# Building Louisiana's Innovation Economy

## A Plan to Foster University Technology Development and Commercialization

Prepared For:

Louisiana Board of Regents

Louisiana Recovery Authority

Submitted by
Regional Technology Strategies, Inc.

Carrboro, North Carolina

November 2007

# Preface

This report, prepared by Regional Technology Strategies (RTS) of Carrboro, North Carolina, under contract to the Louisiana Board of Regents and the Louisiana Recovery Authority, offers a plan to use the research capacity and talent within Louisiana's university system to generate new knowledge-based companies, support the growth of existing Louisiana companies and produce more high quality jobs across the state. The science and technology-based economic development process is dynamic and complex, but the goal is straightforward: more wealth in Louisiana communities and more opportunities for all of Louisiana's citizens.

The plan focuses on three important elements of the technology-based economic development process that fall within university purview: strategic investment in building R&D capacity, improving and accelerating technology transfer, and producing the people to start, manage and grow technology-based companies in Louisiana.

### ⇒ Strategic Investment

Louisiana must **identify and build upon the state's most competitive R&D assets** and invest at a scale that allows success. The plan recommends actions to propel state-of-the-art research in carefully defined areas through investments in top-flight faculty and their research, facilities, and equipment.

### ⇒ Technology Transfer

The ability to improve capacity to **move university technology from the lab bench to the marketplace will govern the success of this entire strategic plan.** The plan recommends actions to build a bigger and better bridge from university labs to the private sector by providing more resources and assistance to the technology transfer operations at Louisiana's universities.

### ⇒ Entrepreneurial Talent

Universities can't start and grow companies, but they can **produce the people who can**. The plan recommends actions to support entrepreneurial training and education for university students and faculty, encourage a more entrepreneurial culture within universities, and raise awareness of technology entrepreneurship within the general population.

This is a strategic plan to use university assets to produce economic development outcomes, rather than a statewide economic development plan. The latter would be much broader in scope, involve a much larger number of actors, and would focus on private sector assets. It is important, however, to stress that the private sector is where technology is commercialized, companies start and grow, and jobs are created. This plan must ultimately be grounded in private sector sensibilities, and its centerpiece organization, the Louisiana Innovation Alliance, must be led by the private sector if it is to have the greatest chance of success.

## This Report's Structure

This report begins rather than ends with its major recommendation: an operating plan for the creation of the Louisiana Innovation Alliance (LIA). The mission of LIA is to accelerate the growth of Louisiana's economy by enhancing technology-based research, developing and attracting talent, encouraging technology commercialization, and nurturing entrepreneurial skill and spirit. LIA is designed to generate direct impact through its programs and to drive systemic change by encouraging and rewarding entrepreneurial, strategic, and collaborative behaviors.

The remainder of the plan comprises a series of appendices that serve as foundation blocks for the plan. Appendix A, *Louisiana R&D and Technology Assessment,* provides a detailed analysis of academic research and development (R&D) strengths by discipline, performer, location, institutional affiliation, sector, and funding sources. It also summarizes emerging knowledge industries and clusters and their potential intersects with the university R&D community. The final section of this document identifies eleven university R&D areas as strong candidates for targeted investment and then selects four from this list as the highest priority targets based on match-ups with current and emerging strengths within the economy.

Appendix B, *Fostering University Technology Development and Commercialization: A Strategic and Tactical Analysis of Key Elements*, contains five white papers that analyze key factors governing the success of efforts to boost university research capacity and technology transfer prowess to produce economic development outcomes. The papers include benchmarks, best practice analyses, and recommendations on strategy and tactics for LIA and for actions and behaviors on campus that LIA should encourage and enable when possible.

Appendix C, *The Louisiana Innovation Alliance and Workforce Development*, addresses LIA's workforce development objectives both in terms of its internal program and in the manner that LIA connects to the state's overall workforce development system.

## A Strategic Focus with a System Orientation

The Request for Proposal for this project issued by the Louisiana Board of Regents and the Louisiana Recovery Authority called for a plan that features a strategic investment focus that builds on strengths within Louisiana's research universities and centers, with the goal of converting this research into marketable products and processes to be commercialized in Louisiana. The intent of the RFP as well as its language pointed to an established best practice model—the Georgia Research Alliance. The RFP did not stop there, however. It took one more big step. It required that this program to invest in established R&D strengths be linked to a statewide system to foster the commercialization of these university- and research center-generated technological opportunities within Louisiana.

From the project team's perspective, it makes sense to feed and nurture the system that enables technology commercialization and the start-up and growth of the kind of knowledge-based companies that could use the intellectual property generated by this strategy. The state needs a system that views all of Louisiana's colleges and universities as potential contributors as well as all of the regional and local economic development organizations, education and training providers and the thousands of private sector companies and entrepreneurs within the state's regional economies.

The state does not have a huge cadre of firms that might be interested in licensing intellectual property generated by its research institutions, and the level of its research enterprise is substantive but well below those of the states and institutions that set the competition. Even while Louisiana works to boost its research strengths, however, it can also make up ground by getting good at commercializing what it does produce and by supporting the growth of its technology companies.

The plan on the following pages is designed to do just this. Through a strategic focus, it invests in and builds on existing nationally competitive R&D strengths within the state's major research universities and centers. For the purposes of this plan, these are defined as those institutions with a minimum of $12 million in total R&D funding (as reported by the National Science Foundation).[*] Through its commercialization system orientation it offers programs designed to develop entrepreneurial talent, encourage connections between university resources and the private sector, and support the continued growth and development of technology transfer capacity. These programs will engage with all colleges and universities and are designed to reach into all of Louisiana's regional economies.

## Feedback

Seven formal briefing sessions with groups of university representatives and the technology-based economic development community were held during the course of this work. The first sessions were conducted in Shreveport, Baton Rouge, and New Orleans and presented the University R&D Strengths Assessment draft findings as well as sought guidance on R&D and technology transfer issues. The second briefing session was held in Baton Rouge in August 2007, and solicited feedback from university representatives throughout the state on the findings from the white papers as well as on

[*] As of this writing, these institutions are: LSU Health Sciences Center in New Orleans, Tulane University, Louisiana Tech, LSU A&M (including the Agricultural Center and the Pennington Biomedical Research Center), University of Louisiana at Lafayette, and the University of New Orleans.

organizing principles for the new organization. The final briefing sessions focused on the first draft of the operating plan for LIA and were held in October 2007 in Shreveport, Baton Rouge, and New Orleans. The project team extends its thanks to the more than two hundred people who attended these sessions. Their feedback was and is critical to the success of this initiative.

## The First Step

The LIA operating plan concludes with a brief discussion of implementation considerations. One aspect of this discussion, however, should be mentioned at this juncture. In the project team's judgment, it is important that the plan represent a good marriage of analytical skill with practical experience. The group concluded—based on its members' own research experience and experience in starting, building, managing, and re-engineering technology-based organizations—that it would be necessary to walk a line between painting with too broad or too fine a brush. The plan requires clarity about the objectives of the programs, their structure, their budget levels, and the kinds of activities in which they should be engaged—but it would be a mistake to be too prescriptive with exactly how the various programs would be administered. In moving from this planning stage to implementation, a good board and strong management must put their own stamp on all of the detail offered here. They will be the implementers, and the activities, policies, and procedures will be theirs. Getting overly prescriptive with procedures at this stage will create major distractions with straw man debates over details that must necessarily shift as the Board and management work through the implementation process.

This plan, then, is intended to represent a good start. It is designed to be the first step in the process that will be advanced by champions and supporters throughout the state and implemented by the first board of directors and management team. The real work begins now.

# Louisiana Innovation Alliance: Plan for a Statewide Innovation Economy Organization

## Part 1: Overview

The past several decades have witnessed a remarkable shift in what constitutes value. While the most valuable companies in the world used to be companies with vast physical assets, now many of the most valuable companies (such as Google, Apple, and Microsoft) have most of their wealth concentrated in intellectual assets—that is, knowledge. Louisiana's future economic success will be directly tied to its ability to create new knowledge, accumulate and share existing knowledge, and apply knowledge competitively. The entire education enterprise is dedicated to accumulating and sharing existing knowledge. This plan and these recommendations are intended to specifically support Louisiana's efforts to create new knowledge and to apply new and existing knowledge in order to create and grow companies, jobs, and wealth. ***Louisiana must become a world-class knowledge manager in order to excel in the knowledge economy.***

The proposed Louisiana Innovation Alliance (LIA) will set Louisiana on the road toward that world-class status. LIA will act as the vehicle for investing both public and private funds in Louisiana's public and private program areas. The organization, which will have a statewide mandate, will also act as a catalyst to develop partnerships and consortia among academic institutions, private industry, and the public sector. LIA will focus on supporting research niches in which the state has competitive advantages, including ways of recruiting top-flight faculty, growing technology-based companies, developing a more highly skilled workforce, and attracting both private and federal funds to support these initiatives. As a nonprofit organization that is independent of both the higher education system and the private sector (though representatives of both will participate in its governance), LIA will be able to provide a critical bridge between Louisiana's significant higher education resources and its burgeoning private sector capacity.

### Building on Louisiana's Existing Capacity

If it is to succeed in this venture, Louisiana will need to learn one of the most important lessons to be gleaned from reviewing the practices of successful technology development organizations—***build upon its existing strengths.*** To that end, it is worth revisiting the R&D Strengths Assessment delivered in an earlier stage of this project.[1] The purpose of this assessment was to systematically identify the strongest strategic R&D investment areas within the statewide academic research enterprise from an economic development standpoint. It should be stated at the outset that the purpose was *not* to choose "winners and losers," nor to exclude other industries from consideration in LIA's portfolio down the line. The goal is simply to answer the question: given that LIA must start its investment process somewhere and should do so in a way that capitalizes on existing strengths and builds on emerging potential, where does it make sense for LIA to start?

The team's answer was developed in three steps. The first step was to develop a predominant view of the strongest existing and emerging research areas on the state's campuses. Second, the team analyzed Louisiana's economy region by region to identify areas of competitive advantage that could match up with academic R&D strengths. The research team "layered" several analytical methods to identify two types of industry areas: those in which Louisiana's private sector already shows competitive strengths, and emerging knowledge-intensive markets in which there is some potential for the state to establish a new competitive advantage.

The third step was to compare the assessment of Louisiana's higher education R&D strengths with the identified industry areas. The outcome of this step was a list of eleven potential viable R&D investment areas—some of which are in industries of established strength in Louisiana, and some of which are in emerging or potential knowledge-based markets, but all of which build in some way upon existing R&D capacities on the state's campuses. Of these eleven, four industry areas (with more narrowly defined sub-areas also identified) were selected as being the highest priority strategic targets at the present time. Table 1 shows these four areas.

1 The full R&D Assessment is in Appendix A.

**Table 1:**
**Recommended Targets for LIA Investment**

| |
|---|
| **Agricultural sciences**<br>Food science<br>Plants & plants ecology<br>Forestry sciences |
| **Life sciences**<br>Immunology and infectious diseases<br>Genetics and genomics (including stem cells)<br>Bioengineering<br>Peptides |
| **Materials science & materials engineering**<br>Nanostructures<br>Thin films<br>Metallurgy |
| **Chemistry & chemical engineering** |

It is important to note that when viewed as a whole, all of the areas and sub-areas are intended to represent the group from which specific endowed chair and research enhancement investments should be selected. LIA Board and management should not seek to invest in every one of these domains. Rather, they should concentrate on the most compelling opportunities from an LIA mission standpoint and invest at levels that allow for success. It goes without saying that good board leadership, professional management, and strong investment discipline are required.

It is also critical to understand that these areas have been assessed as the best investment targets as of 2007. The worldwide academic R&D environment is very dynamic and constantly shifting, and Louisiana's industry and R&D strengths are in (or should be in) a continuous process of development. The state's recent investments in high-performance computing, for example, may, over the next couple of years, yield results that would justify making this one of the higher priority investment areas for LIA. For this reason, it is important that LIA develop the capacity to analyze the competitiveness of its existing and emerging investment targets on an ongoing basis.

## Operating Principles

LIA will accelerate the growth of Louisiana's economy by enhancing technology-based research, developing and attracting talent, encouraging technology commercialization, and nurturing entrepreneurial skill and spirit. It will do so by using the full range of Louisiana's institutions of higher learning and all of the state's technology assets.

