three bioscience startups have been created by SRI and an existing SBIR-oriented holding company. Still, the region succeeded at developing both a technology leadership council and a BIO affiliate biotechnology association, and the

[11] Its roots actually go back to the 19th century in Mobile; it was moved to Tuscaloosa in 1919.
[12] Currently comprising the UAB-owned hospital and clinic, and also a VA, an independent Children's Hospital, HealthSouth, and several smaller hospitals such as Cooper Green and St. Vincent's.
[13] Along with the main UA campus, University of Southern Alabama, and UA Huntsville.

venture community is surprisingly strong. The campus remains a cornerstone of civic leaders' downtown revitalization efforts,[14] but bioscience still takes a back seat to the state's interest in attracting automotive manufacturing plants and aerospace firms that can lever the NASA Marshall Space Flight Center in Huntsville.

STRATEGY ENVIRONMENT

The State of Alabama has no coordinated strategy for technology-based economic development, and what little funding it used to make available on an ad hoc basis has largely dried up. Until recently, the metropolitan region's technology-based development strategy was co-managed ad hoc by the **City of Birmingham**, the UAB and its **Research Foundation**,[15] and the **Metropolitan Development Board**,[16] a nonprofit business-attraction agency.

In 2001, spurred by the **Birmingham Regional Chamber of Commerce** and leading participant law firms, these actors collaborated on a multi-team **Birmingham Area Technology Task Force**. In 2002 the Task Force delivered a multi-sector strategy whose first priority was creation of **TechBirmingham**,[17] a regional technology leadership council. It was created successfully and is now supported by sponsors at the level of $300,000 a year.

In the biosciences, additional strategic leadership comes from the **Biotechnology Association of Alabama**[18] (BAA) which frames its own organizational strategic plan around about 10 goals including some that have been achieved (an Alabama venture-capital fair) and some that have not (re-creation of a pre-seed fund). However, the reach of BAA is statewide and also includes the Huntsville region, where another acquisition (Nektar) has just completed a 60,000 square foot bioprocessing facility that meets FDA GMP/GLP standards.

STRATEGY CONTENT

The TechBirmingham Strategic Plan[19] targets the following clusters within biotechnology (it also addresses information technology, healthcare, automotive and banking):

- Drug development and design;
- Drug delivery systems;
- Biodefense initiatives;
- Genomics and proteomics; and
- Medical devices.

Other recommendations included:

[14] See http://www.onb.org/.
[15] See http://www.uab.edu/uabrf/.
[16] See http://www.mdb.org/.
[17] See http://www.techbirmingham.org.
[18] See http://www.bioalabama.com.
[19] See http://www.techbirmingham.org/pdf/BATT%20Force%20Exec%20Summary.pdf.

- Further development of the technology transfer infrastructure at the UAB and other Alabama institutions;
- Development of an "entrepreneurial district"[20] (see below) on brownfield land at the northwest quadrant of the UAB campus;
- A cooperative investment fund to replace the defunct pre-seed vehicle and an early-stage investment fund;
- A Statewide Alabama Technology Development Council to unite the interests of each community in which UA has a branch, and also Auburn, the home of the land-grant university; and
- Branding Birmingham as a technology and bioscience center.

RESEARCH CAPACITY BUILDING

UAB's development of new research specialties has been mainly opportunistic rather than strategic, and was built on rapid expansion of facilities. Starting in 1999, UAB launched a capital campaign with an initial target of $250 million. It was later expanded to $350 million and currently stands at $388.7 million raised from diverse sources. According to a recent presentation by the campus president, the campaign financed the following elements:[21]

- $27.4 million for 126 new endowed scholarships and fellowships;
- $46.5 million for 56 endowed chairs and professorships;
- $41.8 million for construction and renovation; and
- $273 million for "program enhancement."

In recent years UAB has built two major new research facilities[22] as well as a completely new main hospital building:

- A 12-story, $90 million, 340,000 square foot [Sen.] Shelby Interdisciplinary Biomedical Research Building. The financing was split in roughly equal measure among state bond funding committed by the governor, line items arranged by the Congressional delegation, and funds from the UAB campaign.
- A $37.6 million, 155,000 square foot Human Genetics Building.
- A 9-story, $275 million, 885,000 square foot hospital center.

Some sense of UAB's priorities for research growth can be gained from its statement of which activities it plans to place in the new Biomedical Research Tower:

- Autoimmunity and immunobiology;
- A brain initiative;
- Biomedical engineering and bone matrix research; and

[20] See http://www.techbirmingham.org/pdf/TechBirmingham%20EntDistrict.pdf.
[21] See http://www.uab.edu/images/web/BOT2004/BOT2004.htm.
[22] See http://www.uab.edu/uasom/research/html/newrschfacilities.htm.

- Diabetes research (a major clinical specialty and of special interest to the city's African American population).

INSTITUTIONAL COLLABORATION

With minimal state programming to ensure connectivity, the communities hosting UA university campuses function as competitive "city states" with few if any ties among them. There is almost no cooperation at the strategic level with Huntsville, Tuscaloosa, Mobile, or the land grant college at Auburn.

The strongest regional collaboration UAB has is with the **Southern Research Institute**, a nonprofit created in 1941 to serve as the research arm of Alabama companies that were not large enough to afford their own internal R&D programs.[23] Starting by investigating new uses for the region's agricultural products, the Institute steadily added capability in drug screening, automotive and environmental technology, and most recently in homeland security technology.

The Institute's drug discovery unit has six anti-cancer compounds approved by the FDA, apparently a national record for any similar entity. The Institute's drug-delivery technology was recently spun off as **Brookwood Pharmaceuticals**, a well regarded startup that has settled in the Oxmoor zone in space vacated by **Southern BioSystems** when it was acquired and moved to the West Coast. The Institute went into financial crisis in the late 1990s, and UAB co-signed for its loans.

Although the Institute regained stability without the guarantee ever being called, UAB gained interlocking directorships of the institute: the UAB president now serves as board chair, and the university VP for development as board secretary. In all likelihood, the Institute will remain corporately independent and retain its focus on applied, downstream problems.

INDUSTRY COLLABORATION

From time to time, the state has funded small-scale projects in academic/industrial collaboration through the **Alabama Research Institute** (ARI), a modest endowment co-chaired by the UA system chancellor. The former governor never realized ambition to recapitalize this endowment in part through Gulf Coast oil-lease payments so that it was large enough to fund capacity-building projects. The ARI is currently inactive.

TECH TRANSFER/COMMERCIALIZATION

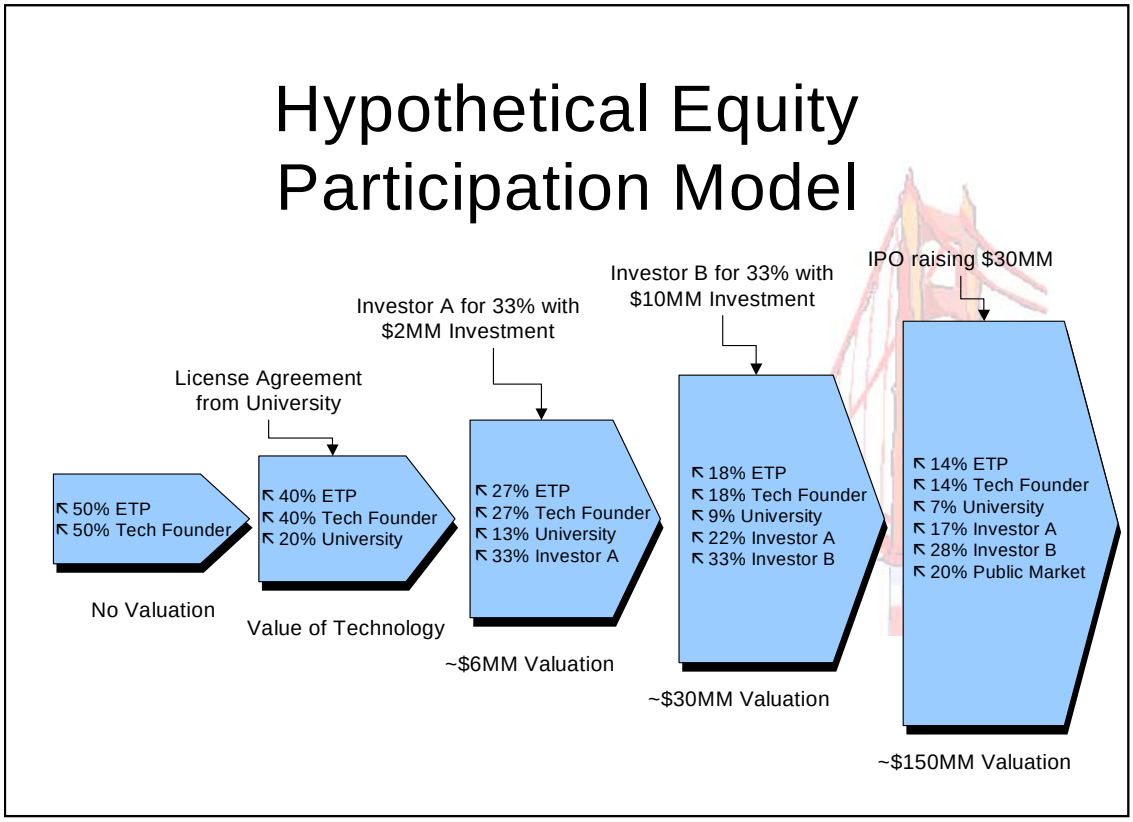
Aside from its management of the Research Park and incubator, the UAB Research Foundation had no special, internal capabilities for technology commercialization. In fact, in the last several years it went into severe crisis. The campus president admits in her public presentation on the university strategic plan[24] that the Foundation's new management is working through a five-year backlog of disclosures, and will be paring a list of 1,200 down to 200 likely possibilities. There have been no recent bioscience spin-offs from UAB.

[23] See http://www.southernresearch.org/home/index.html.
[24] See http://main.uab.edu/sys/images/fd/stratplan/bot-2004-final.ppt.

PRE-SEED STAGE FINANCE

One extremely innovative program in which UAB Research Foundation participated was **Emerging Technology Partners** (ETP), the recently shuttered pre-seed fund.[25] This fund was structured as an LLC, 85 percent owned by the endowment foundation supporting the statewide **Alabama Economic Development Partnership**, with the remaining shares bought over time ($50,000 a year for four years) in equal measure by UAB, the University of Alabama at Tuscaloosa, and Auburn University. ETP provided management and pre-seed funding to establish eight embryonic startup companies from 1997 to 2002.

The diagram below describes the equity model used. The new company started with equal ownership by ETP and the founder (usually the university inventor). Ownership was diluted if applicable by a share issued to UAB in consideration of a technology license, and then further by participation of an affiliated, $10 million seed fund (**Paradigm Venture Partners**) in which leading area corporations also had purchased interests. The ETP had been expected to ride along with Paradigm through later-stage venture investment and all the way to IPO.



New corporate leadership behind the Alabama Economic Development Partnership (AEDP) recently decided to freeze the fund due to a change in priorities at AEDP.. Though most of the companies founded by ETP continue to grow, one has failed and one has a pending IPO. However, the ETP portfolio is not being managed and is being diluted by later-stage financings.

[25] Disclosure: this fund was created by Battelle team member Michael Alder, who provided the diagram.

VENTURE CAPITAL

Birmingham has emerged as a relatively strong center for venture-capital operations, albeit at later stages of investment than those pioneered by ETP and Paradigm. There are currently six firms in Birmingham and four others elsewhere in the state active in various technology sectors, attracted by the central location that gives their partners access not only to deal emerging from UAB but also the ability to travel easily to Texas, Florida, and North Carolina. The **Birmingham Venture Club**[26] **and TechBirmingham** are collaborating with the BAA and the **Alabama Information Technology Association** to sponsor the Investor's Choice Southeast Venture Capital Forum,[27] in collaboration with the **Wayne Brown Institute** of Salt Lake City. A regular regional venture conference of this kind has been a long-time goal of the bioscience sector. The conference intends to lever the interest of many investors in the Porsche Driving Experience at the highly successful Barber Motor Sportspark, a motorcycle racetrack near Birmingham.