In order to be successful and meet its long-term objectives, the organization will embrace ***four Operating Principles***:

## 1. Strategic Focus

For LIA to be effective in a very competitive research environment it must **think and invest strategically**. It must identify and build upon the state's most competitive R&D assets and invest at a scale that allows success. It is important that LIA focus on investing deeply in a relatively small number of very strong university R&D domains that speak to existing or emerging strengths in the state's economy. Inevitably, this will mean that some appealing ideas go unfunded—but disciplined, strategic R&D focus is critical.

## 2. All Assets on the Table

Though strategic focus is critical, that does not mean that LIA should limit its operational scope to the state's major research universities. **All of the state's higher education institutions should be in position to contribute to the mission.** There will be roles to play in developing commercialization networks and infrastructure, in connecting to the private sector, in workforce development, and in building and filling the Science, Technology, Engineering, and Mathematics (STEM) pipeline. All assets must be on the table.

## 3. Real Statewide Presence

If LIA is to live up to its mission and enjoy statewide support, it must ultimately have an impact throughout the entire state. LIA should commit to creating **some form of presence within each of the state's regional economies**.

## 4. Private Sector Support and Participation

**Technology is commercialized, companies start and grow, and jobs are created in the private sector**. Louisiana private sector leadership, participation, support, and funding are requirements for LIA to be successful.

# Part 2:
# Operating Plan for a Statewide Innovation Economy Organization

Following is a set of recommendations for what a statewide plan for commercializing Louisiana's research assets and translating that capacity into new Louisiana companies, new markets for existing Louisiana companies, and high-quality jobs across the state, should look like. This operational plan is based on extensive research into the most successful statewide organizations in the nation, culminating in the identification of those elements that are most likely to lead to a successful launch as well as long-term sustainability.

The plan below represents a best-case scenario for Louisiana. This means that the proposed model will have the greatest chance of success over the long term. This **does not mean** that other types of mechanisms or entities might not work—only that a different model will have greater hurdles to overcome. The model recommended is for Louisiana to create, through a partnership of both private and public interests, an independent 501(c) 3 non-profit corporation—**the Louisiana Innovation Alliance (LIA)**—to act as the vehicle for investing both public and private funds in strategic program areas.

The organization, which will have a statewide mandate, will also act as a catalyst to develop partnerships and consortia among academic institutions, private industry, and the public sector. LIA will focus on supporting research niches in which the state has competitive advantages, including ways of recruiting top-flight faculty, growing technology-based companies, developing a more highly skilled workforce, and attracting both private and federal funds to support these initiatives.

LIA will be a departure from traditional grant-making technology-based economic development organizations in the way it functions. Rather than existing simply as another funding vehicle to support university research, its role will be to make investment decisions that are in the best long-term interests of the state of Louisiana. LIA will not run or manage programs, but will work closely with research institutions to enhance their contributions to growing Louisiana's technology business community.

The recommendations below are designed to offer guidelines concerning organizational structure, governance, staffing and funding. They are not intended to offer detailed and prescriptive mechanisms for a newly created organization to follow. The new LIA Board of Directors and its management should have the leeway to address these issues in response to the needs of stakeholders and the marketplace.

# I. The Big Picture

While specific details of how a new organization might function are often a source of anxiety, most concerns are addressed through negotiation and compromise. At this early juncture, it is more critical that there be agreement on three "big picture" issues: organizational mission and goals, governance of the new entity, and the structure and culture of the organization. Without buy-in and commitment from stakeholders on these key elements, all other issues will be rendered moot.

## A. Mission

The Louisiana Innovation Alliance will accelerate the growth of Louisiana's economy by enhancing technology-based research, developing and attracting talent, encouraging technology commercialization and nurturing entrepreneurial skill and spirit. It will do so by using the full range of Louisiana's institutions of higher learning to encourage and facilitate economic growth throughout the state and by taking advantage of all of the state's technology assets. In all its work, LIA will pursue its mission in a manner that encourages the formation of an effective statewide science- and technology-based innovation system and culture.

## B. Governance

The recommendation in several respects follows the Georgia Research Alliance (GRA) model. In this instance, the "champions" of this initiative, industry leaders, banded together to establish the GRA prior to any financial commitment from the state. In addition, they committed funds for GRA's operating costs, choosing not to use state dollars — a practice that continues today. Under this scenario, the incorporators of the GRA appointed the initial Board, with new appointments managed internally so that the Board has become self-perpetuating. Today's Board includes 25 members—18 industry executives and seven university presidents.

The recommendation is for LIA to be governed by a fifteen-member Board of Directors, with a majority of the Board representing private industry interests. In addition to private sector leaders, Board membership should also include presidents of the major Louisiana academic institutions that currently spend more than $12 million on R&D annually and whose institutions would thus be eligible to receive significant LIA support.[*] This would place the Board composition at nine private sector members (strong consideration should be given to including non-Louisiana residents) and six

[*] As of this writing, these institutions are: LSU Health Sciences Center in New Orleans, Tulane University, Louisiana Tech, LSU A&M (including the Agricultural Center and the Pennington Biomedical Research Center), University of Louisiana at Lafayette, and the University of New Orleans.

university representatives, three of whom would come from qualifying LSU system entities. This Board of Directors will have final approval of all investment of funds and be responsible for setting policy for the organization.

"Champions" who are committed to the mission should establish the organization, without state support. The incorporators should be leaders from the private and public sectors that are committed to building a stronger technology-based economy in Louisiana and are willing to go public and lobby on behalf of LIA. It is recommended that the initial Board be appointed by a steering committee comprising LIA's incorporators, as well as representatives from the academic community and public sectors. The Board itself should make future Board appointments and be self-perpetuating.

An alternative method to creating an industry-driven, independent non-profit entity, was used in Pennsylvania when it established the Ben Franklin Partnership (BFP). There, the State indicated in the 1982 enabling legislation of the BFP that it would invest funds only in a non-profit organization created for the purpose of meeting the program's objectives.

A scenario that is not recommended is for the selection of Board members to be made through gubernatorial and legislative appointments. Experience indicates that while these types of appointments can be beneficial in getting new organizations off the ground, over the long term (with different governors and legislators) appointees have tended to shift the mission of the organization—exactly what LIA must avoid.

LIA cannot be perceived as a "political" organization or as simply another way of funding Louisiana's university community. LIA will not be another grants mechanism; rather it should be seen and act as an investment strategy for the state. The investment decisions made by LIA should be based on the best long-term interests of Louisiana and not on those of any particular institution.

## C. Funding

While there are always great expectations that organizations such as these will somehow generate enough funds to support programs, the reality throughout the US and abroad is that public funds make up the vast majority of these investments.

The internal administrative and operating costs for running LIA should be the responsibility of the governing Board, and programmatic investments should be supported through state and other funds. Using state funding as a base, LIA will be able to leverage federal, foundation, and private funds, but at the end of the day, without substantial public financial support, the initiative will fail. The reason is simple—the rationale for creating these types of organizations is to serve a public purpose and, for the most part, only public dollars will support these goals.

The relationship between LIA, an independently created non-profit organization, and state government will be very clear-cut. LIA will propose an annual budget to be approved by the state legislature, which will include the various program funding levels. Once these requests are approved, the State would appropriate funding to LIA through a state agency. Public funds will not be provided directly to LIA. These funds will be released to academic institutions participating in LIA programs through a contractual arrangement between LIA and the designated state agency.

Because LIA will have a contractual or grantee relationship with the State, to invest funds allocated by the legislature, it will not be perceived as a government entity. Rather, the State will be perceived as being an investor in LIA. The benefit, to both LIA and the state, will be that the organization will have the flexibility to attract other funds from the public and private sectors in order to accomplish its mission.

## D. Organizational Culture and Long-Term Sustainability

While a clear mission and an effective organizational structure are critical components to success, in many ways it is the cultural identity of the organization and how it perceives itself that is the difference between those organizations that excel over the long term and those that merely survive from one legislative session to the next.

Establishing an entity to bridge the gap between university research and commercialization is, to a great extent, about creating a culture of change. Successful organizations reflect this philosophy and imbed it into how *they themselves operate*. Entities that have seen themselves as simply a funding vehicle for the state have failed.

Success has come to organizations that have defined themselves and their mission as being more than simply the sum of their parts. The real success for the GRA and BFP has been to translate their successes into economic impact for their communities and to become a valuable asset and advisor to politicians in helping develop and implement policy for their states. This has led to more sophisticated and beneficial relationships among government, industry, and academia—all of which currently contribute to economic growth in their states today.

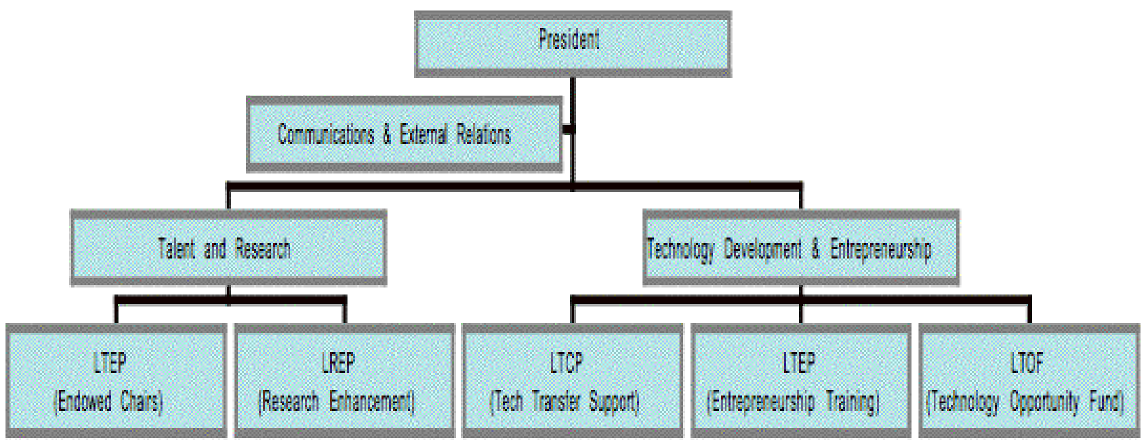
These organizations have become “players” in their states and created a national brand image, indicating that they are at the leading edge of technology development—an attractive proposition for emerging technology companies, entrepreneurs, and the image of the state.

# II. Operational Plan

## A. Organizational Structure

As shown on the accompanying organizational chart, it is recommended that LIA organize around three offices. The Office of the President will manage and administer the organization, as well as chart its direction with the Board of Directors. Two program-driven offices will address LIA's programmatic objectives. The Office of Talent and Research (OTR) should establish and manage the two programs aimed at strategic investing within Louisiana's major R&D strengths—the Louisiana Talent Excellence and the Louisiana Research Enhancement programs (described in Section III). The Office of Technology Development and Entrepreneurship (OTDE) should establish and manage the three programs that focus on developing a more effective technology commercialization system throughout the State: the Louisiana Technology Commercialization, the Louisiana Technology Entrepreneurship programs, and the Louisiana Technology Opportunity Fund (described in Section III).

LIA Organizational Chart




### 1. Office of the President

The Office of the President will have ultimate responsibility over program activities through the two Office Directors and, with its Communications and External Relations Manager, will be responsible for LIA's mission-related awareness activities and media relations as well as for leading the organization's fund-raising efforts.

LIA will be about much more, however, than programs. Success at LIA will mean that it has helped change the way the state and its citizens think about knowledge, talent, innovation, technology commercialization, and entrepreneurship. The Office of the President has a responsibility to provide leadership, to be a fulcrum and catalyst for innovation and a crusader for Louisiana's place in the 21st century global economy. The Office of the President has a prime responsibility to keep LIA goals at the forefront and maintain its keen technological and programmatic focus.

## Special Initiatives

The Office of the President will play a prime role in influencing mission-critical issues within the state that are outside of LIA's control. To that end, the office should routinely spearhead special initiatives that could have a major impact on Louisiana's technology economy. Two kinds of activities immediately come to mind. First, there will be occasions when technology-based initiatives with major statewide economic consequences surface that are outside LIA's established strategic investment foci. LIA's Office of the President should play a leadership role in supporting, promoting, and finding funding (external to LIA) for these efforts—especially for activities that build research, technology transfer, and commercialization capacity. The recently announced presence of the Air Force Cyber Command at Barksdale Air Force Base near Bossier City, as well as the potential of an associated civilian-run Cyberspace Innovation Center, is an excellent example of what should be an LIA special initiative. Another timely example is the state's very substantive investments in high-performance computing and cyber-infrastructure. As a technology platform, high-performance computing will have major applications within the four technology domains targeted by this plan for R&D investment. Just as importantly, as the high-performance computing investments continue to produce research outcomes, the research potential this technology domain represents should become a major research strength area.

A second group of activities that should garner special initiative support from the Office of the President are LIA mission-critical workforce and education efforts that address the status of STEM education in the state and workforce requirements for the growing cadre of technology-based companies. In this instance, an example would be an innovative program to keep the best and brightest students in the state, such as stipends and paid internships for National Merit semifinalists, finalists and Scholars and National Achievement Scholars (a companion program for African-American students). Additionally, LIA could establish a leadership position in this area by producing a biannual report on the state of Louisiana's science and technology workforce. The report would, for example, benchmark STEM graduation rates and monitor the workforce needs of the high-performing technology-based firms.

## Communications and External Relationships

The Office of the President will be tasked with encouraging and supporting the formation of technology commercialization infrastructure and networks within regional economies throughout the state. As stated in White Paper #4 of Appendix B, *Enabling*

*University Technology Commercialization in One Louisiana: External Infrastructure and Networks:*[2]

The processes of technological innovation and commercialization involve an interacting set of organizations and individuals, almost all of which are external to the research university. They may include: law firms with IP expertise, equity investment firms and solo angels, outsourcing specialists, management and human resource experts, product development specialists, manufacturing engineers, plant designers, and many other experts. Two important points: first, in order to facilitate the processes of commercializing academic science and technology, these specialty assets need to be relatively dense within a region—and hopefully adjacent to a university—as well as extensively "networked" with each other. Second, some networking evolves as a natural result of business transactions. In addition, in many areas there are non-profit or government organizations whose primary purpose is to facilitate interactions among these specialists, perhaps a local software association, a regional technology council, or a technology-oriented chamber of commerce. These network-facilitating organizations are important for a state like Louisiana.

Moreover, in order to be of significant help to the commercialization of early stage, new-to-the-world technology, this cohort of experts needs to have a mindset and an experience base that is oriented to the craft of entrepreneurial start-up companies. That is often the most logical path for commercialization, instead of licensing to existing enterprises. Over the past two decades, an increasing number of the most compelling and successful tales of university technology commercialization have involved startup companies, as opposed to straight license deals with existing larger companies.

In those places that are less naturally endowed with "soft infrastructure" assets as embodied in a well-developed business services industry, creative solutions are pursued. University leaders trying to promote technology commercialization, regional economic development organizations, and local technology industry may all join forces to jump-start a more comprehensive technology business development infrastructure.

It should be the responsibility of the Office of the President, through its external relations function, to engage with the private sector in all of Louisiana's regional economies by developing strong relationships with each region's key economic development intermediaries, including regional economic development corporations and authorities, regional and local economic development foundations, and chambers of commerce. A roster of Louisiana entities that represent the kinds of organizations that would comprise this network is attached to White Paper #4.

Examples of activities envisioned for this function include:

---

2 The full white paper can be found in Appendix B.

- Starter grants to support networking events at local, regional, or statewide levels;
- Awards to launch or support regional technology councils and networks;
- A statewide program that is a co-convener of activities and events that connect university capacity and private sector actors within specific technology domains or market applications;
- More research and analyses on the processes of network promotion;
- Communications through electronic and print media that consistently provide useful information to the R&D (university and private sector), entrepreneur, risk capital, and appropriate workforce development communities.

## 2. Office of Talent and Research

The Office of Talent and Research will build on existing research strengths by focusing on recruiting and enabling world-class talent within Louisiana's academic and research institutions in LIA's strategic R&D investment target areas. Funds from LIA programs such as the Louisiana Talent Excellence Program and the Louisiana Research Enhancement Program (described in Section III) would be used for activities under this group, such as endowing faculty chairs, supporting research teams, and investing in labs and facilities.

Attracting world-class faculty to Louisiana will be accomplished by having LIA work closely with Research V.P.s (or other designated officials) at each respective university. Academic institutions wishing to attract an individual to Louisiana using LIA funds would need to identify the specific researcher being recruited and submit their name to LIA for approval. As noted earlier, LIA will not be simply a grant-making organization, but will represent the interests of the state of Louisiana. This will help researchers being sought under this process to understand that they are being recruited as part of a unique opportunity.

Universities eligible to participate in LIA's Talent and Research programs would include those Louisiana research institutions that receive more than $12 million in total R&D support (as reported by the National Science Foundation).[*] (This benchmark corresponds to the lowest funding level among GRA-eligible institutions.)

[*] As of this writing, these institutions are: LSU Health Sciences Center in New Orleans, Tulane University, Louisiana Tech, LSU A&M (including the Agricultural Center and the Pennington Biomedical Research Center), University of Louisiana at Lafayette, and the University of New Orleans.

## 3. Office of Technology Development and Entrepreneurship

The Office of Technology Development and Entrepreneurship (OTDE) will establish and manage the three LIA programs designed to foster a more effective technology commercialization system within the state's regional economies. This office will also be tightly linked to the Office of the President's commercialization infrastructure and network development activities. These activities should routinely generate engagement and funding opportunities for all three OTDE programs.

# B. Staffing

It is anticipated that nine full-time staff will be needed to manage an effective statewide program. For planning purposes, a staffing roster is included at the conclusion of this document. The Board of Directors and staff will raise the annual budget of just over $1.67 million from private-sector recurring contributions—not through state appropriations.

Roles of staff will include: developing relationships with all institutions of higher education, industry technology organizations, economic development groups, and federal agencies; soliciting and evaluating projects from partners; seeking out new investment opportunities and funding sources; and creating, communicating and marketing the program brand. Anticipated staffing needs include:

- President
- Administrative Assistant for the Office of the President
- Manager of External Relations and Communications
- Director for the Office of Talent and Research
- Program Associate for the Office of Talent and Research
- Director for the Office of Technology Development and Entrepreneurship
- Program Associate for the Office of Technology Development and Entrepreneurship
- Administrative Assistant to support the Offices of Talent and Research and Technology Development and Entrepreneurship
- Office manager and bookkeeper

In addition to its core staff, LIA should also take advantage of the human resources available within the university community and private industry to enhance its capabilities. For example, having an ongoing liaison relationship with each academic institution will facilitate transactions, and using venture capitalists as advisors for commercialization projects will add significant value to the potential deal.

Initially, to provide additional technical expertise, the Board may want to consider creating a small (4-6 members) advisory panel for each of the strategic focus areas to provide ongoing guidance as the program is launched and executed. This small committee would consist of state and/or federal officials, drawn heavily from the region, who have designed and operated successful programs of a similar nature, as well as industry research executives.

# III. LIA Objectives, Programs, and Activities

Perhaps the most important lesson learned from the review of other state programs is that success comes to those who build on their existing R&D strengths and capabilities. In keeping with this lesson, LIA should focus on four major operating objectives, each with a corresponding program, that focus on research enhancement, talent, technology commercialization, and entrepreneurship skills and training.

## A. LIA's Program Objectives

This section presents the four program objectives that will be the underpinning of all LIA's activities and initiatives. For each objective, a program is designated to house the activities that speak to that objective. Section III(B) presents details on each of these four programs.

### Objective 1. Attracting and recruiting top-flight faculty.

As with the Georgia Research Alliance, a primary emphasis will be to support research-universities in nationally recruiting top-flight faculty to support work on the focus technology areas and expand those capabilities. *The Louisiana Talent Excellence Program (LTEP)* will focus on these needs.

### Objective 2. Enhancing research in focused technology areas at Louisiana's research universities.

LIA will invest in labs and equipment and build consortia to support the technology focus areas in which Louisiana institutions hold a competitive advantage. It is anticipated that a substantial amount of this investment would go towards supporting the work of the research faculty recruited to the state. *The Louisiana Research Enhancement Program (LREP)* will advance this initiative.

**Objective 3. Growing technology-based companies by commercializing university technology and utilizing faculty, student, and laboratory resources.**

A third priority will be to use the resources available at Louisiana institutions of higher education to grow the technology-based business community in the state. *The Louisiana Technology Commercialization Program (LTCP)* will lead this effort.

**Objective 4. University-Industry Technology Training.**

Working with universities, community colleges, K-12 systems, and the private and non-profit sectors, LIA will work to increase the supply of appropriately skilled people who can lead technology-focused entrepreneurial companies in Louisiana and strengthen the capabilities of local and regional companies throughout the state. *The Louisiana Technology Entrepreneurship Training Program (LTET)* will lead this effort.

The programs will be structured to (1) address key elements of this innovation process in ways that not only improve them, but link and leverage them whenever possible, and (2) encourage and reward behaviors, policies, and activities in other entities—including the university community—that support its entrepreneurial mission. The first two objectives will be narrowly focused on targeted technology areas, while the latter two will have a broader audience.

In addition, to provide LIA's Board with flexibility to take advantage of the technology assets and expertise available in smaller academic institutions throughout the state, LIA should include the creation of a *Technology Opportunity Fund* (described at the end of this section).

## B. LIA's Programs and Activities

This section presents the four programs that will house and carry out LIA's activities. The programs correspond sequentially to the objectives numerated above in Section III(A).

**Program 1: The Louisiana Talent Excellence Program (LTEP)**

**The goal of the LTEP is to significantly increase the depth and breadth of productive, commercialization-oriented R&D talent in Louisiana's universities.**

The LTEP, which will be directed by the Office of Talent and Research, will base its activities on the following program objectives:

- To create and successfully fill 30 endowed senior professorships over several years, with individuals of national prominence in both fundamental science and commercial development; and
- To build a cadre of talented people in Louisiana who combine R&D excellence as well as entrepreneurial fervor, and help build a culture that rewards and recognizes those activities.

## *Examples of Activities*

The range of projects will be confined to relatively few types, all of which involve some combination of science recruitment and retention:

A branded, nationally prominent endowed chairs program, akin to the Georgia Research Alliance practice, in which senior faculty positions are recruited by a research-intensive campus or a partnership of two or more campuses;

Cluster recruitments in which, over a 2-3 year period, one or more endowed chair positions are paired with several tenure-line or non-tenure line positions in the same area of science and technology, and also involve two or more institutions.

## *Project Selection*

Selection of senior recruitment efforts will consider criteria such as academic and research excellence, the centrality of the focus area of science to the technology focus areas, the level of fit between the proposed hire or hires and existing research programs, the credibility of the proposed recruitment process, and the likelihood that there will be near-term commercialization impacts as a result of the proposed hire. To the extent feasible, the program will seek hires that are both research stars as well as advocates of a culture of technology entrepreneurship.

## *Program Budget and Matching Funds*

The endowed chairs program will be launched with an aggressive effort during the first 4-5 years, and then in out-years add one to two chairs per year. After initial ramp-up, the program will require an annual budget of $10 million. The target will be to maintain

30 endowed chairs, plus related appointments, in Louisiana academic research programs, all working in technology focus areas.

With the cost of attracting nationally recognized faculty continually on the rise, it is recommended that LIA invest a maximum of $2 million for each endowed chair. Matching funds from the participating university should, at minimum, total 25 percent of LIA's investment.

**Program 2: The Louisiana Research Enhancement Program (LREP)**

**The goal of the LREP is to significantly increase the scope and quality of R&D in technology focus areas in which Louisiana institutions hold a competitive advantage.**

LREP's priority will be providing significant investment to support the work of eminent scholars recruited to Louisiana. Like the LTEP described above, it will be directed by the Office of Talent and Research. Program objectives include:

- To build and fund nationally pre-eminent, institution-specific and institution-shared laboratory facilities and equipment;
- To increase the scope and impact of fund-raising and grant success in technology focus areas;
- To increase the frequency, scope, quality, and success of research consortia and organized research units (ORUs);
- To increase the frequency, scope, and commercialization potential of industry-sponsored research;
- To focus research resources on projects that embody an entrepreneurial mindset and approach.

## *Examples of Activities*

The range and scope of activities under this program will be quite wide. Examples include:

- Laboratory capital improvement projects;
- Post-award (e.g., from NSF, NIH or other federal agencies) enhancements of projects with significant commercialization potential;
- Planning grants to develop technology commercialization-oriented research centers and/or consortia;
- Applied research funding to extend the commercialization potential of new technology developed at a Louisiana institution.

## *Program Budget and Matching*

At maturity, the program will be funded at an annual level of $15 million. It is recommended that the program be launched initially at an annual level of $5 million and expand to its steady state level. This will parallel the growth of the Louisiana Talent Excellence Program (LTEP, see above). Awards will require monetary and/or in-kind matches ranging from 25 to 50 percent. Match levels may be an award criterion.