The majority of the resident venture capital investors are active at the later stages of investment. A newly formed State of Alabama's venture-capital development initiative operates at a similar if not more conservative stage. Final selections were recently made under a $100 million **CAPCO** (certified capital company) program under which insurance companies gain credits for investment in certified venture funds. To avoid some of the problems with CAPCOs that have emerged in other states, the Alabama program requires out-of-state firms that specialize in running CAPCOs to partner with in-state venture managers. However, this requirement does not affect the other requirements, which encourage or at least tolerate fairly low-risk investments. The CAPCOs may invest in any firm with fewer than 100 employees and more than 80 percent of its payroll in-state, provided that it is *not* in banking, insurance, real estate or retail. Investments may be in equity or debt and must be 50 percent committed by 2009. The certified venture funds (fund name, together with local manager) are:

- Advanced Capital Alabama Partners LP paired with **Southeastern Technology Fund** of Huntsville[28];
- Enhanced Capital Partners Alabama paired with **Redmont Venture Partners**[29] of Birmingham;
- Stonehenge Capital Fund Alabama LLC paired with **Hickory Venture Group**[30] (Huntsville);
- Waveland NCP Alabama Ventures paired with **New Capital Partners**[31] of Birmingham;
- Whitecap Alabama Growth Fund I LLC paired with **Greer Capital Advisors LLC**[32] of Birmingham; and
- Wilshire Group paired with **Merchant Capital Corporation**[33] of Montgomery.

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[26] See http://www.ventureclub.biz/.
[27] See http://www.sevencap.org/mendocinoSplash.asp?ID=2.
[28] See http://www.setfund.com.
[29] See http://www.redmontvp.com.
[30] See http://www.hvcc.com.
[31] See http://www.newcapitalpartners.com.
[32] See http://www.greercap.com.
[33] See http://www.merchantcapital.com.

WORKFORCE

With a full complement of professional schools UAB has assembled a collaboration among its business and medical schools for a joint MBA/PhD program and a **Venture Capital Life Sciences Entrepreneurship** program. Workforce efforts by TechBirmingham are under development.[34]

RESEARCH PARK/INCUBATOR INFRASTRUCTURE

The 100-acre **UAB Research Park** is situated not downtown but rather in the 8,000 acre Oxmoor Valley, a redevelopment of property once owned by USX Steel about a 15 minute drive from the campus. The overall Oxmoor project is a mixed use development that will include private commercial development, housing, schools, and a major golf course. The first 50 acres of the Research Park were deeded by the City to UAB Research Foundation, and the second were purchased directly by the Foundation. The park currently contains three structures:

- The **Office for Advancement of Developing Industry** (OADI), [35] a 67,000 square foot incubator including 20,000 square feet of wet lab. The OADI is managed by the same professional who manages the downtown Entrepreneurial Center,[36] which is not wet-lab equipped. Initial planning for the incubator was subsidized by the Birmingham Community Foundation, and the City contributed $1 million toward its construction cost. Some $6 million of the total $13.6 million cost was borrowed by the Research Foundation from the university, and when the loan is repaid the latter will own the building.
- A 114,000 square foot single-tenant building occupied by the regional headquarters of **Caremark** (formerly PCS Health Systems), a pharmacy-management firm with national headquarters in Nashville. This was constructed by a third-party developer operating on a land-lease.
- A 50,000 square foot multi-tenant speculative building.

Ironically, the overall Oxmoor project seems to be developing well as a suburban venue in which many bioscience companies seem to feel comfortable, but UAB Research Park itself is still not an unalloyed success. The UAB president admits in her public presentation that "issues have arisen due to OADI's distance from campus." This seems to mean that faculty who wish to retain their UAB laboratories while also participating in a startup are generally unwilling to make the 10 or 15-minute drive out to Oxmoor. As a result, UAB is expressing interest in the TechBirmingham concept for an **Entrepreneurial District** at the northwest corner of the UAB campus, linking it to the neighborhood north of the railroad tracks where the Entrepreneurial Center incubator is found. However, this is a brownfield site with mixed ownership, and a second research park with wet-lab incubation capability seems unlikely to come together in the near term.

[34] See http://www.techbirmingham.org/workforce_development.asp.
[35] See http://www.uab.edu/oadi.
[36] See http://www.entrepreneurialctr.com/

Business Climate

Pending suggestions for refundable tax credits and other improvements in the bioscience business climate have not advanced in Alabama.

Summary and Lessons

Birmingham benefited from the sheer momentum of research growth at UAB, and secondarily from the visibility that HealthSouth gave the region while it was a healthy enterprise. However, because of the fast ascension of UAB as a bioscience research powerhouse, the surrounding entrepreneurial environment has had some trouble keeping up. Despite the leadership of a few key individuals, the region does not have a well elaborated long-term strategy. Also Birmingham has had a number of promising startups move away either because they were unable to attract CEOs, or could not find later-stage capital, or found that the rapidly growing UAB had absorbed all the region's trained technicians. In addition the region suffered from lack of state-government leadership in planning and development, and especially failed to anticipate that initiatives like ETP and Paradigm would need longer staying power and some "evergreen" mechanism in order to endure the long lifecycle of bioscience company development. If the region succeeds at attracting large-scale anchor companies, some of these problems may resolve with a corporate leadership more expert in these particular problems.

Dallas/Fort Worth, Texas

THE STORY

In the Dallas/Fort Worth "Metroplex," the word "technology" has long meant strictly the telecommunications and IT cluster along the "**Telecom Corridor**" reaching from North Dallas along U.S. Highway 75 northward to Richardson/Plano.[37] Until recently, the biosciences have taken a back seat in regional development strategy, compared with targeted efforts in Houston/Galveston and San Antonio. However, **UT Southwestern Medical Center at Dallas** was gaining note for research excellence as early as 1985, the year of its first two Nobel prizes. Active consideration of the biosciences as a target of opportunity for the Dallas region began about a decade ago, and accelerated as the telecom industry and therefore the Telecom Corridor stumbled at the turn of the millennium. Regional leaders now count about a hundred bioscience firms including **Alcon Laboratories**, a $3 billion medical device and pharmaceutical company, and regional facilities of **Abbott Laboratories**, and a number of smaller biomedical companies as well as local startups, but excluding hospitals and clinical practices or laboratories.

The bioscience sector in the Metroplex looks for leadership to **UT Southwestern** and the **University of North Texas Health Sciences Center at Fort Worth,** and there is also significant bioscience research at the private **Baylor Research Institute**. Both by size and accident of geography, a major role has fallen to UT Southwestern, which does about 10 times the sponsored research of the next two largest universities in the region (**UT Dallas** and **UT Arlington**).[38] UT Southwestern is located at the core of a huge, multi-institutional medical district along Hines Boulevard, just to the southeast of Love Field. Hospitals in the district include Zale Lipshy and St. Paul University Hospitals, Children's Medical Center, the county-owned Parkland Memorial, and the Dallas VA. The region is also headquarters to both the for-profit **Tenet** Healthcare system and the large nonprofit **Texas Health Resources** system.

The roots of UT SW date to 1939, when regional leaders founded the Southwestern Medical Foundation to promote biomedical education and research.[39] In 1943, when the Baylor College of Medicine split away from Baylor University in order to relocate to Houston, the Medical Foundation received state designation as the Southwestern Medical College. The Foundation subsequently turned its assets over to the University of Texas system, which agreed to invest in the campus and advanced it steadily toward recognition in 1987 as a university Health Sciences Center analogous to those in Houston or San Antonio. The **Baylor Research Institute** and a dental college continue the university's local presence in bioscience research. About a decade ago, working with large donors like Ross Perot and Harold Simmons, UT SW acquired additional land from the holdings of the MacArthur Foundation for its "north campus" across Hines

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[37] For a compact description of the corridor see http://www.telecomcorridor.com/ed/downloads/telecomcorridor.pdf. The corridor was built around Texas Instruments and inward investments by Collins Radio/Rockwell, but now encompasses facilities by nearly every major telecom manufacturer.

[38] A study in 200 by the Dallas Citizens council recommended enhanced collaboration as a step toward creation of the region's first research-extensive (Carnegie classification) non-specialized institution.

[39] See http://nobelprize.org/medicine/articles/impact/.

Boulevard and significantly expanded its research capacity. The UNT Health Sciences Center in Fort Worth is a more recent entity, built around a college of osteopathic medicine at some distance from the main UNT campus in Denton. Both health science centers have graduate schools of biomedical sciences in addition to their professional schools.

STRATEGY ENVIRONMENT

Texas has traditionally had weak state-level economic-development programming. There is a history of line-item funding through the legislature of specific initiatives in various regions. In fact, the state Department of Economic Development was abolished several years ago, even as the legislature allocated $385 million to individual university-based life science initiatives in adisconnected fashion across the state. Economic-development functions are now run directly from the Governor's office, which makes decisions jointly with the legislature on allocation of discretionary grants from the $295 million **Texas Enterprise Fund.** This fund has been used mainly for tactical relocation assistance across many industrial sectors, although it has also played a strategic role in the Dallas region. In 2003, $50 million was allocated to encourage Texas Instruments to invest $300 million in research and educational partnerships with UT Dallas as part of the company's construction of a nearby $3 billion semiconductor fabrication facility.

Ever since a cluster-mapping exercise initiated in 2001, biotechnology has been one of six fields targeted by the governor's office. In 2002, Gov. Perry commissioned a roadmap from a **Council on Science and Biotechnology Development**, published in collaboration with the Texas Healthcare and Bioscience Institute, the state-level BIO affiliate. Partly as a consequence of this work, summarized below, the Governor has called for creation of a parallel $300 million **Texas Emerging Technology Fund,** described further below. However, this mechanism does not yet exist. Several earlier initiatives approved by the legislature have either withered on the vine or were deliberately shut down by gubernatorial veto in response to continued overall budgetary stress and/or conflict with the state comptroller. However, ad hoc legislative initiatives continued, including laws that allowed the public universities to retain indirect costs recovered from research grants; clarified their legal authorities to spin-off businesses; and authorized them to issue revenue bonds for creating new research facilities. Dallas/Fort Worth institutions participated in and benefited from all these initiatives.

Biosciences were only a small component of regional strategy work done in 1998 under sponsorship of the **North Texas Commission**.[40] However, the **Dallas Plan**[41] took a stronger interest, based on the city's particular strengths. As UT SW dramatically grew its research program and added venture-development staff to its Office for Technology Development,[42] it began hosting a monthly informal **breakfast meeting** on the biosciences. In 2002-03 the **Greater Dallas Chamber of Commerce**[43] created a Biotechnology & Life Sciences Committee and launched what came to be called the **Life Sciences Coalition**. With the partnership of the Fort Worth Chamber, the North Texas Commission, the regional Health Industry Council, city

[40] Donald A. Hicks. "The Evolving Dallas/Fort Worth Metroplex Economy: Performance and Prospects." Available online at www.ntc-dfw.org/publications/eereport.pdf.
[41] A planning agency spun out by city government after the recession of the early 1990s and now sunsetted).
[42] See http://www8.utsouthwestern.edu/home/research/techdevelopment/index.html.
[43] See http://www.gdc.org/.

government, the university community, and STARTech Early Ventures (see below), the coalition was renamed **BioDFW**[44] and became the organizational (but not fiscal) sponsor of the breakfast meetings. These now attract as many as 150 guests a month and rotate between UT SW and the UNT HSC in Fort Worth, which has established its own **Office of Research and Biotechnology**.[45] (This office also participates in a separate forum.[46])

STRATEGY CONTENT

Under the strategy published by the Governor's Council,[47] initiatives were recommended in capital formation, research funding, tech transfer, and workforce development. The specific elements of the recommended statewide strategy were:

- Create a sustainable leadership mechanism;
- Fill the research-to-market gap with pre-seed, seed-stage venture capital including participation by public pension funds;
- Develop collaborative regional tactics (meaning collaboration *within* regions);
- Develop a statewide federal funding strategy; and
- Improve education and skills development, including both K-16 and postgraduate.

The strategy identified the following sub-fields as particular targets of opportunity for bioscience development:

- Nanotech (bio-applications);
- Vaccines;
- Molecular sciences;
- Advanced materials and manufacturing (bio-engineering);
- Animal and plant modeling; and
- Wireless/IT convergence.

In 2002, subsequent to a strategic overview,[48] the Dallas Plan commissioned and published its own **BiotechnologyDallas Strategy**,[49] which included the following principal recommendations:

- Create the BiotechnologyDallas Corridor (research park) at the Medical Center;
- Prepare other areas in the region for bioscience development and create a "BioReady Building" certification process;

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[44] Website http://www.biodfw.org/.
[45] See http://www.hsc.unt.edu/research/researchoffice/.
[46] See http://www.dfbt.org/.
[47] Governor's Council on Science and Biotechnology Development. "Biotechnology and the Life Sciences: Building our Strengths, Sustaining our Competitiveness." Report to the Governor, March 2003. Not available online.
[48] New Economy Strategies. *The Life Sciences Initiative: North Texas in the BioEconomy."* Washington, February 2002.
[49] The Dallas Plan. "biotechnologyDallas: A Strategy for Targeted Economic Development in the Life Sciences." November, 2002. No longer available on-line.

- Enhance the Life Sciences Coalition, including emphasis on networking opportunities and communications; and
- Focus on venture capital and local entrepreneurship and indigenous development rather than relocation, expecting results only over a decade or more.