## *Project Selection*

Review criteria will encompass scientific excellence, commercialization potential, and participant cost sharing, along with other criteria specific to a particular activity. Review of projects will vary by activity but may include peer review by panels incorporating university and industry experts, LIA staff screening, and potentially an Omnibus Program Review panel.

**Program 3: The Louisiana Technology Commercialization Program (LTCP)**

**LTCP's goal is to significantly increase the scope and speed of commercialization of university-originated technological advances in Louisiana.**

While this program's funding level and scope are relatively modest when compared to the Talent Excellence and Research Enhancement programs, the LTCP, which will be directed by the Office of Technology Development and Entrepreneurship, is every bit as important because it is the bridge to the private sector. In fact, a convincing case can be made that the ability to improve capacity to move university technology from the lab bench to the marketplace will govern the success of this entire strategic plan. In order to accomplish this, university technology transfer operations should be professionally managed, adequately funded, valued by university leadership, and clearly understood by the private sector. As it relates to the technology transfer operations at Louisiana's universities, it is important to note that LTCP is designed to function as an enabler. It exists to provide additional financial resources and technical support to these operations.

This program will concentrate on building capacity to improve technology transfer of university intellectual property and/or expertise to already-established technology companies, as well as accelerating the successful launch of startups based on university inventions. Program objectives include:

- To increase the quality, quantity, expertise, and performance of university-based technology transfer functions throughout the state;

- To foster technology entrepreneurship generally, particularly that involving university programs and activities;
- To enhance existing regional and community-based networks of private, public and non-profit organizations that work together to foster technology commercialization, entrepreneurship and regional economic development;
- To foster the creation and growth of university-linked seed and early-stage equity funding;
- To foster technology development and commercialization partnerships between universities and rapid-growing technology companies in the state.

### Examples of Activities

This program will have the widest range of projects of any directed by LIA. The themes that tie them all together are: (1) cutting edge technology, (2) rapidly-growing new technology companies, (3) intellectual property, (4) entrepreneurial mindset, and (5) technology focus areas. Examples include:

- Training and professional development grants to technology transfer offices;
- Grants for new or expanded university-based entrepreneurial centers and awards to expand the scope and quality of commercialization training for faculty;
- Program enhancement grants for university-linked technology business incubators;
- Awards to expand the activities of existing community-based technology councils, alliances, networks, or similar organizations;
- Grants and matches to expand training and assistance in SBIR/STTR programs;
- Projects to stimulate the formation and operation of angel networks;
- Curriculum development in entrepreneurship education.

### Project Selection

Review criteria will encompass scientific excellence, commercialization potential, and participant cost sharing, with other criteria being specific to a particular activity. For this program there will be a reliance on internal staff screening and review with assistance by a single omnibus Program Review Panel.

### Program Budget and Matching

The program's annual budget will be $3.5 million. Awards will require monetary and/or in-kind matches of at least 50 percent.

**Program 4: The Louisiana Technology Entrepreneurship Training Program (LTET)**

**LTET's goal is to increase the supply of appropriately skilled people who can lead technology-focused entrepreneurial companies in Louisiana.**

This need is acute in the state, and endemic everywhere in the US. There are a number of nationally notable entrepreneurship education and training programs in the state. This program, which will be directed by the Office of Technology Development and Entrepreneurship, is intended to supplement and build on what is already there. Objectives of this program include:

- To build a cadre of technology-smart business degree holders, as well as a comparable group of engineers and scientists who are knowledgeable about the business of doing technology start-ups;
- To enhance a mindset among talented young people that encourages technology entrepreneurship as an attractive career path—and one that can be executed in Louisiana;
- To foster general knowledge—within educational settings, but also across the general population—about technology entrepreneurship.

### *Examples of Activities*

All of the activities funded within this program will be designed to enhance knowledge, skills, and positive mindset around technology entrepreneurship and not just within the focus technology target areas. A wide range of types of projects and participating organizations will be encouraged. Examples of activities include:

- Projects that will provide matching enhancements to awards from national entrepreneurship funding organizations (e.g., National Collegiate Inventors and Innovators Alliance);
- Projects to fund and place university interns into Louisiana companies that have licensed Louisiana university technology;
- Projects that will develop joint degrees between Colleges of Business and Colleges of Engineering (or other technical disciplines);
- Projects that will provide seed funding ($5K to $10K) for graduate students pursuing a technology start-up while in school;
- Projects to support knowledge dissemination (e.g., conferences) regarding key components of the technology venturing process, such as angel investing;
- Projects that will introduce concepts and basic understandings of technology and technology entrepreneurship to K-12 students in Louisiana communities;

- Projects that will encourage the print and electronic media in Louisiana to become more knowledgeable about technology entrepreneurship (e.g., a study visit to Santa Clara County), and presumably to increase their coverage of these topics.

### *Project Selection*

Review criteria will encompass innovation, collaboration, knowledge transfer potential, and participant cost sharing, along with other criteria specific to a particular activity. Staff review of proposals will be supplemented by ad hoc groups of reviewers organized around a particular domain of entrepreneurship education and training.

### *Program Budget and Matching*

The program's annual budget will be $3.5 million. Awards will require matching monetary and/or in-kind matches of at least 50 percent.

**The Louisiana Technology Opportunity Fund**

**This fund's goal is to take advantage of statewide opportunities to bring together academic resources and the private sector to make significant contributions to regional economies.**

Whereas LIA's primary focus is to support world-class research leading to commercializing, it also has a statewide mandate for commercializing Louisiana's research assets and translating that capacity into new Louisiana companies, new markets for existing Louisiana companies as well as high-quality jobs across the state. Given this mandate, LIA's Board should have the opportunity to make investments in technology-based projects that are partnerships of university talent and knowledge and private industry expertise *and* that will make a significant contribution to the growth of Louisiana's economy. The Louisiana Technology Opportunity Fund, which will be directed by the Office of Technology Development and Entrepreneurship, will give LIA's Board that opportunity.

### *Examples of Activities*

This program is designed to take advantage of singular opportunities that might present themselves during a fiscal year. Following are the types of projects that would be eligible to apply under this initiative.

- Partnerships between organizations such as the Cyber Innovation Center in North Louisiana and academic institutions and private companies within the state;

- Existing Louisiana companies which require technology expertise for product and process development from an academic institution within the state;
- Consortial activities such as those undertaken at Xavier University, which was supported by the Board of Regents Research Commercialization and Educational Enhancement program during the summer of 2007. Support was provided to create a new Center for Nanomedicine and Drug Delivery at Xavier. The project provided the opportunity for an under-served population of students to be trained in this highly biotechnical area of research. The Center would expose pharmacy undergraduate students to nanoscience and technology, which could have a tremendous impact on the economic growth and sustainability of biotechnology in the region. The goal is to attract the attention of pharmaceutical companies that will develop specialized drugs and systems in New Orleans, thereby generating more money for the region.

### *Project Selection*

There are currently no specific guidelines recommended for this initiative other than that the project be technology-based, be a partnership between an academic institution and private industry, and indicate significant contribution to the growth of the Louisiana economy. Other selection criteria and project selection processes should be left to the discretion of the Board; in fact, under this program they would not be obligated to invest state funds if no suitable projects were presented to them.

### *Program Budget and Matching*

The recommendation is to initially budget $1 million for this program, to be capped at $3 million in year three. All LIA investments would require a 50 percent match.

# IV. Budget and Costs

The program and operating budgets presented below are intended as general estimates. They should be viewed as points of departure that may need to be fine-tuned throughout the implementation process.

## A. Program Costs

It is anticipated that annual programmatic costs for the Louisiana Innovation Alliance when it is fully operational in year 3 will total some $35 million. These funds will be matched in some capacity by partnering organizations. It should be recognized that funds made available to LIA through the State do not replace or compete with appropriations made to the higher education community. LIA has very distinct economic development goals that are separate from those associated with basic research. Estimated program costs are:

- The Louisiana Talent Excellence Program: $10 million
- The Louisiana Research Enhancement Program: $15 million
- The Louisiana Technology Commercialization Program: $3.5 million
- The Louisiana Technology Entrepreneurship Training Program: $3.5 million
- The Louisiana Technology Opportunity Fund: $3 million

## B. Implementation Timetable

To achieve this goal the following timetable is recommended:

Start-up costs: $500,000. These funds would go towards recruiting and paying the salaries of a CEO and Communications/External Relations Manager and other start-up costs for up to 9 months. Primary activities would be to build relationships and ownership with all stakeholders and develop guidelines for all program areas. Table 3 presents estimated ramp-up costs for LIA's first two years.

**Table 3: Estimated LIA Program Expenses, Years 1 and 2**

| Program | Year 1 Investment | Year 2 Investment |
|---|---|---|
| Talent Excellence Program | $4 million | $6 million |
| Research Enhancement | $6 million | $10 million |
| Technology Commercialization | $1.5 million | $2.5 million |
| Technology Entrepreneurship | $1.5 million | $2.5 million |
| Technology Opportunity Fund | $1 million | $2 million |

### *Operating Costs*

As previously mentioned, it is recommended that the internal administrative and operating costs for running LIA be the responsibility of the governing Board and programmatic investments be supported through state and other funds. Raising and funding the annual operating budget through private sector sources and other "non-state" sources will be a best practice challenge; it can be accomplished, however, with strong leadership from private and public sector champions.

Annual operating costs are estimated to be just under $1.7 million when LIA is fully functional. Budget and staffing breakdowns are presented in Tables 4 and 5.

**Table 4:**
**Louisiana Innovation Alliance Annual Operating Budget Estimates**

| **Expenditures** | |
|---|---|
| **Administration (Office of the President)** | |
| Salaries & Benefits | $531,250 |
| Expenses | |
| General & Administrative | $150,938 |
| External Relations and Communications | $195,000 |
| **Total Administrative** | **$877,188** |
| | |
| **Programs** | |
| Talent & Research | |
| Salaries & Benefits | $237,500 |
| Expenses | |
| Direct costs | $35,625 |
| Technical assistance | $125,000 |
| *Subtotal* | *$398,125* |
| Technology Development & Entrepreneurship | |
| Salaries & Benefits | $237,500 |
| Expenses | |
| Direct costs | $35.625 |
| Technical assistance | $125,000 |
| *Subtotal* | *$398,125* |
| | |
| **Program Operating Costs** | **$796,250** |
| | |
| **Total LIA Annual Operating Costs** | **$1,673,438** |
| | |
| ***Budget notes*** | |
| Benefits estimated @ 25% of salary | |
| G&A estimated @ 15% of salary plus fringe | |
| External Relations and Communications: media costs, sponsorships, etc.: $70,000 | |
| R&D Strength Assessment, Annual Workforce Assessment: $125,000 | |
| OTR & OTDE Direct costs estimated at 15% of salary plus fringe | |
| OTR & OTDE technical assistance: technology assessment, etc. | |

**Table 5:**
**Louisiana Innovation Alliance Staffing Roster and Salary Estimates***

| | |
|---|---|
| **Administration** | |
| President | $225,000 |
| Administrative Assistant74 | $50,000 |
| Director: External Relations & Communications | $90,000 |
| Office manager and bookkeeper | $60,000 |
| **Administrative Salaries** | **$425,000** |
| | |
| **Programs** | |
| Director: OTR | $100,000 |
| Director: OTDE | $100,000 |
| Program Associate OTR | $65,000 |
| Program Associate OTDE | $65,000 |
| Administrative Assistant | $50,000 |
| **Program Support Salaries** | **$380,000** |
| | |
| Annual Salaries Total | $805,000 |
| Fringe & Other Benefits | $201,250 |
| | |
| **Total Salaries and Fringe** | **$1,006,250** |
| | |
| Notes: | |
| * includes fringe benefits—estimated at 25% of salary | |

# Implementation: Next Steps

The final element of this report addresses the issue of implementation. How does Louisiana get from this report and its recommendations to creating a successful, sustainable statewide system?

Making the Louisiana Innovation Alliance a reality will require much legwork and coalition-building to address the myriad details and questions that will be posed. It will require a dedicated group of individuals to commit themselves early to addressing a number of critical issues.

Most important is the recognition that an initiative of this magnitude will be challenging to establish unless there are one or more champions who are available to see it through its birth. These champions can come from private industry, as in the case of the GRA, or government, as with Pennsylvania's Ben Franklin Partnership and the Arkansas Science and Technology Authority, two successful models of state-based organizations promoting technology development and commercialization.

Building broad coalitions will be equally important. Establishing the Louisiana Innovation Alliance should not be seen as a partisan or political issue—the BFP was created by the Republican Governor Thornburgh while ASTA was created by Democratic Governor Clinton, and various political administrations have supported the GRA equally.

Lastly, the mission of LIA should be clearly defined. "Clarity of purpose" is often the most important element in getting a new initiative off the ground. It is why stakeholders buy into the concept, why legislatures decide to invest, and why the general public approves of it as an appropriate investment of public funds.

The tendency in creating a new program is that any number of parties will want to add new elements to the core mission. This should be avoided. Attempting to be all things to all people will surely lead to failure.

# Appendix A: Louisiana R&D and Technology Strengths Assessment

This assessment, prepared by Regional Technology Strategies (RTS) of Carrboro, North Carolina under contract to the Louisiana Board of Regents and the Louisiana Recovery Authority, is part of an effort to design and implement a comprehensive system throughout Louisiana for increasing research and development capacity, developing scientific and technological competitive advantage on an on-going basis, and then building a system that can translate that capacity and advantage into new Louisiana companies, new markets for existing Louisiana companies and new, high quality jobs. The science and technology-based economic development process is dynamic and complex, but the goal is straightforward: more wealth in Louisiana communities and more opportunities for all of Louisiana's citizens.

The analysis presented on the following pages represents Task 1 of this effort: a comprehensive assessment of the academic research strengths currently existing and emerging in Louisiana.

## Introduction

The academic science enterprise plays multiple complementary roles in Louisiana's economy. Effectively targeted investments to expand existing strengths or develop new or emerging areas of science can reinforce and strengthen those roles. First, university and college research and development (R&D) activities produce innovations, technologies, and skilled workers for the state's existing mix of industries. Second, academic R&D yields innovations with potential in wholly new or emerging markets, helping to spark the development of Louisiana's next generation of competitive industries. Third, academic science in Louisiana and higher education in general is a significant economic engine in itself, irrespective of its immediate connections with new or existing markets, or its technology transfer activities. Finally, the work of universities in basic research, much of which may have little discernable market connection in the near term, lays an essential foundation for applied innovation that produces tangible economic development outcomes and improvements in quality of life. Cutting-edge basic research is also often the source of prestige that attracts the very best scientists and students, many of whom will then become the state's most important technology-based economic development assets: educators, researchers, workers, and leaders.

A key element of this assessment of Louisiana's academic research and technology strengths is an effort, through industry cluster analysis, to identify existing and potential linkages to the state's industrial base. Any assessment of mutual complementarities between Louisiana's industrial strengths and academic R&D assets for the purposes of targeting higher education investments must take the different roles that academic science plays into account. Industry cluster analysis, to the degree that it emphasizes established competitiveness and critical mass, tends to be most useful for identifying existing industrial strengths. It is much less effective at identifying prospective industrial strengths, labeled "emerging," "potential," or "embryonic" clusters in many studies. Indeed, the most common method for detecting prospective industry clusters is to evaluate academic and private sector R&D activity to identify those fields of basic and applied inquiry that are most likely to produce marketable products and services.

Furthermore, because such studies are typically hampered by the absence of detailed information on corporate R&D, academic R&D implicitly drives the results. Thus "potential" clusters are often not "industry" clusters at all, if the latter is conventionally understood as an existing critical mass of related and competitive businesses and supporting institutions. Some states and regions have formed their cluster-based economic development strategies primarily around such R&D assets, under the assumption that scarce resources should be focused on promoting new market formation and entrepreneurship. The Research Triangle Park region in North Carolina is a notable recent example.

Given the different roles academic institutions play in regional economies, as well as different approaches to cluster-based development planning, this industrial and R&D enterprise assessment seeks to inform a portfolio-oriented strategy in the targeting of academic science investments (see Figure 1). It assumes that investments that will support or help build on existing competitive industrial strengths (industry clusters) are favorable, other things being equal.

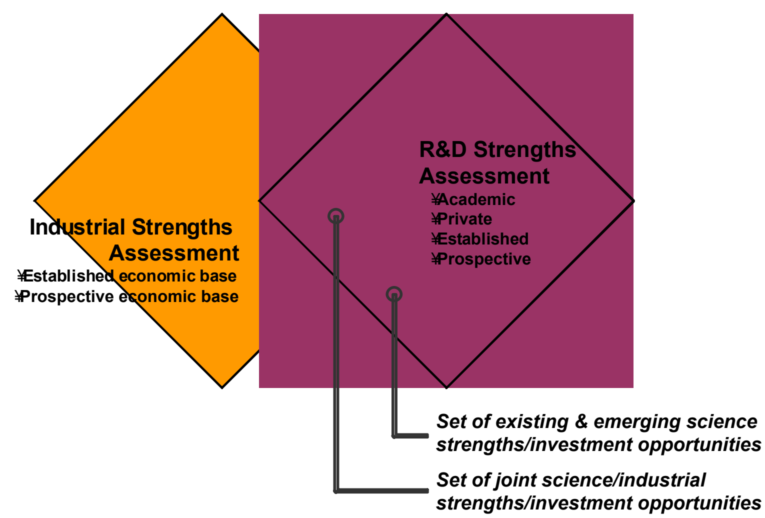



**Figure 1. R&D Assessment Approach**

It also, however, assumes that demonstrated areas of academic or private R&D strength with few linkages to the current industrial base may be attractive candidates for investment as well, particularly if they have linkages to emerging markets in which Louisiana might establish a new competitive advantage. Investments may also be made in especially strong areas of pure or basic research, if that research forms a demonstrable critical foundation for the success of existing, emerging or new and especially promising markets. A portfolio-based approach makes sense because any assessment of joint economic and R&D strength—which implicitly involves an element of technology-based economic development forecasting—is fallible. Investments in technology-based opportunities are always uncertain and new competitive advantages are not always born from existing advantages and complementarities.

The process begins by identifying key industrial clusters in Louisiana as a whole and in its eight major regions, using both previously published work and the assembly of new data. The next step is to identify the research areas of greatest strength and which have the potential to become national centers of excellence. Finally, the team describes those areas of greatest research strength that "match up" best with existing or potential competitive strengths within the state and regional economies, such that the research areas will have the greatest likelihood of stimulating long-term growth in the knowledge-based economy in Louisiana and its regions.

# Industrial Strengths Assessment

## Methods and Approach

Industry cluster analysis has become a common technique for detecting existing and emerging state and regional industrial strengths. A cluster is a geographic concentration of interrelated competitive firms and institutions that is of sufficient scale to generate external economies—innovation and productivity advantages which propel expansion through company growth and new company formation. A true cluster has advantages which make the whole greater than the sum of its parts (i.e., the individual industries and institutions that make it up).

A number of extensive studies of industry clusters in Louisiana and various regions of the state have been conducted since 2000. However, some of those studies use different definitions of industry clusters, employ different methodologies and data sources, and serve varying public policy purposes. Therefore, they are not all directly comparable. Moreover, the most recent of the existing studies make use of 2002 data, whereas detailed data on industry trends in the state and its regions are available through 2005 as of this writing. To develop a current and systematic assessment without unduly duplicating or ignoring existing research, this updated analysis of Louisiana's industrial strengths uses both the most recent data available and a cluster analysis methodology consistently applied at the state and regional levels. The findings are then compared with studies conducted previously to develop a final assessment of Louisiana's industrial strengths.

The assessment begins with a quantitative scan to identify "candidate" clusters of two kinds. The first are labeled "established clusters." Established clusters are those with established scale or critical mass in the state or a given region. Not all established clusters are growing or what might otherwise be called "competitive." Some established are mature—large but declining—while others are stabilizing—large but diversifying into new areas and thus forestalling decline. The second major kind of cluster is labeled "prospective." Prospective clusters have not yet achieved critical mass—they are comparatively small when compared to other industries in the state and when compared to national benchmarks—but they have characteristics that suggest potential for growth. Those characteristics might include rapid recent growth that suggests future critical mass (an *emerging* prospective cluster), the cluster may be a target of public sector driven policies or investments (a *strategic* prospective cluster), or the cluster may represent a very high growth opportunity nationwide or globally that Louisiana believes—or perhaps simply hopes—it can capture (a *potential* prospective cluster).

The scanning approach is based on the concept of industry value chains. An example is the U.S. automotive industry value chain, which includes final market assemblers together with the many first, second, and multi-tier suppliers that serve those assemblers. Suppliers may be producers of manufactured goods or commodities (parts, equipment, machinery, etc.) or advanced or basic services (e.g., legal, advertising, finance, accounting, etc.). Each value chain is centered on a "core" industry. In the U.S. automotive value chain, the vehicle assembly industry is the core industry and supplier sectors are the "linked" industries.

One useful way to sift through the more than 1,000 detailed industries in a given state or region to identify possible clusters is to look for critical mass and growth in core industries that is *accompanied by* critical mass and growth in linked industries, thereby suggesting localized depth in linked and related industries. The presence of a core industry without the presence of related industries suggests an industrial specialization but not a cluster. Individual industry specializations may represent good targets for economic development policies, or possible linkages to the state's knowledge base, but they do not have the established critical mass of a cluster itself.

The value chain definitions are derived from an analysis of purchasing and sales patterns among hundreds of industries in the U.S. economy. From those patterns, identified 180 core industries were identified, each of which has the potential to serve non-local markets. In other words, the core industries exclude purely local-serving industries such as retail trade, basic consumer services, and government. For each of the 180 core industries, there is a unique set of related or linked industries. The team scanned trends in the Louisiana economy and its regions using the 180 chains, isolating candidate clusters by applying criteria such as absolute employment size, relative employment size (compared to a national benchmark), number of establishments, and recent growth. These methods are described in more detail below.

## Background: General Economic Trends

The Louisiana Department of Labor reports the state's private non-farm employment at 1,904,200 in March 2007, up 3.6 percent from the previous March.[3] Statewide, the education, health services, and leisure and hospitality sectors generated the most job gains over the previous year. At 4.1 percent, Louisiana's March 2007 unemployment rate was three tenths of a percentage point below the national rate, and ranged from 2.6 percent in Lafayette and Lafourche parishes to 8.5 percent in East Carroll Parish. Five of the six Louisiana parishes hit hardest by Hurricanes Katrina and Rita—Orleans, Jefferson, St. Bernard, Plaquemines, St. Tammany, and Cameron—posted unemployment rates below the 4.1 percent state figure (Orleans was the exception among the six at 4.2 percent unemployment).

Louisiana continues to rebuild from the 2005 hurricanes and associated flooding. While available studies suggest a relatively rapid recovery overall, trends vary widely by location, sub-population, and demographic indicator.[4] Out-migration from Southeast Louisiana has reduced unemployment but population remains significantly below pre-Katrina levels. The U.S. Department of Labor and the Federal Emergency Management Agency estimate that roughly 19,000 establishments employing over 316,000 employees and paying quarterly wages in excess of $3 billion were located in Katrina-damaged areas of Louisiana.[5] A recent study by researchers at Louisiana State University reports some 5,000 business closures in the immediate aftermath of the storms, with the biggest losses felt in Orleans and Jefferson parishes (roughly 2,580 and 1,200 closures, respectively).[6] The LSU study's initial results suggest that closures had bottomed out the by first quarter of 2006. The total number of employers covered under employment

---

3 "Strong Nonfarm Job Growth Continues," Louisiana Department of Labor, 27 April 2007. See also Louisiana Workforce at a Glance, Louisiana Department of Labor, Release Date 23 June 2006.

4 "Recovery After Hurricane Katrina: Employment in the Gulf Coast Area," Issues in Labor Statistics, Summary 07-01, May 2007, U.S. Department of Labor, U.S. Bureau of Labor Statistics; "The labor market impact of Hurricane Katrina: an overview," Monthly Labor Review 129 (8): 3-8; "Hurricane Katrina's effects on industry employment and wages," by Molly Garber, Linda Unger, James White, and Linda Wohlford, Monthly Labor Review 129 (8): 22-39; "The effect of Hurricane Katrina on employment and unemployment," by Sharon P. Brown, Sandra L. Mason, and Richard B. Tiller, Monthly Labor Review 129 (8): 52-69.

5 "Labor Market Statistics Prior to Disaster for Areas Affected by Hurricanes Katrina and Rita," U.S. Department of Labor, Bureau of Labor Statistics, http://www.bls.gov/Katrina/data.htm#3. See also 2005 Louisiana Hurricane Impact Atlas, Volume 1, Louisiana Geographic Information Center, Updated May 2006.