RESEARCH CAPACITY BUILDING

The Dallas area institutions have employed both line-item funding and categorical programs to build their research capacity. Until two years ago, all the major institutions in the region were eligible to compete for grants from a $60 million pool of annual funding through the Advanced Research Program and Advanced Technology Program offered by the Texas Higher Education Coordinating Board, but this program was first downsized and then eliminated in the 2003 legislative session. The Texas Excellence Fund, created in the 2001 session with $50 million in earnings from the **Permanent University Fund**, is to be migrated to a Research Development Fund with the same general purposes, with specific allocations made by each institutional board of regents. This fund may become active later this year. In addition, the **Texas Emerging Technology Fund** requested by the governor would allocate $150 million for the capital costs of regional "centers of innovation and commercialization," $75 million to provide state match to large federal research grants, and $75 million to help public universities

However, for purposes including facilities and faculty recruitment, UT SW has not waited for state funding to materialize. In 1998 the center matched an anonymous donor's commitment of $25 million to raise a total of $60 million for an endowed scholars program.[50] This pays full salary and $500,000 in startup costs for up to four years for targeted faculty recruits. In all, UT SW has probably added $200 million in research facilities over the last decade and a half and is concluding a $500 million capital campaign. Additional public and private funds have gone to bioscience or interdisciplinary facilities at UNT, UT Dallas, and UT Arlington.

INSTITUTIONAL COLLABORATION

The primary goal of the BioDFW is to foster regional cooperation and collaboration, leading to growth in R&D and a better environment for development of commercial applications. Subsequent to the launch of the bioscience breakfast meetings, UT SW began convening a separate working group of North Texas technology transfer offices that meet under a blanket confidentiality agreement so that members can speak jointly with industry about opportunities for sponsorship and to bundle intellectual property. Other than this initiative, there is little funding available for inter-institutional collaboration, at least until the Texas Emerging Technology Fund is put into place, with its emphasis on intra-regional centers of excellence. UNT HSC and UT Arlington recently created a $50,000 fund to support collaborations between researchers at the two institutions.

[50] See http://www8.utsouthwestern.edu/utsw/cda/dept114009/files/114243.html.

INDUSTRY COLLABORATION

With the expiration of the technology transfer set-aside within the old Advanced Technology Program, there are no formal state programs to encourage industrial collaboration. A group of faculty at UT SW created a **Center for Biomedical Inventions**;[51] intended to conduct applied research in partnership with industry on proteomics, array and imaging; cell targeting; and vaccine development, but this is not an institutionally funded program.

TECH TRANSFER/COMMERCIALIZATION

The largest technology transfer office in the region is the UT SW Office for Technology Development which was separated from the Legal Affairs office in 1999 and has since quadrupled licensing revenue to $12 million. The OTD is now staffed at 15 over three divisions—licensing, venture development and portfolio management. The venture-development group has a staff of four and claims four startups including:

- **Myogen**,[52] developing small molecules for treatment of cardiovascular disorders;
- **Reata Discovery**,[53] working on cancer and neurodegenerative disease;
- **Eliance Biotechnology** which merged with **MacroGenics,**[54] a developer of immunotherapeutics for cancer, infectious disease, and autoimmune diseases; and
- **Light Biology**, genetic analysis; sold in 2004 to NimbleGen Systems.

The OTD says it may take equity in lieu of royalties for a license, and may accept additional equity (not shared with the inventor) as founder's equity in consideration of its services in forming the startup.

PRE-SEED STAGE FINANCE

Some $45 million in pre-seed funding initiatives[55] passed by the Legislature in 2003 were never implemented. The most important factor in pre-seed finance has therefore been **STARTech Early Ventures**[56]—a for-profit company created by Texas Instruments alumni that bills itself as a "business accelerator" and which has also raised two seed-stage venture funds (one at $4 million and the second at $32 million). It has also created an educational foundation to support its mentoring activities. STARTech's idea is to provide larger venture capital firms a way to participate, at the earliest stages, in half-million-dollar deals for which they cannot afford the time to perform the due diligence and to track the companies while they are small. STARTech has helped launch three of UT SW's startups. A locally initiated early-stage, **eHealth**, has not made any major investments in companies located in the region. Meanwhile, the NTEC MedTech

[51] See http://www.utsouthwestern.edu/utsw/home/research/cbi/index.html.
[52] See http://www.myogen.com/.
[53] See http://reatadiscovery.com/.
[54] See http://macrogenics.com/.
[55] A $25 million "Product Development Fund" and a $20 million "Incubator Fund," both to be managed by the Controller's Office.
[56] See http://www.startechev.com/aboutus.htm.

Incubator (see below) has announced plans to raise a companion $10 million seed fund, targeting wealthy individuals and institutions. No closing has yet been announced.

VENTURE CAPITAL

Texas has had mixed results with public pension investment in venture-capital funds that promise a regional focus. In fact, just such an investment made a decade ago in the **Texas Growth Fund**[57] was recently allowed to expire.[58] However, UTIMCO, the nonprofit created to manage the Permanent University Fund and other investment funds that support the public universities, has agreed to target part of its large venture capital allocation to venture funds that agree to work with public university technology transfer offices. The first deal announced, $25 million to a Houston-based fund, is targeting life sciences spin-offs from the entire UT system.[59] The state has also announced a CAPCO program which has not yet completed the certification process. A statewide coalition has formed to increase pressure for rapid advancement of these efforts.[60]

ENTREPRENEURSHIP

The major entrepreneurship centers in Dallas are at universities with smaller research programs: the University of Dallas, Southern Methodist University, and Texas Christian University. Their interaction with bioscience commercialization efforts at UT Southwestern appears so far to be minimal, although they may interact through STARTech.

WORKFORCE

The workforce initiatives called for in the BiotechnologyDallas plan are not yet elaborated.

BUSINESS CLIMATE

The proposed Emerging Technology Fund would extend the government's discretionary grant-making authority from traditional relocation assistance to technology initiatives in all sectors.

RESEARCH PARK/INCUBATOR INFRASTRUCTURE

UT Southwestern has acquired a 13-acre site for $4.15 million from the City of Dallas. The site master plan calls for the construction of 300,000 to 400,000 square feet of bioscience space including one building of about 100,000 square feet which would be a university-affiliated wet-lab incubator. The term "Biotechnology Corridor" (though used in the Dallas Plan to this research park initiative) also refers more broadly to an ambition to populate the entire "Stemmons Corridor" with bioscience companies.

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[57] See http://www.texasgrowthfund.com/.
[58] See http://www.utwatch.org/oldnews/aas_tgf_3_14_04.html.
[59] See http://www.utimco.org/pressreleases/11132003_pressrelease.htm.
[60] See http://www.texascapital.org/about/index.php.

Other incubators active in the region are:

- **North Texas Enterprise Center for Medical Technology**[61] – an 11,000 square foot light manufacturing facility in Frisco. It is not university affiliated but rather a nonprofit backed by the City of Frisco Economic Development Corporation and the **Hall Financial Group**, a local private investment group in whose office park the center is located.[62] Of 140 ventures reviewed since 2002, three were admitted as of October 2004.
- **Tech Fort Worth** (formerly Fort Worth MedTech Center) – a 15,000 square foot nonprofit that rents space in the UNT HSC biotechnology building.
- **Arlington Technology Incubator** – a dry lab facility that has originated one or two life science companies including some that have subsequently moved closer to UT SW like **TissueGen**.[63]

SUMMARY AND LESSONS

Dallas considers itself a "best kept secret" in biosciences, an underappreciated leader even by comparison with higher-profile Texas bioscience centers like Houston/Galveston. However, the biosciences struggle for visibility against the backdrop of a large technology-manufacturing sector (which includes medical devices) and the oil sector. The beginnings of inter-institutional collaboration are emerging, and there is a new focus on building the entrepreneurial and financial infrastructure necessary to support bioscience startups. Like many of the benchmark regions, Dallas struggles to attract early stage capital that is interested in life science deals—many of its most experienced investors know only the IT sector.

[61] See http://www.ntec-inc.org/content-about-history.asp.
[62] See http://www.hallfinancial.com/.
[63] See http://www.tissuegen.com/index.htm.

Kansas City (Kansas and Missouri)

THE STORY

A state line community with multiple institutions conducting bioscience research on both sides of the border, Kansas City had underperformed its potential for decades, despite the presence in the region of corporate leaders like Bayer Animal Health, Aventis and Boehringer-Ingelheim. Kansas City has been home to the University of Kansas medical school since 1905 and clearly leads the state in biomedical research. On the Missouri side, however, the public medical school was originally a small private institution, integrated into the University of Missouri system only in 1963 with minimal new investment. Overall, the region benefits from linkage with the strong cluster in St. Louis but in some ways also suffer by comparison. Kansas has had active but modest state-government programs to develop the bioscience sector, while Missouri has had nearly no effort at the state level. Institutional fragmentation and lack of investment in facilities and recruitment were problems that the Kansas City region had never managed to address until recently.

Regional economic-development initiatives were focused almost entirely on the telecom services sector when Jim and Virginia Stowers—the founder of the highly successful American Century mutual fund family and his wife, both cancer survivors—changed everything by settling a $1.1 billion endowment of American Century stock on a newly created **Stowers Institute for Medical Research** (see below).[64] They did so after considering and rejecting the alternative of donating to one of their hometown universities. Instead, after consulting with national leaders like Leroy Hood of Seattle, they aimed at creating an independent institute that would allow scientists to concentrate solving large challenges by freeing them of the burdens of grants-seeking.

Although the Stowers family understood the potential of their gift to transform the regional economy, and are strongly supportive of that goal, their primary and driving interest has always been health outcomes from biomedical research. However, the Kansas City business community immediately saw the necessity and opportunity of working in sync. From the outset, the Stowers family envisioned adding to the endowment and liquidating shares in waves, so that additional facilities and programs could be created (the endowment stands at $2 billion). For this vision to be realistic, the region's institutions needed to be recapitalized so they could recruit worthy peers to the scientific teams Stowers planned to recruit. Conversely, the higher profile created by Stowers made attracting this investment more feasible.

With $200,000 in sponsorship from the local **Ewing Marion Kauffman Foundation**, the Civic Council of Kansas City and the Kansas City Area Development Council co-led a planning exercise that resolved the need for an umbrella nonprofit that could raise the region's research base from $86 million at the time to a target of $500 million annually, over a 10-year period. This became the **Kansas City Area Life Sciences Institute (KCALSI)**,[65] which joins the interests of eight stakeholder institutions: the KU Medical Center; the University of Missouri at Kansas City; the Stowers Institute; the Midwest Research Institute; the University of Kansas main campus in

[64] See http://stowersinstitute.org/.
[65] See http://www.kclifesciences.org/.

Lawrence; the KC University of Medicine and Bioscience (an osteopathic medical college); and two hospitals, Children's Mercy and St. Luke's. The board includes leaders of three of these institutions, four local business executives, and the KCALSI president, who is a former MRI scientist.

The original concept for KCALSI was to ask the business and philanthropic community to contribute to a $300 million investment program that would lead to the desired increase in annual sponsorship over the decade. However, it was soon apparent that there was little appetite to finance an unrestricted kitty. Rather, the model shifted to a project orientation (see below). As of the latest measurements published (covering 2003), the region was capturing $219 million a year, a significant advance from the starting point toward the $500 million goal. More importantly, the initiative has attracted the attention of state government (see below) and has stimulated intense interest in creating, financing, nurturing and retaining bioscience startups. KCALSI has received $600,000 in funding over the last three years from the Civic Council and a further commitment for $1 million over the next five.

STRATEGY ENVIRONMENT

Cluster development has long been a goal of **Kansas Inc**.,[66] a private nonprofit that conducts strategic economic-development planning for state government, and of the **Kansas Technology Enterprise Corp**., a nonprofit that has run the statewide S&T programs for two decades and which produced a well elaborated cluster strategy in 2000.[67] Along with KCALSI these entities all contributed to the consensus behind the 2004 Economic Growth Act that created a **Kansas Bioscience Authority** (see below) which promises to completely transform the state approach to capacity building, even while KTEC continues to work on commercialization assistance. At the local level, the KCALSI itself is the custodian of the regional development strategy.