6 "A Report on the Impact of Hurricanes Katrina and Rita on Louisiana Businesses: 2005Q2-2006Q2," by Dek Terrell and Ryan Bilbo, Division for Economic Development, E.J. Ourso College of Business, Louisiana State University, no date.

security law in the five Southeast parishes (Jefferson, Orleans, Plaquemines, St. Bernard, and St. Tammany) had fallen to 83 percent of its pre-storm level in 2nd quarter 2006 before rising to 87 percent in 2nd quarter 2006, the latest period covered in the study. The LSU study anticipates that the number of businesses will continue to rise but it is very much unclear at what pace.

It is difficult to confidently assess the impact of the 2005 storms on Louisiana's economic base. On the one hand, the LSU study finds that the hardest hit industries are those serving local consumer demand (retail trade, other services, health care and social assistance, and accommodation and food services). Moreover, failure rates have been significantly higher for small businesses, especially those with 1-5 employees. Those results would suggest that exporting industries, as well as larger businesses anchoring key clusters, may have suffered only modestly. On the other hand, the LSU analysis necessarily focuses only on employers and employment measured under the Quarterly Covered Wages and Employment (QCEW) series collected by the Louisiana Department of Labor, a dataset that excludes sole proprietors as well as selected industries not subject to reporting requirements under employment security law. Many entrepreneurial businesses are sole proprietorships or key services providers (e.g., consultants) to entrepreneurial or technology-based firms. The loss of such companies could have an adverse effect on emergence of technology- or knowledge-based clusters that are of special interest in this assessment.

Unfortunately, the detailed industry-specific data necessary to conduct a post-Katrina/Rita industry cluster analysis are not yet available. The most recent year in the U.S. Census Bureau's *County Business Patterns* (CBP), for example, is 2004. Since CBP data are collected in March of each year, even the 2005 data will precede the hurricanes when released late in 2007. The most recent QCEW data (which used below) are 2005, which are annual estimates that average pre- and post-Katrina quarterly figures.

The problem is not simply a matter of the absence of current data, however. Even if mid-2007 data were available, the reliability of a current-period cluster analysis would be questionable for the disaster-impacted regions of the state, as the recovery path of various affected industries is still difficult to determine at this time. The severely impacted area's industrial base is likely both stronger and weaker in various respects than even detailed current-period secondary data could reveal. So what to make of the results of an economic base analysis using 2005 data? In general, the findings in pre-event analysis like this one are probably most robust for the larger, existing clusters that have a long, established presence in the Louisiana. There is greater risk that Katrina and Rita will have lasting negative consequences for the growth of smaller or prospective clusters. The challenge is that the latter types of clusters are those mostly likely to be technology-intensive and for which the Louisiana's academic science base is a particularly important asset.

## Background: Selected Benchmark Industry Trends

Certain industries are useful benchmarks for gaining an overall sense of Louisiana's economic structure. They include those export-oriented industries that are currently generating a high share of new jobs nationwide, especially information services, advanced services, secondary business services, health care, and tourism and arts; sectors identified by the federal government as "leading" U.S. industries either because of their importance to the U.S. economy at present or their growth potential; and high technology industries, due to their greater potential to link to Louisiana research and development activity. Table 1 reports basic employment trends for each of these groups; the trends for the each of the detailed industries that make up each group are reported in Addendum Table A1.1.

Table 1 reports establishments and employment figures for the core industries in each group as well as each group's associated linked industries. For example, the set of detailed NAICS industries that the U.S. Bureau of Labor Statistics identifies as high technology-intensive together employed 61,881 workers in Louisiana in 2005, and increase of 2,346 workers from the level of employment in 2002. That put the state's high tech industry employment growth rate at 3.9 percent over the three-year period, a period of comparatively slow job growth nationwide. Indeed, nationally employment in high technology-intensive industries fell slightly over the 2002-2005 period—by a 0.2 percent. Employment in industries linked to various high technology-intensive industries in Louisiana employed 381,096 workers in 2005 across a total of 17,510 business establishments. Those industries linked to the high-tech sector grew robustly as well, at 6.1 percent over the three year period versus 3.1 percent nationwide.[7]

7 Note that some industries are linked to multiple core industries; the value chains organized around each core industry are not mutually exclusive. This reflects the highly interdependent character of the U.S. and Louisiana economies. Thus some of the linked industries to high technology sectors are themselves high technology. Comparing core and linked industry growth patterns is essentially an exploratory technique intended to identify existing and emergent strengths among related industries.

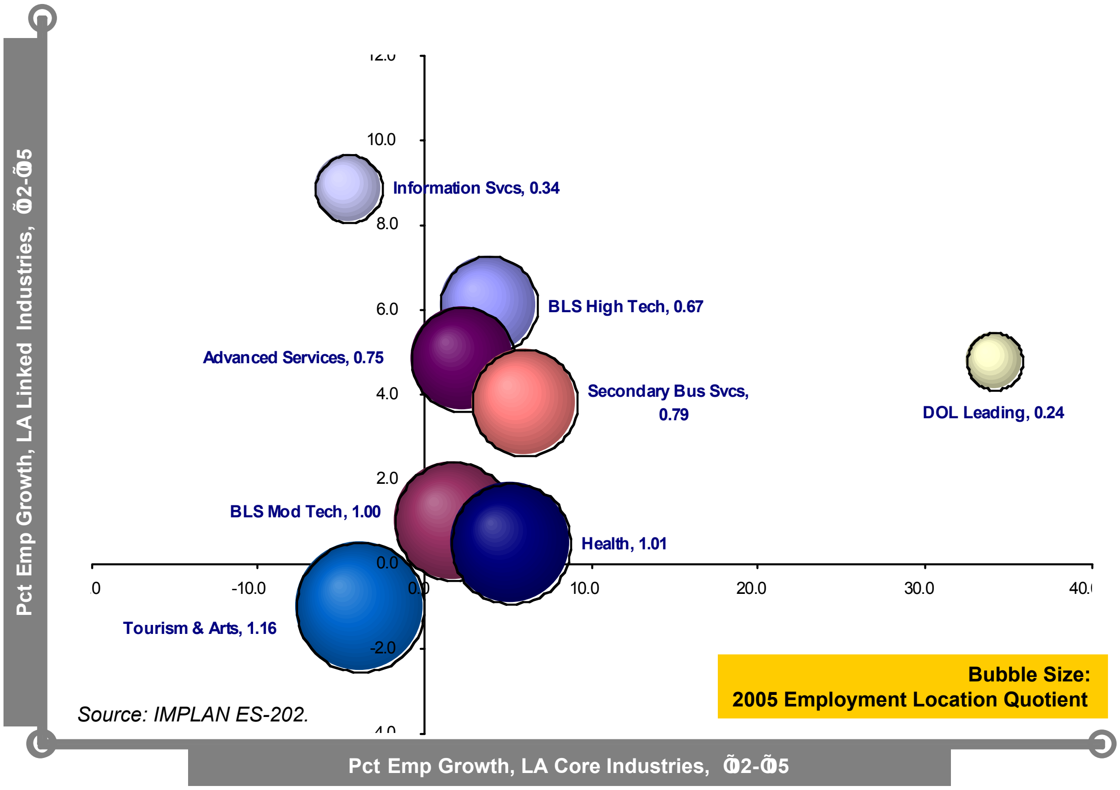
## Table 1: Benchmark Industry Trends, by Group

| *Core Industries* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Establishments** | | **Employment** | | | | | |
| | | | | | **LQ** | | **Pct Growth '02-'05** | |
| **Industry Group** | **2005** | **Change '02-'05** | **2005** | **Change '02-'05** | **2002** | **2005** | **State** | **US** |
| BLS High Tech | 4,251 | 223 | 61,881 | 2,346 | 0.62 | 0.67 | 3.9 | -0.2 |
| BLS Mod Tech | 3,960 | 157 | 146,247 | 2,525 | 0.95 | 1.00 | 1.8 | -0.1 |
| DOL Leading | 1,282 | 116 | 12,019 | 3,061 | 0.16 | 0.24 | 34.2 | -2.9 |
| Advanced Services | 10,851 | 488 | 83,393 | 1,890 | 0.75 | 0.75 | 2.3 | 5.1 |
| Secondary Business Services | 4,639 | 408 | 63,379 | 3,611 | 0.77 | 0.79 | 6.0 | 6.7 |
| Tourism & Arts | 2,243 | -23 | 58,135 | -2,298 | 1.19 | 1.16 | -3.8 | 1.3 |
| Information Services | 356 | -20 | 3,149 | -149 | 0.31 | 0.34 | -4.5 | -8.8 |
| Health | 7,662 | 596 | 124,818 | 6,173 | 0.99 | 1.01 | 5.2 | 5.9 |
| *Linked Industries* | | | | | | | | |
| | **Establishments** | | **Employment** | | | | | |
| | | | | | **LQ** | | **Pct Growth '02-'05** | |
| **Industry Group** | **2005** | **Change '02-'05** | **2005** | **Change '02-'05** | **2002** | **2005** | **State** | **US** |
| BLS High Tech | 17,510 | 1,419 | 381,096 | 20,662 | 0.69 | 0.73 | 6.1 | 3.1 |
| BLS Mod Tech | 25,518 | 1,387 | 475,891 | 5,697 | 0.67 | 0.71 | 1.0 | -1.1 |
| DOL Leading | 9,533 | 752 | 215,403 | 12,345 | 0.61 | 0.66 | 4.8 | 1.5 |
| Advanced Services | 37,031 | 1,991 | 444,226 | 18,382 | 0.77 | 0.79 | 4.8 | 4.6 |
| Secondary Business Services | 19,692 | 1,608 | 285,359 | 11,676 | 0.77 | 0.77 | 3.8 | 6.5 |
| Tourism & Arts | 6,211 | -22 | 96,987 | -2,712 | 0.87 | 0.88 | -1.1 | -0.7 |
| Information Services | 4,677 | 569 | 121,252 | 9,452 | 0.68 | 0.72 | 8.8 | 6.0 |
| Health | 10,276 | 719 | 175,132 | 6,415 | 0.84 | 0.87 | 0.5 | 4.2 |

Also reported in Table 1 is something called a location quotient (labeled "LQ" in the table). An employment location quotient is a ratio of two numbers: the share of Louisiana's employment in a given industry over the share of U.S. employment in a given industry. If high tech employment in Louisiana constituted 2 percent of all employment, and high tech employment in the U.S. made up 1 percent of all national employment, the Louisiana high tech location quotient would be 2.0 (2 percent in Louisiana divided by 1 percent in the U.S.). A location quotient higher than 1.0 for a given industry indicates a share of activity in the industry in Louisiana that exceeds the national share; location quotients over 1.0—particularly those appreciably over 1.0—suggest a specialization in Louisiana's economic base. In Table 1, the only group of benchmark industries with a location quotient exceeding 1.0 is tourism and arts, industries which include, among others, lodging establishments and casinos; gambling and recreation industries; travel arrangement and reservation services; motion picture and video industries; performing arts; spectator sports; and camping facilities and boarding houses (see Addendum Table A1.1).

Louisiana's share of employment in moderately technology-intensive industries roughly parallels that of the U.S., while its share in very high tech lags considerably behind. Those trends reflect the state's traditional manufacturing-intensive economy, and are a pattern common to many states in the U.S. South. Moderately technology-intensive industries include mostly durable manufacturing industries in machinery, electronics and transportation equipment, as well as petroleum and coal, hospitals and higher education. The high tech group comprises primarily life sciences and information technology industries.

Figure 2 offers a "forest for the trees" perspective on Table 1. On the horizontal axis is the employment growth rate for the core industries in each benchmark group. On the vertical axis is the growth rate for related industries to each group. The size of the bubble in the chart is the 2005 employment location quotient. Bubbles in the upper right quadrant are benchmark groups that are growing in both their core and linked industries. The pattern very much suggests an emergent technology-based and services-based economy. All groups but information services and tourism & arts produced employment gains between 2002 and 2005, and all but tourism & arts also produced gains in their set of linked industries. However, the various industries are still small in relative terms, as reflected by their low location quotients.




## Figure 2. Benchmark industry group trends

The group of "leading" industries as identified by the U.S. Department of Labor posted especially rapid employment gains over the three-year period. DOL leading industries include pharmaceuticals, industrial machinery, metalworking machinery, computer and peripheral equipment, communications equipment, semiconductors, electronic instruments, software, computer systems design and services, and scientific R&D services. Louisiana's rapid growth is partly a small numbers effect. This group of sectors employed only roughly 9,000 workers in 2002, growing to over 12,000 by 2005. Of the gain of 3,000 workers, the overwhelming majority came in the computer systems design and services industry (NAICS 5415).

Figure 3 provides a more detailed perspective on Louisiana activity in moderately and very technology-intensive industries. On the axes are U.S. employment growth rates (core and linked) over the 1st quarter 2002 to 2nd quarter 2006 periods.[8] The size of the bubble is the location quotient for the industry in Louisiana. The chart effectively creates four quadrants: in the northeast quadrant are industries posting national growth for both their core and linked industry components; in the southwest quadrant, both

---

8 We can obtain more recent detailed industry employment data for the U.S. as a whole than for Louisiana. Thus we use the most recent trend information through 2nd quarter 2006 in Figure 3.

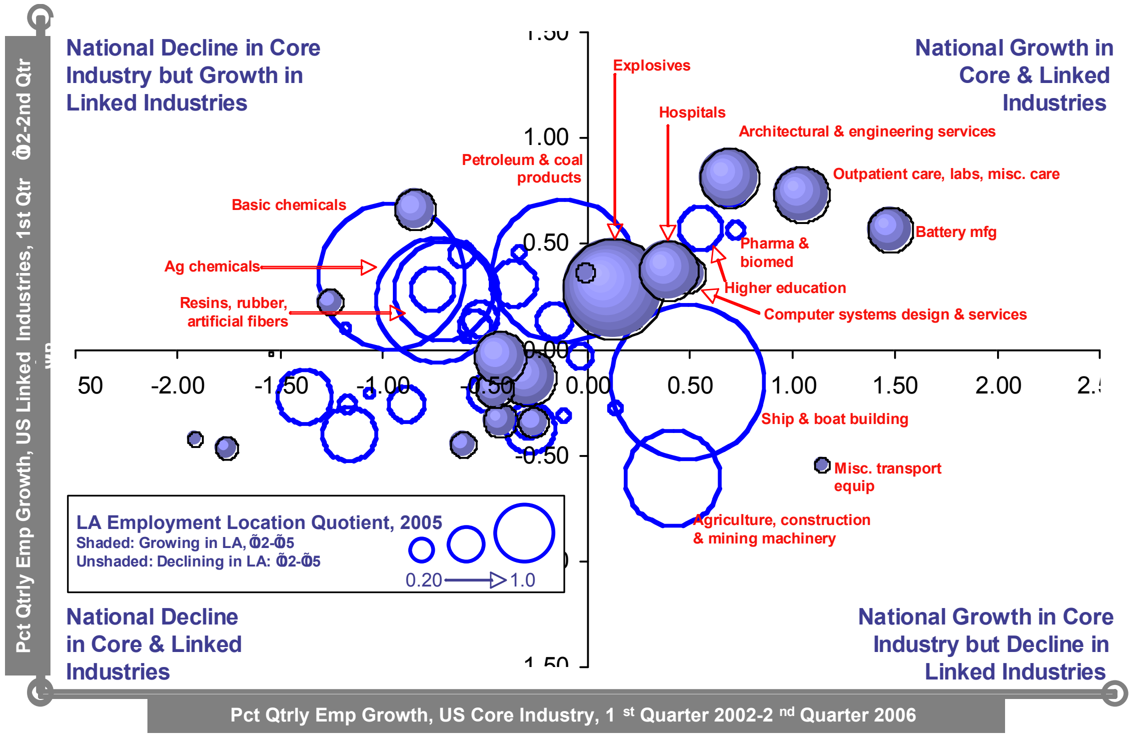



**Figure 3. U.S. technology industry trends, specialization in LA**

core and linked industry components declined nationally; in the northwest quadrant, the core industry declined but its linked industries grew; in the southeast quadrant, the core industry grew but its linked industries declined. The bigger the bubble, the larger the relative size of the industry in Louisiana, and the bubbles for industries that grew in Louisiana over the 2002-2005 period are also shaded; unshaded bubbles are industries that declined in employment in the state.

Figure 3 suggest three key features of Louisiana's technology economy. First is that many of its largest technology-intensive sectors are enjoying some growth nationwide in either their core or linked industries, but often not both. Thus, while the chemicals and petroleum and coal industries, relatively big industries in Louisiana, declined nationwide over the 2002-2006 period, the industries linked to chemicals and petroleum and coal actually grew somewhat. The ship and boat building industry added employees nationally over the period, but the industries linked to the ship and boat building industry declined slightly. The second major finding in Figure 3 is that many of the bubbles in the northeast quadrant are comparatively small, yet most are shaded, indicating growth in Louisiana. Therefore, the state is growing in those industries also doing well nationally. Whether or not it will develop specializations in such industries depends on its surpassing national growth rates over extended periods. Finally, the third major finding in the figure is the relatively few small bubbles in the southwest quadrant. Louisiana's technology sector portfolio is not oriented toward industries that are currently performing poorly in employment terms nationwide. That bodes well for the continued emergence of a robust technology base in the state over the near term.

## Value Chain Scan

Given this background on Louisiana's technology sector, the same basic data and indicators in Table 1 are applied to a comprehensive analysis of all 180 core industries and Louisiana's eight regions: Southeast, Capital, Bayou, Acadiana, Southwest, Central, Northeast, and Northwest. Figures 4 and 5 illustrate the basic approach for sifting through the volume of data to identify established and prospective clusters, which are then juxtaposed against the results of existing studies described in the next section.

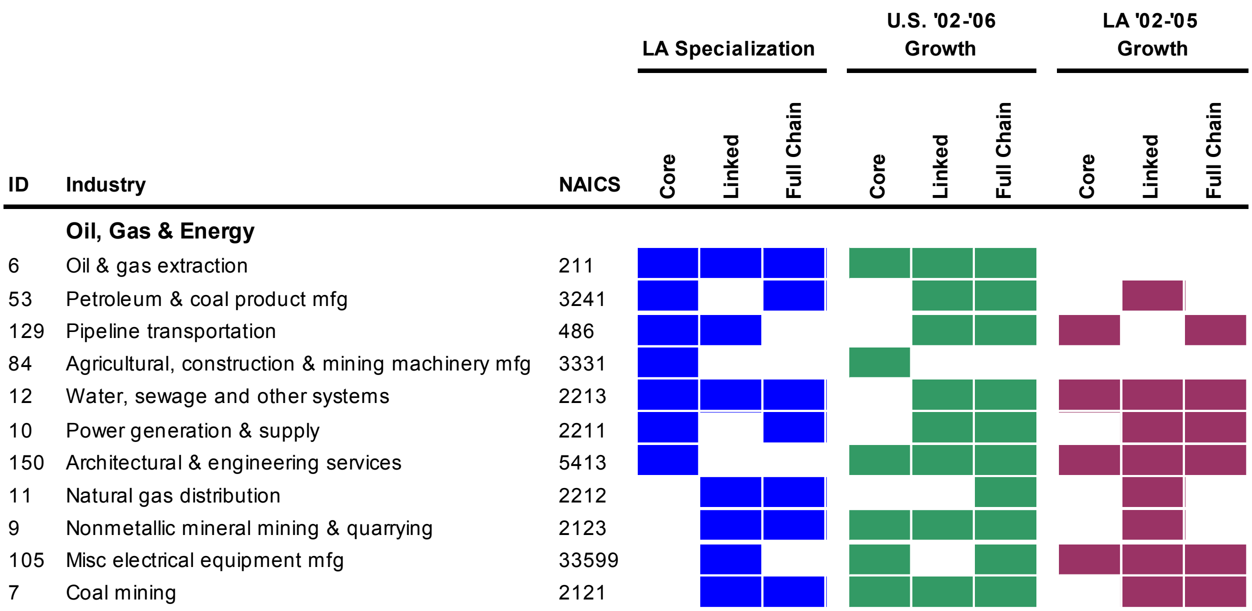



**Figure 4. Example of value chain industry scan: Established cluster**

Each core industry is subjected to three major questions: is the industry and/or its linked industries concentrated in Louisiana (or the given region); is the industry and/or its linked industries posting national growth coming out of the 2001 recession; and is the industry and/or its linked industries posting growth in Louisiana (or the given region)? Using knowledge of linkages among core industries, the team then grouped various core industries into clusters based on evidence of absolute size, relative size (the first question), and growth (the second and third questions). Figure 4 illustrates the approach, in this case for a cluster identified as established in the state: oil, gas, and energy. Cells are shaded if location quotients exceed 1.1 and recent U.S. and Louisiana employment growth is positive. It is clear that this related group of core industries in oil, gas, and energy is an important existing Louisiana specialization, one that is producing employment gains in core and linked components both nationally and in the state in recent years.

Figure 5 illustrates an alternative set of industries, those in information technology. Such industries are not relatively large in Louisiana, but they are expanding nationwide and are growing in the state. This particular group is labeled "prospective," because of evidence of its emergence and growth potential (as represented by U.S. and local trends).

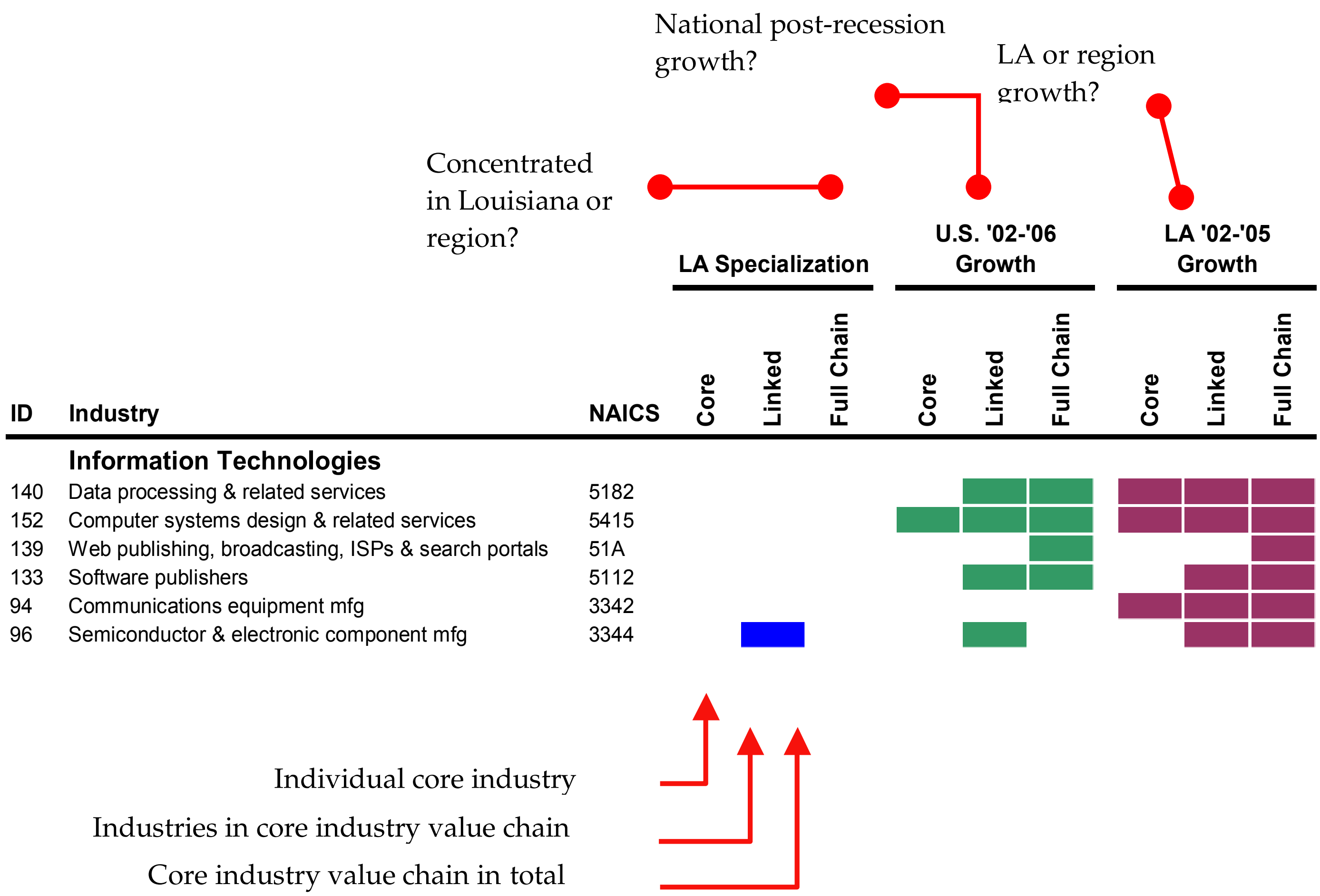



**Figure 5. Example value chain industry scan: Prospective cluster**

Applying this scanning technique and criteria to all 180 core industries produces the result for the state as a whole detailed in Appendix Table A1.2. Similar analyses were conducted for each of the eight regions, with the result for each an initial list of clusters. The next step was to juxtapose the detailed findings from this scan with that of existing studies in the state and its regions. Some of the studies offer valuable contextual information as well as more focused analysis of specializations and strengths that are difficult to detect with secondary data alone.