STRATEGY CONTENT

Since the early 1980s, KTEC has supported a network of university-based centers of excellence. Of these, the one in life sciences is the **Higuchi Bioscience Center**,[68] an interdisciplinary center headquartered at the Lawrence campus but encompassing collaborative research with the medical center in Kansas City. KTEC also offers commercialization and finance programs described below. However, much of its cluster strategy will yield in favor of programs yet be developed by the **Kansas Bioscience Authority**.[69] The overall outline of the Authority's mandate is to allocate $500 million in incremental tax revenue expected to be captured from growth of the bioscience

[66] See http://www.kansasinc.org/.
[67] See http://www.ktec.com/pdf/kstcaplan.pdf.
[68] See http://www.hbc.ku.edu/. Named after a distinguished physical chemist at KUMC who co-founded several local companies.
[69] See http://www.ktec.com/bioauthority/bioscience_overview.pdf for a summary of the Act and http://kdoch.state.ks.us/public/agency/programs/pgm_details.jsp?pgID=1055854230911 for program elaboration by the state commerce department.

sector. Suggested initiatives include:

- Funds for recruitment of eminent scholars and rising stars on university faculty;
- Matching funds for major federal proposals;
- Revenue bonding for construction of new research facilities;
- Vouchers to encourage bioscience firms to engage in joint projects with universities;
- Tax increment-financed bioscience development districts;
- Grants for creation of high-school based bioscience academies; and
- Grants for curriculum development in higher education.

The Act further suggests overall focus on the following sectors:

- Genomics;
- Proteomics;
- IT/bioinformatics;
- Imaging; and
- Analytical sciences.

At the regional level, the 1999 study that led to the creation of KCALSI was updated in 2004 in a document[70] that highlighted the following focus areas:

- Health care knowledge and personalized medicine;
- Animal health and research;
- Bio-pharma drug discovery pathways;
- Oncology;
- Cardiovascular research and tissue engineering;
- Neuroscience; and
- Medical transaction management (a cross-cut with the regional IT theme).

The strategy suggests that further investments by government, business and philanthropy be conditioned on a "quid pro quo" that institutions commit to commercialization procedures that favor local development. Meanwhile, operations of KCALSI itself have focused on four major strategic roles:

- Voice of the bioscience research community to the region at large;
- Coordinator of initiatives to finance research infrastructure that allows the institutions to participate in new funding flows;
- Facilitator of collaborative research proposals; and
- Advocacy, through its sister 501(c)(4) KCALSI Association.

[70] New Economy Strategies. "The Case for KC Life Sciences and Convergent Technologies." Washington, June 2004. Available on-line at http://www.kclifesciences.org.

RESEARCH CAPACITY BUILDING

To appreciate subsequent capacity-building programs, it is important first to understand the scale and scope of the Stowers Institute, whose construction was financed through sale of tax-exempt bonds backed by a Stowers gift. The first phase of development is a six-story, 600,000 square foot laboratory building built to span two wings of a former community hospital on a 10-acre site across the street from the UMKC main campus. The building opened in 2000 and is still being filled. It is intended ultimately to house 40 to 45 teams of 10 to 12 scientists and technicians each. The Stowers family is already considering a second phase, whose location has been used as a lever in negotiations with the Missouri legislature over general support for UMKC and specific statewide policy on stem-cell research. It is possible that the endowment will support creation of a similar amount of space every 10 to 12 years.

In this context, the Kansas Legislature passed in 2001 a University Research and Development Act that floated $130 million in revenue bonds through the Kansas Development Finance Authority, allocated to several projects including a new $60 million, 200,000 square foot research tower at KUMC, due to open in 2006. The bonds will be serviced by appropriations for the first five years and subsequently by increased indirect-cost recovery from incremental sponsored research made possible by these investments (similar to the California Institutes "Garamendi bond" model).

In 2003, the State of Missouri—pressured by constituencies in both St. Louis and Kansas City—agreed to allocate starting in 2007 a quarter of its tobacco settlement to a **Life Sciences Trust Fund**[71] that will invest 80 percent in capacity building (the balance in technology transfer and commercialization). The state also committed to a new research building at UMKC, although not the number of new faculty slots recommended[72] by a task force chaired by Dr. William Danforth, a leader of the St. Louis effort.

Both university construction projects received matching grant assists from the regional **Hall Foundation** ($29.5 and $5 million, respectively). Adding these projects and others to facility investments in the private sector, KCALSI counts about $1 billion in recent capital investment in the biosciences in the Kansas City Region.

Although the state governments can operate at the scale of entire buildings, KCALSI addresses the regional business and philanthropic community at the scale of laboratories. For example, through its proteomics initiative, KCALSI identified about $20 million in facilities improvements that it believed could lever significant new competitive research funding. It was able to raise the commitments through both donations and federal earmarks, and enjoyed broad institutional support even though the allocation of equipment funding was not equal across the eight stakeholders.

The remaining programs for capacity building—both those managed by KTEC through its **Strategic Technology and Research Fund**[73] and by KCALSI through its **Research Development Grants—**are essentially operational in nature. KCALSI reports that its first eight awards of $200,000 levered $2.6 million in federal grant support, a 13:1 ratio.

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[71] See http://www.lifesciences.mo.gov/qa.html.
[72] University of Missouri-Kansas City Life Sciences Task Force. "Report." January 6, 2003. Available on-line http://www.umkc.edu/lifesciences/mc/feedback/Final_Report.1.06.htm.
[73] See http://www.ktec.com/research/section/star.htm.

INSTITUTIONAL COLLABORATION

A particularly important nexus for collaboration has emerged through the **Midwest Research Institute (MRI)**,[74] a stakeholder of KCALSI. MRI was founded in 1944 to provide R&D for industry, especially in agricultural processing. Like the analogous Southern Research Institute in Birmingham, it has since developed multiple research divisions spanning a broad set of technologies and including facilities in the Washington, D.C., area. The MRI CEO is chair of the KCALSI board, and the KCALSI President is a former MRI scientist. Even before creation of KCALSI, MRI and KUMC formalized previously informal bench collaborations into a KUMRI Alliance with formal structure for joint appointments and equipment sharing. Its goal is to raise by 2010 an incremental $50 million in research sponsorship directly attributable to the partnership. Since that time, MRI has established four other alliances (children's health, heart disease, veterinary, and seeds) Kansas and Midwest institutions.[75]

KCALSI itself invests in similar partnerships, on the theory that in combination the institutions can capture more funding than singly.

INDUSTRY COLLABORATION

KTEC offers an **Applied Research Matching Fund**[76] which offers grants of $5,000 to $125,000 to programs conducted jointly by a Kansas business and a university researcher. The grant must be matched 1.5:1 and is repayable from royalties on any intellectual property licensed.

TECH TRANSFER/COMMERCIALIZATION

Both industry-sponsored research and technology transfer at KUMC are funneled through a separately incorporated KUMC Research Institute, Inc. This entity is home to the KUMC Office of Technology Transfer, Intellectual Property, and Commercialization, which counts six recent spin-offs.[77] The institute is designated as one of KTEC's regional "incubators" (really full-service commercialization centers) and as such is a partner in a locally financed but state-endorsed pre-seed fund (see below).

PRE-SEED STAGE FINANCE

As noted, the KUMC Research Institute, Inc is a partner in one of KTEC's regional seed funds, in this case called the **Precede Fund**. Like the other funds associated with public university campuses in Lawrence and Manhattan, it is run by a for-profit management company and raises funds from local institutions including leading corporate citizens and institutional endowments.[78]

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[74] See http://www.mriresearch.org. Disclosure: MRI partners with Battelle to operate DOE's National Renewable Energy Laboratory in Golden, Colo.
[75] See http://www.mriresearch.org/WorkingWithMRI/Alliances.asp#mahislh.
[76] See http://www.ktec.com/investment/armf/armf.htm.
[77] See http://www2.kumc.oedu/researchinstitute/tech/startup_companies.html.
[78] A description of the funding model can be found at: http://www.ssti.org/Publications/Onlinepubs/Kscom98.PDF.

In addition, KTEC directly operates a **Technology Commercialization Seed Fund**,[79] which makes equity investments of up to $250,000 provided it can "syndicate" with other investors by a factor of at least 3:1. KTEC also offers a $4,000 grant to assist companies in applying for SBIR funding.

Several other local institutions have tried to establish their own early stage venture funds, with varying results:

- **MRI Ventures**,[80] a for-profit subsidiary of MRI founded in 1982, continues to operate but focuses only on MRI-owned technology;
- **Biomed Valley Discovery Inc**., a for-profit holding company of Biomed Valley Corporation, a nonprofit affiliate of Stowers, was capitalized at $60 million but sources technology broadly, not just in Kansas City;
- **KC BioHoldings** is a for-profit subsidiary of KCALSI intended to work with KCCatalyst (see below) but has not been launched.

VENTURE CAPITAL

See below under business climate.

ENTREPRENEURSHIP

Kansas City is strongly focused on entrepreneurship as the home to the **Ewing Marion Kauffman Foundation**, for which this is a program area of mission-critical importance.[81] In fact, at about the time of KCALSI's launch, the **Ewing Marion Kauffman Foundation** and the Missouri Department of Economic Development joined to support **KCCatalyst**,[82] which was intended as a commercialization resource for entrepreneurs across all sectors. However, the initiative seemed in some ways out of sync with the new life science focus, and it has decided to cease operations as of this year. Under the Economic Development Act, there will be a new, statewide Kansas Center for Entrepreneurship with its own board and staff, budgeted at $3.5 million over 10 years and the capacity to provide grant support for local initiatives.[83]

WORKFORCE

As an outcome of the KU-MRI alliance, KU now offers a non-thesis master of biotechnology, with coursework at KU and lab training at both KUMC and MRI.

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[79] See http://www.ktec.com/investment/tcsf/tcsf.htm.
[80] See http://www.mriresearch.org/AboutMRI/MRIVentures.asp.
[81] See http://www.kauffman.org/entrepreneurship.cfm for the overall (national) entrepreneurship program, and for efforts within the Kansas City program see: http://www.kauffman.org/kansascity.cfm/kc_entrepreneurship.
[82] See http://www.kccatalyst.com/networking.cfm.
[83] See http://kdoch.state.ks.us/public/news/news_release.jsp?rlsID=1102619250690.

BUSINESS CLIMATE

Kansas previously had a 25 percent **Seed Capital Tax Credit**.[84] Under the Economic Development Act, this was converted to 50 percent credit (capped statewide at $2 million) for investment in seed-stage funds certified by KTEC. Missouri's economic development programming depends heavily on tax credits, but they are often created for ad hoc purposes.

RESEARCH PARK/INCUBATOR INFRASTRUCTURE

Kansas City has accomplished all it has in recent years without a classic research park, or even a full-sized wet-lab incubator, although there is progress on both fronts. At the KUMC campus on the Kansas side, there is a 6,000 square foot **Business Development Center**[85] that was recently renovated to full wet lab capability and opened to all entrepreneurs, whether or not they are KUMC spin-offs. On the Missouri side, developers are discussing a research park development in the Beacon Hill residential neighborhood adjacent to Hospital Hill, home to the UMKC Schools of Medicine and Dentistry, Truman Medical Center, Children's Mercy, and Missouri Western Mental Health. This facility could include a wet-lab incubator. As with other major economic development projects, the location ultimately chosen may end up, for political reasons, on the state line, close to KUMC.

SUMMARY AND LESSONS

KCALSI is in the process of a board-level consideration of future directions. It attributes its success to its ability to empower collaboration. As an independent entity with senior leadership of the major institutions represented on its board, it has created a safe and acceptable space for collaboration. The senior KCALSI staff are themselves former scientists and have good credibility with the research teams they are trying to assemble. Targeting funding opportunities greater than $1 million (such as multiyear NIH program-project grants), KCALSI has had mixed success but finds that even if you lose you win, because the collaborations you create remain active and often result in later funding success. As part of a current board-level review, KCALSI is also looking for ways to better address the regional corporate constituency in animal health, by better connecting Kansas City institutions to veterinary medicine and plant science research at KSU in Manhattan and the University of Missouri-Columbia, which are not currently designated KCALSI stakeholders.

[84] See http://www.ksrevenue.org/taxcredits-localseed.htm.
[85] See http://www.kcbdc.com/.

Louisville, Kentucky

THE STORY

Louisville began conceiving plans for a "health enterprise" and bioscience cluster in the late 1990s, during the first two terms of Mayor Jerry Abramson (now presiding again, as mayor of the recently consolidated city/county government). Abramson and his immediate successor David Armstrong led a 15-year, $500 million renewal of the city's Ohio River waterfront district—ultimately replacing decrepit properties with recreation facilities and the Slugger Field minor league ballpark. These improvements made possible the development of a brief-lived internet cluster along Main Street, which was rebranded in 1999 as "emainUSA."[86] A few blocks further inland from Main Street lies the downtown medical district itself, a 20-block area comprising seven acute-care hospitals (several dating to the 19th century), additional specialized institutions, and the health sciences campus of the **University of Louisville**. U of L, whose other schools are based outside downtown at its Belknap campus, is somewhat smaller than the University of Kentucky in Lexington.[87] In fact, U of L achieved the top classification in the Carnegie Institution scheme only in 1994, although its growth accelerated later.

In 1997, civic leaders created **Greater Louisville Inc.**,[88] combining the former Greater Louisville Chamber of Commerce and the Louisville Economic Development Partnership. As part of its launch, Greater Louisville convened a "visioning task force"[89] that focused the region on its lagging culture of entrepreneurship but also on the potential inherent in Louisville's assets, including its status as corporate headquarters for several major national hospital chains—especially Humana and Kindred (now Vencor). This visioning work was conducted in conjunction with the earliest stages of the state's investment in R&D through the "bucks for brains" challenge grant (see below). The task force identified as targets of opportunity several fields stemming from the hospitals' set of clinical excellence: cardiovascular disease; human genetics; neuroscience; oncology; transplantation; environmental health; and ophthalmology.

At a broader level, Greater Louisville ultimately targeted two sectors: logistics, culminating in recruitment of the UPS air hub in 2000, and health enterprises, resulting in spin-off of the **Louisville Health Enterprises Network**,[90] now claiming nearly 200 members. In 2001, the same year the Abiomed artificial heart was first implanted at Jewish Hospital Center, the Network published a major study of the health-enterprise sector. [91] Researchers counted 72,000 workers in 2,000 health enterprises, and estimated that health enterprises accounted for eight of the region's top 20 employers and three of the state's eight Fortune 500 companies. The Network maintains an index of 20 health-related companies in the region, and has published a "family tree" [92] of

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[86] See http://emainusa.com/ourstory/default.htm.
[87] The land grant institution, but with its own separate medical school.
[88] See www.greaterlouisville.com/.
[89] Original report no longer available on line.
[90] See http://www.healthenterprisesnetwork.com/about.html.
[91] Paul A. Coomes and Raj Narang. *Louisville's Health-Related Economy: Size, Character and Growth.* Louisville: May 2001. Available on-line from Greater Louisville Health Enterprises Network.
[92] See http://www.healthenterprisesnetwork.com/publications/2004familytree.jpg.

spin-offs from the major hospital chains and the University of Louisville, but it operates mainly as a steering and lobbying group, rather than a direct provider of services to bioscience firms.

In 1999 (see below), the state launched its own technology-based development strategy and soon offered to support Innovation and Commercialization Centers (ICC) in each region of the state. At about the same time, Greater Louisville had created another spin-off, the **Enterprise Corporation,**[93] and charged it with revitalizing the city's entrepreneurial sector through training, mentoring, networking and individualized consulting**.** Enterprise Corporation therefore became the obvious recipient of the state's ICC funding. Now occupying the famous "clock tower" building on East Main Street, Enterprise Corp. puts prospective entrepreneurs and university spin-outs through an elaborate stage-gate process that introduces them to state commercialization programs (see below) and prepares them to raise private capital.

During this same period, the U of L and its Hospital joined with Jewish Hospital Center, Norton Healthcare and the City as incorporators of **Louisville Medical Center Development Corporation** (LMCDC).[94] This entity does not "own" the entire medical district but is intended instead as a coordinating entity for a research park to be built on an in-fill basis, and as the operator of an associated, state-funded bioscience incubator. In 2002, as these events unfolded with strong state support, Greater Louisville reassessed its progress and resolved a continued focus on entrepreneurship.[95] Louisville has not yet reached critical mass, but there is an accelerating flow of university spin-offs. Two recent acquisitions have remained in Louisville: **Aptamera**, a university spin-off acquired by a UK firm, and **Advanced Imaging Concepts**, a medical records-management company acquired for $22 million by Allscripts, a Chicago company.[96]

STRATEGY ENVIRONMENT

At the city level, Mayor Abramson stays in close control of the city's technology-development strategy through a special assistant for entrepreneurship who is himself a former entrepreneur[97] and via the city's board representation on both the research park development corporation and a long-standing and powerful downtown development district.[98] The state-level strategy that led to the funding flows described above was commissioned in 1999 by the **Kentucky Science and Technology Corp**.,[99] a nonprofit that has long enjoyed a special relationship with the state government, as operator of the EPSCOR program to build R&D capacity. As a follow-on to the strategy, the state created an **Office of the New Economy**,[100] which invests some funds directly on a project-by-project basis, but has also farmed out several new and continuing programs back to KSTC, which is budgeted for them at just under $5 million.

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[93] See www.enterpriselouisville.com/.
[94] See www.louisville-medcenter.com/.
[95] See http://www.greaterlouisville.com/content/aboutgli/2002_vision_update.pdf.
[96] See http://www.aicsoft.com/newsahs.htm.
[97] See http://www.loukymetro.org/mayor/staff.asp.
[98] See http://www.lca-inc.org/lca/about/default.htm and http://www.lca-inc.org/lca/lcmd/default.htm.
[99] See http://www.kstc.com.
[100] See http://www.one-ky.com. Since renamed the Department for Innovation and Commercialization for Knowledge-Based Economy (DICKBE).

STRATEGY CONTENT

The 1999 KSTC strategy[101] encompassed 10 major actions, including investments in R&D capacity, which had already begun as early as 1997, funds for technology commercialization, and efforts to build more financing sources for early-stage technology businesses. The KSTC strategy did not itself identify specific technology niches, but once it became operational, the **Office of the New Economy** invited each region to consider its own priorities and also identified several cross-cutting themes with the potential to attract substantial new federal funding:

- Visualization;
- Energy and Environmental Consortium;
- Safety and Security;
- Natural Products Center;
- Cardiovascular Research Institute; and
- Rural New Economy Business Building.

The New Economy Office reserved to itself direct, one-time investments in these initiatives, but delegated to KSTC management of two ongoing programs, **The Innovation Group**[102] (the ICC program and a modest sized grant program called the Commercialization Investment Fund) and the **Kentucky Science and Engineering Foundation**,[103] comprising an R&D excellence fund for exploratory research and an SBIR "Phase 0" grant.

RESEARCH CAPACITY BUILDING

The state's major investment in research capacity was through the **Research Challenge Trust Fund**, informally known as "**bucks for brains**."[104] The original goal was to allocate $350 million in state money matched 1:1 by institutional fund-raising, creating a $700 million pool from which investment income could support faculty chairs and recruitment packages necessary to attract highly productive research "stars." The state has contributed to the fund as budgets allowed, and reached a confirmed total of $230 million before a planned additional contribution in 2003 had to be deferred due to a budget shortfall. The entire package was shared mainly by the state's three main research institutions and to a lesser extent by the smaller, regional institutions in rural areas. According to the U of L, it received $100 million,[105] which tripled the number of endowed chairs from 25 to more than 80,[106] bringing the university an incremental $53 million in sponsored-research funding and spurring a concomitant rise in patent and licensing activity. To help U of L accommodate some of this growth, the New Economy Office contributed toward the university's fund raising for twin 130,000 square foot biomedical research towers.[107]

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[101] Kentucky Science and Technology Corporation. *Kentucky's Science and Technology Strategy.* Lexington, 1999. See http://www.kstc.com/?472.
[102] See http://www.kstc.com/?356.
[103] See http://ksef.kstc.com/index.htm.
[104] Summarized with respect to its impact on the U of L at http://www.louisville.edu/bucksforbrains/.
[105] See http://www.louisville.edu/bucksforbrains/donors.htm.
[106] See http://www.louisville.edu/bucksforbrains/facultyA.htm.
[107] Additional support from the Baxter Foundation (Baxter was a U of L alum).

As one example of a productive interaction among these programs, the university cites its use of the "bucks for brains" trust fund in 1999 to recruit Dr. Donald Miller from UAB to direct the U of L James G. Brown Cancer Center. With assistance from the KSTC, Dr. Miller and the team he brought with him were developing a compound for treatment of pancreatic cancer that became the basis of U of L spin-out **Aptamera**.[108] The company was a client of the research park incubator before it moved out to separate space, and recruited a professional CEO from a large local company. It received $5 million in financing from 70 local investors including the **Yearling Fund**; **Anchorage Angels** (based in a nearby suburb); the endowment fund of the locally based **James Graham Brown Foundation**; U of L's own **Minerva Ventures**, and **Prosperitas Investment Partners**, a local SBIC. [109] Aptamera was sold last year for $30 million to **Antisoma plc**,[110] a British firm that decided to keep operations in Louisville. There are hopes that the wealth created for local investors will be recycled into additional startups. Also, the high profile of this success helped U of L launch a $41.5 million capital campaign to expand its cancer center so it can win "comprehensive cancer center" designation from the NCI.

The second and smaller capacity-building program is the above-referenced Kentucky Science and Engineering Foundation, which grants at two tiers of funding: $15,000 to $50,000 per year for up to two years under the "emerging ideas" category (intended to set the stage for pursuing federal funding), and $20,000 to $50,000 a year for up to two years under the "emerging technologies" category (intended as preliminary to finding a technology commercialization partner). Targeted fields are:

- Biosciences;
- Environmental and Energy Technologies;
- Human Health and Development;
- Information Technologies and Communications; and
- Materials Science and Advanced Manufacturing.

INSTITUTIONAL COLLABORATION

Programs to encourage collaboration across the U of L campuses, with the other Louisville hospitals, and with UK in Lexington are the province of the New Economy Office. The signature collaborative initiative in the biosciences is the **Cardiovascular Innovation Institute,**[111] a separately governed joint venture of Jewish Hospital Center and the U of L. The goal is to expand on Jewish Hospital's experience with Abiomed to work on pacemakers and other assistive devices, especially "smart devices" that involve biosensing and biofeedback.[112] Scheduled to open next year, the building is 46,500 square feet over five floors plus an animal-care facility in the basement. The financing scheme includes the following major components:

- $15 million from Jewish Hospital's own fund-raising sources;

[108] See http://www.aptamera.com/.
[109] See http://www.prosperitasfund.com/about.asp.
[110] See http://www.antisoma.co.uk/home.asp.
[111] See http://www.one-ky.com/publications/assist.pdf.
[112] In this sense the strategy imitates that of Pittsburgh, which levered its experience with liver transplantation to get into tissue-engineering and regenerative medicine.

- $6.8 million from the Office of the New Economy;
- $6.2 million from federal earmarks arranged by Sen. McConnell;
- $5 from Kosair Charities (an affiliate of the Norton children's hospital); and
- $1.5 million from the local **Gheens Foundation.**

Other similar collaborative initiatives funded by the Office of the New Economy to create inter-institutional collaboration include:

- the **Natural Products Alliance**,[113] which cross-cuts U of L and UK as well as several companies in Louisville;[114]
- the **Institute of Molecular Diversity and Drug Design**[115] which links the U of L health sciences campus to Belknap, and includes a nutraceutical efforts in alliance with universities in South Carolina and Alabama; and
- two one-time grants of $2 million each for cancer research to both U of L and UK, and a financing package that will allow the bioprocessing facility owned by California-headquartered **Large Scale Biology Corp**[116] in nearby Owensboro to work with both universities on cancer drugs.

INDUSTRY COLLABORATION

Industry collaboration is encouraged through the two main programs under The Innovation Group:

- The **Kentucky Commercialization Fund**[117] makes grants of up to $225,000 over three years, no more than $75,000 in one year, to faculty investigators who have partnerships with Kentucky companies. There is no matching requirement, but there are repayments from royalties from any licensing of resultant IP. The program is capped at 70 percent to U of L and UK jointly.
- The **R&D Voucher**[118] fund makes grants of up to $200,000 over two years, no more than $100,000 a year, to companies for use at least 51 percent at a Kentucky university. This program also has characteristics of a pre-seed fund (see below).
- The Rural Innovation Fund, which allows companies based in rural areas (including bedroom communities to Louisville) up to $100,000 over two years to hire third-party consultants and/or universities to assist in commercializing new products or processes.

[113] See http://www.one-ky.com/publications/products.pdf.
[114] See http://www.ca.uky.edu/NPA/industrial.html.
[115] See http://www.louisville.edu/org/imd3/imd3.html.
[116] See http://www.lsbc.com/history.html.
[117] See http://www.startupkentucky.com/?33.
[118] See http://newsite.startupkentucky.com/?15.

TECH TRANSFER/COMMERCIALIZATION

The University of Louisville established an internal pre-seed fund named **Minerva Ventures**, which appears to be inactive at present. Other than that, there are no special commercialization mechanisms within the U of L Office of Technology Development. However, the entire mission of the Enterprise Corp. as a state sponsored Innovation and Commercialization Center is commercialization, and its clients may be either independent entrepreneurs or faculty spin-outs from the U of L.

PRE-SEED STAGE FINANCE

There are several sources of pre-seed capital available for technology startups, at dramatically different scales:

- Enterprise Corp. administers the **Vogt Invention and Innovation Award**,[119] which is funded by earnings on a $5 million endowment given by the Vogt family. Awards of up to $250,000 are made to companies either based in the region or agreeing to relocate, for commercialization. The program does not fund exploratory research, market entry or sales. Of the two 2003 winners, one was bioscience with a screening system for neurological disorders in newborns.
- The R&D Voucher fund (above) is often used as pre-seed financing for early-stage startups that have close university connections.
- KSEF offers a $4,000 SBIR Phase 0 grant for proposal preparation.

VENTURE CAPITAL

One of the programs of the Office of the New Economy is **Commonwealth Seed Capital LLC**, an internally managed fund of funds capitalized at $11.1 million. The Office has not disclosed the complete roster of holdings, but it is known that among its investee funds are:

- Chrysalis Ventures,[120] a pre-existing fund that is now the largest venture capital firm in the state with $140 million under management; and
- A $5 million **Natural Products Fund,**[121] a seed-stage fund operated by Sheltowee LLC.

The **Venture Club of Louisville**[122] was founded only recently, in 1995, and is now closely tied to the Enterprise Corporation.

ENTREPRENEURSHIP

The University of Louisville College of Business and Public Administration now offers an MBA with concentration in entrepreneurship,[123] and its **Institute for Entrepreneurial Research** has

[119] See http://www.vogtawards.com/Homepage/home.htm.
[120] See http://www.chrysalisventures.com/.
[121] See http://www.sheltowee.com/knpf.html.
[122] See http://www.ventureclub-louisville.org/.

provided a framework through which business students interested in entrepreneurship can assist the business incubators.[124]

WORKFORCE

The Health Enterprises Network is using a $3 million grant from the U.S. Department of Labor to launch a **Kentuckiana Healthcare Workforce Initiative**.

BUSINESS CLIMATE

In lieu of conventional R&D tax credits, Kentucky offers a credit of five percent against expenditures by companies on facilities that house R&D. In addition, the state offers income tax credits to investors in early-stage funds certified by the **Kentucky Economic Development Fund Authority**. Several funds have been certified, but the initial credits have not yet been claimed.

RESEARCH PARK/INCUBATOR INFRASTRUCTURE

The **Louisville Medical Center Development Corp**.[125] is developing a life sciences research and business park on disconnected sites in the medical district. In all, 25 acres will be developed for commercial use. Facilities in development at present are:

- **MedCenter One** – a three-story, 90,000 square foot multi tenant office facility created from three rehabbed older structures. The anchor tenant is **EmergINT,**[126] a small but established healthcare informatics consultancy recruited from Atlanta where it still maintains an office.
- **MedCenter Two** – a renovated two-story, 90,000 square foot facility equipped with 20,000 square feet of lab space, occupied mainly by **MedVenture Technology Corp**.,[127] which started as a commercialization company but shifted to work as a rapid-turnaround medical device manufacturer. Additional companies in this building include ApoImmune, a startup in Phase I trials of a personalized cancer vaccine.
- **MedCenter Three** – a newly constructed, three-story, 48,000 square foot Class A building equipped for both IT and wet labs. It houses both the university's **Information Technology Resource Center**[128] incubator and **MetaCyte Business Lab**,[129] a life sciences incubator owned by LCMDC and co-sponsored by the Office of the New Economy and the university's business college. The anchor tenant is the **Kentucky Proteomics Training Program**, financed by a grant from the New Economy Office. Other tenants are primarily startups taking 1,000 to 2,000 square feet each. They include

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[123] See http://www.cm.cbpa.louisville.edu/content.asp?id=443.
[124] See http://136.165.62.51/Institute/entrepreneurship_council.htm.
[125] See http://www.louisville-medcenter.com/.
[126] See http://www.emergint.com/About.htm.
[127] See http://www.medventure.com/Home.htm.
[128] See http://www.theitrc.com/.
[129] See http://www.metacyte.biz/aboutus_description.htm.

both U of L spin-offs, recruits, and companies started by scientists who left larger, distressed companies.

- The four-building **Haymarket** complex which could add up to 700,000s square feet of post-incubation and multi-tenant space, and serve to bridge the existing facilities.

The development model was mostly city financed purchases, supplemented by key grants from the New Economy Office.

SUMMARY AND LESSONS

Louisville was able to lever the state government's willingness to invest heavily in research capacity at the same time the region was already focused on pursuing the "health enterprise" sector as a strategic priority for regional economic development. These two policy tracks—state and local—worked together remarkably well. Even as the state supported faculty recruitments, the region was focused on building an entrepreneurial support structure that benefits university spin-offs, independent ventures, and inward attractions. There is now a heavy focus on commercializing early-stage discoveries, and while capital is still lacking, the process seems to be at an early stage. State money has also served as glue for collaborations that knit the clinical expertise of the downtown hospitals (cardiovascular and cancer) to the research capacity of the University of Louisville.

St. Louis, Missouri

THE STORY

St. Louis has a large Midtown medical district framed by **Washington University**; several affiliated hospitals including the well known **Barnes Jewish**; and **Saint Louis University** including a separate medical center. Until the last decade, little had been made of this physical asset, or of the region's rapidly growing bioscience research capacity. St. Louis thought of itself mainly as a manufacturing town, anchored by fabrication plants first erected by the McDonnell Douglas side of what is now **Boeing**, and by the giant electrical conglomerate **Emerson**. However, the city was also favored by the presence of the **Ralston Purina** Company, since merged with Nestle, which provided the family wealth behind the **Danforth Foundation**. A grandson of the founder, Dr. William Danforth, is a medical doctor who served as Chancellor at Washington University and also as chairman of the family foundation. Along with similar entities formed by the McDonnell family, the Danforth Foundation has been deeply involved in transforming the region.

A good part of this initiative was stimulated by civic leadership's interest in **Monsanto's** near death experience in the late 1990s, as it transitioned too rapidly from a pesticide manufacturer to a provider of genetically modified organisms. Although Monsanto had acquired a succession of innovative agbiotech startups, it faced substantial opposition to its early product introductions, leading to a decline in its stock price that enabled its acquisition by out-of-town interests. First absorbed into Pharmacia-Upjohn, which was interested mainly in its G.D. Searle pharmaceutical unit, Monsanto was run for a time from Chicago. Later its agbiotech operations were spun out again as an independent division that has since become a locally based company. In the process, civic leaders decided that—along with North American operations of **Bunge** and the headquarters of reagents provider **Sigma Aldrich**—Monsanto constituted the beginnings of a cluster that needed to be nurtured.

In 1997, as the Monsanto drama began to unfold, the Danforth Foundation began a five-year process of reorienting itself from a traditional charity to a driving engine behind the reinvention of St. Louis. The Foundation gave $100 million over five years to Washington University, for a wide range of disciplines, but with particular focus on the plant and life sciences, biomedical engineering, biology and chemistry. The Foundation also gave $60 million starting in 1998 to establish the **Donald Danforth Plant Sciences Center**,[130] an independent nonprofit institute created on the corporate campus of Monsanto and involving research partnerships with Washington University, the Missouri Botanical Garden, the University of Missouri at Columbia, the University of Illinois at Urbana-Champaign, and Purdue University. The grant levered a gift of 40 acres from Monsanto valued at $11.4 million, $50 million in additional gifts from the Monsanto Fund (the corporate foundation) and tax credits from the state worth $25 million. These funds built a 170,000 square foot facility intended to be staffed by 100–200 scientists, unique as a targeted plant science facility anywhere in the world.

[130] See http://www.danforthcenter.org/about/.

Significant recent "wins" for the region include commitments by **Pfizer** for a $100 million R&D center and by J&J's **Centocor** unit for a 250,000 square foot manufacturing facility. The region also hosts an increasing number of startups, some spin-offs from the research institutions, others attracted by proximity to Monsanto, and well supported by the region's two wet-lab incubators (see below). The most successful to date is **Stereotaxis**, originally founded by faculty from Virginia Tech, which came to one of the wet lab incubators several years ago and recently went public. Several other privately held firms on both the biomedical and plant side are graduating from incubator space.

STRATEGY ENVIRONMENT

Starting in 2001, the Danforth Foundation supported staffing for an academic/industrial **Coalition for Plant and Life Sciences**[131] hosted by the **St. Louis Regional Chamber and Growth Association.**[132] which also maintains a **Technology Gateway Alliance**[133] with interest in information technology, bioinformatics, and entrepreneurship. The 37-member Coalition has steered the regional strategy ever since, creating the **BioBelt**[134] branding initiative, spinning off the **MoBIO**[135] trade association, and undertaking a very successful capital-formation program that put $250 million in bioscience venture capital under local management within two years. With coordination from the Coalition, the Danforth Foundation joined with the Ewing Marion Kauffman Foundation in Kansas City to commission from Battelle a statewide bioscience strategy in 2002.

STRATEGY CONTENT

The strategy adopted at the turn of the millennium called for development of a new image for St. Louis as a leading center in plant sciences and a major center in life sciences. Key elements of the strategy included:

- An entrepreneurial culture that supports new firms;
- Ability to capture locally commercial applications of research; and
- Attraction and retention of a quality workforce.

A review by Battelle in 2004 found that of the 20 initial recommendations, there has been substantial progress on seven and some progress on all but two.

RESEARCH CAPACITY BUILDING

The State of Missouri has a state challenge grant for creation of new faculty chairs at the state's research universities, but in St. Louis this program has been far overshadowed by private investment in expansion of research capacity. In 2003 Washington University announced the

[131] See http://www.biobelt.org/pdf/coalition.pdf.
[132] See http://www.stlrcga.org/.
[133] See http://www.technologygateway.org/home.asp.
[134] See http://www.biobelt.org.
[135] See http://www.mobio.org/.

$300 million **BioMed21**[136] initiative, comprising new construction and 50 additional faculty lines. The cornerstone project is a $150 million, 250,000 square foot research facility at the medical center, and two smaller structures are also included. Participating units are the Center for Genomics and Human Genetics (funded by the NIH National human Genome Research Initiative), the Division of Clinical Sciences, and the Center for Biological Imaging.

Some $30 million of previous gifts from the Danforth Foundation were set aside in an endowed fund that will support start-up grants for faculty associated with BioMed21. By applying support from the Danforth Foundation, the university raised an additional $6 million from the John F. McDonnell and JSM Charitable Trusts and the McDonnell family. Across Midtown, Saint Louis University is making a parallel investment in a new $80 million health sciences building, housing its activities development. The Danforth Foundation had already announced it would shrink itself by transferring large shares of its endowment to projects it has already funded. In 2004, it committed $50 million as a matching grant to help the Donald Danforth Plant Sciences Center raise unrestricted funds and/or endowment from now through 2010.

As a consequence of the statewide strategy and lobbying by the Plant and Life Sciences Coalition, the legislature has agreed to allocate 25 percent of the funds it receives from the master tobacco settlement over the period 2007–2025 to a **Life Sciences Trust Fund**,[137] 80 percent of the income from which will be spent on research (the balance on technology transfer). This figure is expected to amount to about $36 million per year.

INSTITUTIONAL COLLABORATION

In response to the statewide strategy, the governor created a **Research Alliance of Missouri** intended to link the research and commercialization interests of the state's entire range of research universities.

INDUSTRY COLLABORATION

Missouri lacks any kind of funding for matching grants to promote industry/university collaboration. This is considered a major gap in programming.

TECH TRANSFER/COMMERCIALIZATION

In 2002 Washington University established what it calls the **Bear Cub Fund:**[138] an internal budget of $250,000 per year for commercialization research on promising discoveries. The program supports about five faculty grants a year of up to $50,000.

At Saint Louis University, the university has created a **Tech Transfer Endowment Fund** through its investment in several regional venture capital initiatives, and also created SLUTEC LLC, a privately held company that will provide proof-of-concept grants of up to $50,000 as a

[136] See http://biomed21.wustl.edu/summary.html.
[137] See http://www.lifesciences.mo.gov/qa.html.
[138] See http://ctm.wustl.edu/otm/otmsite.nsf/WV/90FB52E2DDC4DA7D86256CE2005C8CB2?OpenDocument.

way of preparing promising technologies for spin-off. Founded only in 1998, the office formed three startups in 2004.

PRE-SEED STAGE FINANCE

As a consequence of the early strategy work, business and philanthropic leaders provided $6 million in capital grants to **BioGenerator**, an independent non-profit pre-seed fund charged to work with technologies emerging from any of the region's research institutions, in any technology. Its original business plan called for review of 20 concepts each year, funding five projects at $250,000 each, resulting ultimately in formation of two startups.

VENTURE CAPITAL

Within two years of strategy formation, St. Louis had put $250 million to work in early stage venture capital funds targeting the biosciences. The cornerstone was **Prolog**,[139] created through a combination of state tax credits and investments by leading corporate citizens (including Monsanto) and the endowment funds of both the Danforth Foundation, Washington University, and the University of Missouri. Other funds formed or recapitalized during this period were **RiverVest**,[140] a biosciences oriented SBIC, and **Oakwood Medical Ventures**.

However, because the region was still weak in later stage funds able to do later rounds of financing, the capital formation of the Plant and Life Sciences Coalition worked to create a private-sector "fund of funds." Managed out of Boston by **Brook Private Equity Advisors**, this **Vectis Life Sciences Fund** raised $81.5 million from St. Louis area investors including the same universities and foundations and also several union-sponsored pension funds. This money will be invested in venture capital partnerships on a national basis, but with special attention on St. Louis and on venture partnerships which are likely to look at deals emerging from St. Louis. To date, it has invested $4 million more in Oakwood and an unspecified amount in Prolog, in addition to funds in Boston, New York and Palo Alto. Oakwood's fourth and largest fund has invested both in St. Louis deals and elsewhere, including in **Transmolecula**r of Birmingham and **Favrille** of San Diego. Previously Oakwood had invested largely elsewhere, although it did help bring Stereotaxis to St. Louis.

Altogether, counting both the money they have placed directly with St. Louis area venture funds and the money they have invested in Vectis and the BioGenerator, regional foundations have allocated $120 million in investment capital from their endowment funds. Additional "affinity" funds such as Cincinnati based Triathlon and Illinois-based Arch Development Partners have also scouted for investments and investors in St. Louis.

Arch Angels, an angel network composed of individuals who understand and are interested in plant and life science deals, was announced, with 13 initial members. Members must pledge $50,000 but invest as individuals.

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[139] See http://www.prologventures.com/about.htm.
[140] See http://www.rivervest.com/.

ENTREPRENEURSHIP

Both incubators (see below) have a strong focus on entrepreneurship and business planning, even providing counseling to firms that are not formally tenants. Washington University's Olin School of Business has opened the **Skandalaris Center for Entrepreneurial Studies**,[141] which funnels students from all disciplines (not just MBAs) to regional entrepreneurs through various "hatchery projects," practicums, and internship programs. Students may end up assisting at Boeing, or at the university's licensing office, or at the Missouri Venture Forum's **Invest Midwest VC Conference**.[142] Saint Louis University's **Jefferson Smurfit Center for Entrepreneurial Studies** has a somewhat more conventional program.

WORKFORCE

St. Louis Community College offers an associates degree in applied science biotech.[143]

BUSINESS CLIMATE

Because of constitutional restrictions on assisting private companies, Missouri relies heavily for its economic development programming on tax credits. However, these have been ad hoc and targeted in nature, rather than broad-based. Efforts to create a generous R&D credit have stalled.

RESEARCH PARK/INCUBATOR INFRASTRUCTURE

St. Louis is one of the few communities to have two wet-lab incubators, both fully occupied and operated by managers highly sensitive to entrepreneurship.

The **Center for Emerging Technologies** (CET)[144] is a nonprofit, lab-equipped incubator closely associated with the University of Missouri-St. Louis, which is not itself a bioscience institution. CET includes two buildings, both reclaimed from industrial use: 42,000 and 50,000 square feet, respectively. CET is balanced among bioscience and IT/engineering tenants but nearly all its tenants are linked to Washington University in some way. It was financed primarily by a combination of federal grants and state tax credits and charges $30 per square foot for laboratory space and takes a few points of equity in its tenants. It has launched a five-year, $5 million capital campaign that promises creation of 15 new firms, 200 jobs, and $250 million in capital investment.

CET's two buildings are not on the UMSL campus but rather in the developing Midtown neighborhood at the heart of a 1,000 acre research park/development district called **CORTEX**[145] by civic leaders. CORTEX is anchored at its corners by the Washington University Medical Center; Saint Louis University; Saint Louis University Medical Center; and the Missouri Botanical Garden. The overall commitment to CORTEX includes $15 million from Washington

[141] See http://www.olin.wustl.edu/acadRes/Entrepreneurship.cfm.
[142] See http://www.missouriventureforum.org/investmidwest.html.
[143] See http://www.stlcc.cc.mo.us/fv/biotechnology/degree_options_in_biotechnology.htm.
[144] See http://www.emergingtech.org.
[145] See http://stlcin.missouri.org/devprojects/projinfo.cfm?DevProjectID=274&isHC=1.

University; $5 million each from Saint Louis University and Barnes-Jewish Hospital; $4 million from the University of Missouri-St. Louis; a $2.9 million grant for US EDA; and $12 million in 1:2 state tax credits. Construction has begun on the first post-incubation building, $35 million structure that is 50 percent pre-leased.

The **Nidus Center for Scientific Enterprise**[146] is a 40,000 square foot new building situated on the corporate campus of Monsanto in Chesterfield in central St. Louis County, and its staff are employees of the company. The cost to Monsanto is $500,000 per year or $350,000 after depreciation. Tenants include companies that are not necessarily university spin-offs but those that were attracted by the opportunity to work with the Danforth Center, or were introduced to the region by venture capitalists, including some exploiting work originally done at Saskatchewan. Nidus charges $38 per square foot for lab space and takes an equity stake of up to five percent of the valuation after the first round of institutional investment.

Inability to offer multi-tenant expansion space has caused Nidus to lose one graduate to a new building built by the Missouri Botanical Garden, where 10,000 square feet was set aside for commercial use,[147] and could pose a similar problem for CET when Stereotaxis graduates. A study by a St. Louis based consulting firm confirmed that bioscience companies fall into two clusters: those that prefer a location close to Midtown medical institutions and those with larger space needs that prefer locations in central St. Louis County, such as Chesterfield, or even farther west into exurban St. Charles County. Therefore both the city and county have obtained federal EDA funds to subsidize development of multi-tenant space. CORTEX was the first to break ground. The facility in St. Louis County would be on the "North 8" of the 40 acres ceded by Monsanto to the Danforth Center.

SUMMARY AND LESSONS

The St. Louis experience demonstrates clearly the power of philanthropic involvement in regional strategies for technology-based economic growth. The Danforth and McDonnell families have been involved in every aspect of the regional strategy, from investment in research capacity through creation of new venture-investment partnerships. In so doing, they have brought the region's civic leadership along with them. St. Louis also represents a good example of the synergies between basic biomedical science and agricultural/plant science, especially as they intersect at the region's core industrial competency in specialty chemicals and biologicals. However, despite the region's success in building vehicles for early-stage venture investment, it is still concerned that it loses companies to later stages of financing. The Vectis fund of funds is intended to lever the resources of institutional investors in St. Louis to create obligations by venture partnerships based elsewhere to look carefully at St. Louis deals without seeking to relocate the companies.

[146] See http://www.niduscenter.com.
[147] See http://www.slfp.com/Shaw100801.html.

Saskatoon, Saskatchewan

THE STORY

As a largely agricultural province, Saskatchewan has quietly been building a lead for decades as Canada's center of agbiotech. The **University of Saskatchewan** (founded 1912 in Saskatoon) has a strong engineering school and a good medical school, but its strongest impact has been through its Agriculture College's study of the hybrid oil-seed crops (like canola) in which the region's farmers specialize. Hybrid crops are of intense interest to seed companies, which breed and sell them anew each year, and the university developed an early specialization that served it well as genetic techniques supplemented traditional plant breeding in the 1980s.

As early as 1948, the Canadian federal government was operating at Saskatoon a Prairie Regional Research Laboratory that eventually became the **Plant Biotechnology Institute,**[148] a federally sponsored industry collaborative on the U of S campus that works in close partnership with the Agriculture College's **Crop Development Centre**.[149] At about the same time, the provincial government created the **Saskatchewan Research Council,**[150] a publicly owned applied research institute encompassing both physical and life sciences programs. Another major tenant on campus is the **Saskatoon Research Centre**[151] of Agriculture and AgriFood Canada, a large organization (350 employees) whose closest U.S. analogue would be an agency federal laboratory.

In 1964, Saskatchewan solidified its hold on agricultural biotechnology by adding a well regarded School of Veterinary Medicine, and a closely associated Veterinary Infectious Disease Organization. In the late 1970s, the province started building on 80 acres of university land what would become the highly successful **Innovation Place**[152] research park, which has had good success at attracting Canadian (or western Canadian) research offices for a range of multinational agrichemical conglomerates. At about the same time, the province began supporting the predecessor of what is now **Ag West Bio**,[153] a nonprofit intermediary charged to develop the agbiotech cluster (and now several others as well).

In the past several years, the region's agbiotech strategy was validated by the recruitment of **Pyxis Genomics**,[154] a well regarded spin-off of the University of Illinois. At the same time, however, consolidation in the agri-chemical sector rocked the Innovation Place and focused the attention of leaders on the need for further diversification. As part of the adjustment, Ag West Bio was merged with similar organizations promoting value-added processing of nutraceuticals and bio-products including food, fiber and energy. Moreover, provincial leaders won federal support for two "big science" programs they hope will allow them to promote Saskatoon as a multi-sector "Science City".

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[148] See http://www.pbi-ibp.nrc-cnrc.gc.ca/en/pbi.htm.
[149] See http://www.usask.ca/agriculture/plantsci/cdc.html.
[150] See http://www.src.sk.ca.
[151] See http://res2.agr.gc.ca/saskatoon/index_e.htm.
[152] See http://www.innovationplace.com/html/frameset.html.
[153] See http://www.agwest.sk.ca/.
[154] See http://pyxisgenomics.com/info-o.shtml.

- VIDO was reinvented as the ***Vaccine*** **Infectious Disease Organization**.[155] Recapitalized with a $19 million[156] federal award that doubled its existing facilities near Innovation Place, VIDO will participate along with the Veterinary College in INTERVAC (International Vaccine Centre[157]). This is a new $62 million, 160,000 square foot facility on campus that will include western Canada's first Level 3 biocontainment facility.
- The main campus will host the $175 million **Canadian Light Source**,[158] a third-generation synchrotron that will be operated as a national user facility. A $44 million beam-line expansion planned for completion by 2007 should enable an expansion into highly sophisticated biomedical research that integrates well with VIDO and existing expertise in structural biology.

Originally Saskatchewan specialized in agriculture, while leaving medical biotechnology to the more populous provinces of Quebec, Ontario, and British Columbia, and energy to neighboring Alberta. Now the circle is closing. The biological expertise accreted to develop the agbiotech specialty is being applied to biomedicine, and plant crops are being thought of as a competitor to traditional energy supplies. Among the tenants of Innovation Place are two interrelated initiatives that give a clue to the province's future plans: **Saskatchewan Health Research Foundation**,[159] a provincially funded strategy entity analogous to Ag West Bio, and the **Saskatchewan Drug Research Institute**,[160] an effort by the university itself to build research partnerships in drug development.

STRATEGY ENVIRONMENT

The **Canadian Biotechnology Strategy,** first issued in 1983 and revised a decade later, was rewritten again in 1998 and is currently under the custodianship of the federal Treasury Board Secretariat,[161] an entity with no direct U.S. equivalent. The Biotechnology Strategy provides a charter to the **National Research Council** (operator of the PBI), and strongly affects the bioscience activities of the three major grant-making councils and the federal Agriculture agency (operator of the Saskatoon Research Centre). At the provincial level, the development strategy is expressed through the programs of the Industry Resources and Rural Revitalization Agency, sponsor of Ag West.

STRATEGY CONTENT

The Canadian Biotechnology Strategy calls for sustained investments in policy development, regulatory science capacity, and genomics R&D across six federal departments and agencies (National Research Council, Agriculture, Health, Natural Resources, Environment, and Fisheries/Oceans). A direct outcome of the strategy was formation of **Genome Canada**, a

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[155] See http://www.vido.org/about/fastfacts.php.
[156] All amounts in Canadian dollars.
[157] See http://www.vido.org/news/intervac.php.
[158] See http://www.cls.usask.ca/.
[159] See http://www.shrf.ca/shrf.html.
[160] See http://www.usask.ca/sdri/about.shtml.
[161] See http://www.tbs-sct.gc.ca/rma/eppi-ibdrp/hrdb-rhbd/cbs-scb/description_e.asp.

funding agency that was instrumental in attracting Pyxis, as described below. The strategy also integrates with the **Canadian Research Chairs** and **Canadian Foundation for Innovation** described below under capacity building, although these programs grew instead from the **National Innovation Strategy.**[162] At the provincial level, there is no explicit bioscience strategy. Policy is implicit in support for Ag West and its recent integration of formerly separate provincial initiatives in nutraceuticals and bio-products.

RESEARCH CAPACITY BUILDING

The university and the province have skillfully levered a range of federal government programs to build capacity, in the sense of both physical infrastructure and research talent.

On the infrastructure side, the province has worked especially hard to capture support from the **Canadian Foundation for Innovation**.[163] This is a nonprofit set up under the National Innovation Strategy to help regions build research capacity. It is capitalized by federal appropriations for a multiyear, nationwide investment program of $3.65 billion. CFI operates by granting 40 percent of the cost of infrastructure projects, with the balance to be picked up by other sources, including other federal programs, private donors, and provincial governments. In all, CFI has granted $26 million to Saskatchewan's two "big science" projects, the CLS and the INTERVAC center. In the latter case, the $19.2 million from CFI was the largest capital contribution by far and is itself a significant share of total project cost. The provincial match came in the form of a $9 million grant from the now-defunct **Innovation and Science Fund** that was intended as bridge financing to allow VIDO to develop new funding streams in human health applications. CFI support is a much smaller share of the CLS, matched mainly from the federal government's **Western Economic Diversification**[164] agency and its partnership with Saskatchewan province. The City of Saskatoon participates at a much lower level in both these matches.

To build research talent, the province has likewise levered two major federal programs:

- **Industrial Partnership Chairs** set up by the National Science and Engineering Research Council[165] as long ago as 1984. Saskatchewan now has nine of these, including two recently funded at VIDO to develop vaccines against food-borne pathogens, on which the partner is Ontario-based **Bioniche Life Sciences Inc**.[166]
- **Canada Research Chairs,**[167] a $900 million fund set up under the Innovation Strategy to seed 2,000 university chairs in multiple disciplines, matched by institutional or provincial or philanthropic funds.

Provincial resources for attracting research talent stems from two sources:

[162] See http://www.innovationstrategy.gc.ca/gol/innovation/site.nsf/en/in04113.html.
[163] http://www.innovation.ca/about/index.cfm?websiteid=5.
[164] See http://www.wd.gc.ca/default_e.asp.
[165] See http://www.nserc.ca.
[166] See http://www.bioniche.com.
[167] See http://www.chairs.gc.ca/web/about/index_e.asp.

- **Saskatchewan Research Program,**[168] first established in 1986 by the Agriculture, Food and Rural Revitalization Agency, and renewed for five years starting in 2003 to support 17 new chairs.
- **Innovation and Science Fund,**[169] once a source of matching support to grants from the major granting councils. This fund began life in the provincial Industry Resources agency but has been transferred to the education agency and de-emphasized in favor of direct support like the $9 million grant to VIDO noted previously.

INSTITUTIONAL COLLABORATION

Over the years funding initiatives have brought the U of S closer to its two hosted federal facilities, which whom it often shares joint appointments, and to VIDO. However, there do not seem to be equally strong connections with the provincially sponsored SRC. The region is exploring partnerships with U.S. states also interested in bioprocessing and value-added products.

INDUSTRY COLLABORATION

The main programs to promote academic/industry collaboration are actually federal programs. In fact, the largest single program *described* as collaborative in fact was used as the vehicle to attract **Pyxis** to Saskatoon. This is a firm whose founding team was two faculty members from UIUC, and its initial (and still nominal) headquarters are in Chicago. In 2002 the company created a Canadian subsidiary and relocated it to Saskatoon where it is incubating at VIDO with additional facilities at Innovation Place.

A partner from the life science venture capital firm Burrill and Co. has told Battelle that the key factor was not the presence of Innovation Place, or even the $100,000 that Ag West subsequently placed with Pyxis as a token investment, but rather Canadian federal R&D credits (see below under business climate) and also an enormous subsidy that was directed to Pyxis through a collaboration grant offered by the Calgary-based **Genome Prairie**[170] satellite unit of **Genome Canada**,[171] a $375 million national initiative.

Under this deal, Pyxis and **Inimex Pharmaceuticals** of British Columbia will jointly invest $13 million in a research program on functional pathogenomics and mucosal immunity," matched by Genome Prairie for a total project size of $27 million. The funds will be invested in work conducted primarily at VIDO and secondarily at the University of British Columbia and Simon Fraser University, also in BC. Inimex subsequently established a beachhead at Innovation Place.

The **NRC Institutes,**[172] of which the PBI is one example, are *themselves* intended as vehicles for cluster formation around academic/industrial collaboration. NRC supplements these institutes with a matching grant program called the **Industrial Research Assistance Program**[173] and also

[168] See http://www.agr.gov.sk.ca/docs/research/ADF/StatResearchProgram04.asp.
[169] See http://www.ir.gov.sk.ca/Default.aspx?DN=3150,3148,2936,Documents.
[170] See http://www.genomeprairie.ca/index.html.
[171] See http://www.genomecanada.ca/GCgenomeCanada/enBref/index.asp?l=e.
[172] See http://www.nrc-cnrc.gc.ca/contactIBP_e.html.
[173] See http://irap-pari.nrc-cnrc.gc.ca/main_e.html.

separate grants for "industrial research chairs." Likewise, the three main federal agencies for grant-making to individual investigators[174] collaborate on a **Network Centers of Excellence**[175] program that is conceived as a way to promote academic/industrial collaboration. U of S participates in at least a dozen of these networks, most prominently the agbiotech network. To supplement these networks, the NSERC offers its own version of **industry matching grants.**[176]

At the regional level, Ag West's investments could be described as either incentives for academic/industrial collaboration or pre-seed investments. However, among the other incentives for collaboration, is the ready availability of three separate contract facilities that operate outside the constraints of university sponsored research rules:

- **POS Pilot Plant Corp**.,[177] a nonprofit founded in 1977 and based on campus though independent of the university. It offers a 54,000 square foot facility with 11 laboratory suites that offers contract services in extraction, fractionation, purification, and modification of biological materials using aqueous alcohol extraction.
- The **fermentation pilot plant**[178] and two genetics and analytical laboratories[179] owned and operated by Saskatchewan Research Council.
- A 13,000 square foot **Bio-Processing Centre**[180] at Innovation Place that was bought by the park itself after its tenant/operator entered bankruptcy.

TECH TRANSFER/COMMERCIALIZATION

The U of S recently reinvented its struggling technology transfer corporation as an in-house Industry Liaison Office whose goal is to triple income from licenses and spin-offs over the next several years. The office reports seven startups over the last five years. There are no specific resources to support commercialization research other than the national partnership programs mentioned above.

PRE-SEED STAGE FINANCE

The major source of pre-seed finance for spin-offs from the university and the provincial Saskatchewan Research Council has been Ag West itself, which makes small scale investments of between $50,000 and $300,000. Its most recent $500,000 tranche of investments included $100,000 in Pyxis, and smaller amounts in five other regional startups in agbiotech and environmental technology.[181]

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[174] The Natural Sciences and Engineering Research Council; the Canadian Institutes for Health Research; and the Social Sciences Research Council.
[175] See http://www.nce.gc.ca/index.htm.
[176] See http://www.nserc.ca/programs/indus2_e.htm.
[177] See http://www.pos.ca/.
[178] See http://www.src.sk.ca/html/labs_facilities/pilot_plant/index.cfm.
[179] See http://www.src.sk.ca/html/labs_facilities/index.cfm.
[180] See http://www.innovationplace.com/html/tenantpages/bpc.html.
[181] See http://www.agwest.sk.ca/publications/2004-04-30_nr2.php.

In 2002 the provincial governments of Manitoba and Saskatchewan joined with several private investors[182] to capitalize **Western Life Sciences Venture Fund**,[183] a privately managed venture fund that targets investing $45 million in early stage deals across the western provinces, using a broad definition of life sciences. The most recent local investment was in IL Therapeutics, a university spin-off in veterinary medicine. Western Life Sciences was the sole seed-stage investor. An analogous national resource in biomedicine is the **Canadian Medical Discoveries Fund**,[184] a union-sponsored venture capital fund.

Certain agbiotech companies are eligible for $20,000 product development grants from the provincial **Agri-Value Program**[185] in the same Agriculture, Food and Rural Revitalization Agency that supports Ag-West.

VENTURE CAPITAL

Saskatoon is the western outpost of **Foragen Technology Ventures**,[186] an Ontario-based venture firm that targets development of agriculture-based products and services.

ENTREPRENEURSHIP

The University's College of Agriculture received $1 million from the Canadian financial firm CBIC to establish a Center for Agricultural Entrepreneurship.[187] The College of Commerce also now offers a **Biotechnology MBA.**[188]

WORKFORCE

There is programming in bioscience workforce development at both the federal and provincial levels. The federal government's National Biotechnology Strategy led to formation of a **Biotechnology Human Resources Council**[189] which supports a range of small projects including the **PetriDish** jobs portal. To help place graduating students in bioscience jobs in the western provinces, the Western Economic Development agency supports the **WestlLink** internship program including a "First Jobs in Science and Technology" component.[190] Within Saskatchewan, the university has created a **Virtual College of Biotechnology**[191] that combines programming from four of its divisions.

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[182] Including the Manitoba based, labor-sponsored, venture-capital pension vehicle Ensis; Ontario-based pharmaceutical company Biovail; and Keystone Technologies.
[183] See http://www.lombardlifesciences.com/westernlifesciences/.
[184] See http://www.cmdf.com/en/why_cmdf/lsifs/.
[185] See http://www.agr.gov.sk.ca/docs/research/ADF/agrivalue04.asp.
[186] See http://www.foragen.com/intro.html.
[187] See http://www.usask.ca/events/news/articles/20040621-1.html.
[188] See http://www.commerce.usask.ca/programs/mba/biotech_description.aspx.
[189] See http://www.bhrc.ca/about/index.htm.
[190] See http://www.westlink.ca/programs.php.
[191] See http://biotechnology.usask.ca/index.html.

BUSINESS CLIMATE

Canada has made a number of tax reforms in recent years including generous (up to 35 percent on the first $2 million) R&D tax credits,[192] provisions that allow small companies to roll over capital gains, removal of impediments to pension fund investments in venture capital, and creation of venture-investment arms in several national development banks. The province of Saskatchewan adds its own 15 percent R&D tax credits,[193] and has an "Invest in Saskatchewan Program" that adds 20 percent to the 15 percent federal credit on the first $5,000 an individual invests in "Labour-Sponsored Venture Capital Corporations"[194] that target the province.

The National Biotechnology Strategy is also supporting investment of $90 million over three years in the human resources and internal scientific capabilities of five federal departments involved in regulation or promotion of bioscience-based businesses (Environment; Fisheries and Oceans; Health; Industry; and Natural Resources) and the Canadian Food Inspection Agency.

RESEARCH PARK/INCUBATOR INFRASTRUCTURE

What has become the centerpiece of the province's bioscience development strategy is **Innovation Place**,[195] established in 1977 through an agreement between provincial government and the university, which owned the underlying land. Improvements on the land are now owned by a provincial quasi-public agency. More than $700 million has been invested in the park and related infrastructure by either public, private or university sources. In the years since its founding, the park has become more closely aligned with the university as faculty investigators accrued benefits from the province's early positioning in agbiotech. Current tenants from the large corporate sector include R&D facilities of BASF Canada; Bayer CropScience, Pioneer Hi-Bred, and Dow AgroSciences.

Smaller companies include regional pioneers like **Philom Bios**, an early licensee of PBI, **Prairie Plant Systems**, and more recent entrants like Pyxis and its partner **Inimex**. Innovation Place itself has no formal incubator, but does offer short-term, flexible leases within a 75,000 square foot biotechnology complex. This building includes wet-lab suites suitable for agbiotech or biomedicine companies, 43 greenhouse compartments and a 145-chamber phytotron chamber. This building includes a specialized plant genomics center adjunct to the PBI, which has been a tenant since 1989.

On campus itself, the main PBI has built a $15.4 million, 74,000 square foot **Industry Partnership Facility,**[196] which will function essentially as an incubator. The funding sources were the Western Economic Partnership Agreement ($4.9 million); the now-defunct Canada-Saskatchewan Agri-Food Innovation Fund ($1.5 million) and the NRC itself ($9 million). Initial tenants were announced as Guardian Biotechnologies and Agrisoma Biosciences, Seed Check Technologies and Targeted Growth Canada.

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[192] See http://www.cra-arc.gc.ca/taxcredit/sred/menu-e.html.
[193] See http://www.gov.sk.ca/finance/taxation/rtrbulletin2002.pdf.
[194] See http://www.ir.gov.sk.ca/Default.aspx?DN=3155,3148,2936,Documents.
[195] See http://www.innovationplace.com/html/frameset.html.
[196] See http://www.nrc-cnrc.gc.ca/newsroom/news/2003/ma_pbi_ipf03_e.html.

SUMMARY AND LESSONS

Saskatoon skillfully exploited industrial interest in local crop preferences to build a plant science capability that was unmatched among Canadian universities. This made the city the natural location for a series of federal investments aimed at promoting industrial partnerships and startup formation. While the university was initially a passive partner in development by the provincial government of the Innovation Place research park and the Ag Bio cluster group, it has since embraced the concept. Throughout, the province has skillfully exploited a wide and overlapping set of federal programs that have enabled it to attract a major agbiotech spin-off originally based in Illinois, and which will help transition a veterinary disease institute to a center of research on viral disease generally. With its attraction of the Canadian Light Source instrument, Saskatoon is re- branding itself now as the “Science City” of the Canadian Prairie.