## Summary of Existing Study Findings

The findings of nine available existing studies are summarized in Table 2. The Louisiana Economic Development Council identified fifteen clusters in the state in its Louisiana 2020 economic development strategy completed in 2000, and subsequently updated in 2003. Among the fifteen are eight established clusters and seven emerging clusters. Some of the clusters are geographically concentrated in specific regions of the state while companies in others are distributed more ubiquitously. Subsequent regional studies by JEDCO for Jefferson Parish and for seven Louisiana regions by a team comprised of Regional Technology Strategies, DADCO of Baton Rouge, and PRI of Shreveport provide more focused localized assessments. The regional studies are consistent in broad terms with the statewide results in Louisiana 2020. Where there are differences, they are generally of two kinds. First, statewide existing or potential industrial strengths are sometimes too distributed geographically to show up in the regional assessments. Thus, Louisiana 2020 identifies some clusters—an example is micro- and nano-technologies—that are not identified in any existing regional analysis. Second, sometimes regional studies identify a more specialized component of an identified state cluster. An example is the music, arts, and culture cluster in Acadiana identified by RTS, DADCO, and PRI in their 2005 study.

**Table 2: Findings from Previous Cluster Studies: Identified Clusters**

| Source | Clusters identified for Louisiana and Regions |
|---|---|
| **Louisiana 2020: 2003 Update**<br>Louisiana Economic Development Council. Developed from an analysis in 2000, updated in 2003. Statewide analysis.<br>*Established clusters<br>**Emerging or potential clusters which "do not yet have concentrations, but do have a potential for high growth and evolution into true clusters." | Oil & gas & energy technologies*<br>Petrochemicals*<br>Shipbuilding & other durable goods*<br>Tourism*<br>Transportation*<br>Health care*<br>Agricultural & food products*<br>Wood, lumber & paper*<br>Information technologies**<br>Life sciences**<br>Environmental technologies**<br>Food technologies**<br>Advanced materials**<br>Micro- & nano-technologies**<br>Entertainment** |

## Table 2: Findings from Previous Cluster Studies: Identified Clusters

| | |
|---|---|
| **Industrial Concentration and Specialization Scan for the MetroVision Regional Economy**<br>Regional Technology Strategies, Inc., 2001. Based on employment security data for 1998-1999. Study conducted for the New Orleans metropolitan area. Original study explored trends in clusters previously identified by MetroVision. Results here are based on data assembled by RTS and may be renamed to better reflect strongest industry segments.<br>*Established clusters<br>**Emerging or potential clusters, based on economic trends, entrepreneurial activity, and/or science and R&D assets in private and academic sectors. | *Food products* (esp. raw cane sugar & refining, fish & seafood, prepared fish products, roasted coffee, raw cane sugar, fresh/frozen prepared fish, and wine & distilled beverages)*<br>*Ship & boat building & repair* (incl. misc. heavy construction)*<br>*Aerospace* (esp. space propulsion units & parts)*<br>*Oil & gas* (esp. crude petroleum & natural gas, drilling, exploration services, field services, crude & refined petroleum pipelines, metal barrels & drums, and oil & gas field machinery, lubricating oils & greases)*<br>*Chemicals* (esp. alkalis & chlorine, misc. industrial organic chemicals, misc. chemical & fertilizer mining, and phosphatic fertilizers)*<br>*Freight transport & logistics* (esp. deep sea foreign freight, misc. special warehousing & storage, misc. water freight transport, marine cargo handling, towing & tugboat service, misc. water passenger transport, and fixed facilities for inspection/weighing of motor vehicle transport)*<br>*Arts, entertainment & tourism* (esp. water passenger transportation, sports entertainment & promoters, and miscellaneous amusement & recreation)*<br>*Information technology* (esp. electronic capacitors, process control instruments, computer maintenance & repair, data processing & preparation)**<br>*Biotechnology* (esp. phosphatic fertilizers, miscellaneous industrial organic chemicals, psychiatric & specialty hospitals, and testing laboratories)**<br>*Environmental technologies* (esp. process control instruments, miscellaneous sanitary services, testing laboratories, refuse systems, and engineering services)** |
| **The Jefferson Edge 2010**<br>JEDCO, Jefferson Parish Economic Development Commission, 2006. Results in New Orleans Area column are for Jefferson Parish only. Based on 2003 BLS employment data.<br>*Established cluster.<br>**Emerging cluster. | *Transportation & equipment manufacturing* (esp. ship & boat building, related information technology services)*<br>*Mining* (esp. petroleum exploration, extraction, field services, and software development)*<br>*Transportation & warehousing* (esp. warehousing & distribution centers)*<br>Health care & social assistance (esp. hospitals)*<br>Retail trade, accommodations & food services*<br>Professional & technical services*<br>*Computer systems design* (esp. software & Internet services, software related to logistics, oil industry, & manufacturing)**<br>Motion picture & video**<br>Food manufacturing**<br>Telecommunications** |

## Table 2: Findings from Previous Cluster Studies: Identified Clusters

| | |
|---|---|
| **Bayou Regional Industry Cluster Analysis**<br>Regional Technology Strategies, Inc., DADCO (Shreveport) and PRI (Baton Rouge), 2005. Based on 2002 employment security data, Dun and Bradstreet enterprise-level data, and interviews. Study was designed to complement Louisiana Vision 2020 plan. Region comprised of Assumption, Lofourche, St. Mary and Terrebonne parishes.<br>*Established clusters (competitive, mature, stabilizing).<br>**Emerging clusters (low scale and high growth). | *Shipbuilding & metal fabrication* (esp. offshore marine craft for the global oil & gas industry, and construction & deployment of oil rigs; knowledge base mainly internal company R&D)*<br>*Maritime industry* (esp. tug boat operators, offshore worker transport, vessel maintenance and repair, oceanographic services, stevedoring and transfer services)*<br>*Oil & gas exploration & production* (esp. seismic services, drilling tools & supplies, equipment sales/rental & services, drilling chemicals/fluids, misc. marine services, specialized marine-related services; knowledge linkages to ULL LSU, Louisiana Tech, and University of New Orleans)*<br>*Tourism & ecotourism* (esp. hotels, bed & breakfasts, tours, attractions; knowledge linkages to LTPA training programs, Nicholls Culinary, LSU, University of New Orleans, and Tulane)**<br>*Culinary entrepreneurship & specialty food* (esp. restaurant & packaged food products, and seafood; knowledge linkages to Nicholls Culinary Institute, LSU Agricultural Center, and University of New Orleans)** |
| **Acadiana Regional Industry Cluster Analysis**<br>Regional Technology Strategies, Inc., DADCO (Shreveport) and PRI (Baton Rouge), 2005. Based on 2002 employment security data, Dun and Bradstreet enterprise-level data, and interviews. Study was designed to complement Louisiana Vision 2020 plan. Region comprised of Acadia, Evangeline, Iberia, Lafayette, St. Landry, St. Mary, St. Martin, and Vermillion parishes.<br>*Established clusters (competitive, mature, stabilizing).<br>**Emerging clusters (low scale and high growth).<br>***Other economic drivers. | *Oil & gas & related technology* (esp. oil & gas services for exploration, production and processing)*<br>*Food products* (agricultural product and seafood processing; packaged sugar, confectionary goods, milled products, creation and packaging of Cajun specialty foods; knowledge linkages specific to food trades—publications, associations—and out-of-region consultants)*<br>*Music, arts & culture* (esp. inbound tourism and export of musical and artistic traditions of the region; knowledge linkages to ULL voice, drama and opera programs, Louisiana Folkroots)*<br>*Aviation & aerospace* (esp. services to on- and off-shore oil & gas industry, helicopter maintenance & repair, fixed wing aircraft maintenance & repair, emergency services)*<br>*Transportation, distribution & logistics* (esp. waterborne transport services to oil & gas, trucking & rail service for food products industry, adding additional capacity in retail distribution & warehousing & advanced logistics)**<br>*Healthcare* (basic services for local consumer needs)*** |

**Table 2: Findings from Previous Cluster Studies: Identified Clusters**

| | |
|---|---|
| **Southwest Louisiana Regional Cluster Analysis**<br>Regional Technology Strategies, Inc., DADCO (Shreveport) and PRI (Baton Rouge), 2005. Based on 2002 employment security data, Dun and Bradstreet enterprise-level data, and interviews. Study was designed to complement Louisiana Vision 2020 plan. Region comprised of Beauregard, Calcasieu, and Cameron and Jefferson Davis parishes.<br>*Established clusters (competitive, mature, stabilizing).<br>**Emerging clusters (low scale and high growth). | *Petrochemical & refining* (esp. conversion of natural gas products & imported petroleum to commodity chemicals, gasoline; knowledge based in corporate headquarters)*<br>Oil & gas exploration and production (esp. offshore oil extraction, offshore gas extraction, specialized services to exploration & extraction)*<br>Gaming, hospitality & tourism (esp. gaming-related tourism marketed to consumers in Louisiana, Texas & the Midwest, eco-tourism)*<br>Agriculture & forest products (esp. pulp, paper, plywood & other commodity products)*<br>Aerospace & aviation (esp. aviation support services to offshore & onshore oil & gas industry; helicopter & fixed wing maintenance & repair services)** |
| **Central Louisiana Regional Cluster Analysis**<br>Regional Technology Strategies, Inc., DADCO (Shreveport) and PRI (Baton Rouge), 2005. Based on 2002 employment security data, Dun and Bradstreet enterprise-level data, and interviews. Study was designed to complement Louisiana Vision 2020 plan. Region comprised of Allen, Avoyelles, Grant, Rapides, Vernon, and Winn parishes.<br>*Established clusters (competitive, mature, stabilizing).<br>**Described as "other economic drivers." | *Forest products* (esp. harvesting & processing of timer into treated & unfinished lumber; corrugated wood product; paper; key products include plywood, liner board, trusses; knowledge linkages to LSU Forest Products Laboratory)*<br>*Nursery products* (esp. cultivation of ornamental plants serving 20 U.S. states through mass merchandisers)*<br>*Tourism & convention trade* (esp. historical, cultural & entertainment attractions—music, zoo; regional conventions; knowledge linkages to LPTA training programs and NSU, LSUA)*<br>*Advanced manufacturing* (esp. high value added commercial & consumer products; soaps and cleaning—Proctor & Gamble; chemicals, machinery, metals)*<br>*Healthcare* (esp. basic health services; knowledge linkages to LSU Medical Schools in Shreveport & New Orleans, Tulane University)**<br>*Aviation & aerospace*—inter-regional linkages to Acadiana** |

## Table 2: Findings from Previous Cluster Studies: Identified Clusters

| | |
|---|---|
| **Northeast Louisiana Regional Cluster Analysis**<br>Regional Technology Strategies, Inc., DADCO (Shreveport) and PRI (Baton Rouge), 2005. Based on 2002 employment security data, Dun and Bradstreet enterprise-level data, and interviews. Study was designed to complement Louisiana Vision 2020 plan. Region comprised of Caldwell, Catahoula, Concordia, East Carroll, Franklin, Jackson, Madison, Morehouse, Ouachita, Richland, Tensas, and Union & West Carroll parishes.<br>*Established clusters (competitive, mature, stabilizing).<br>**Emerging clusters (low scale and high growth).<br>***Other economic drivers. | *Forest products* (esp. paper, cardboard, structural wood products such as trusses, commodity lumber for national & international markets; knowledge linkages to LA Tech, ULM, LSU Agricultural Center)*<br>*Metalworking* (esp. specialty metal products, commercial & industrial machinery; knowledge linkages to LA Tech)*<br>*Agribusiness* (esp. meat processing, crop processing, feed, seed, fertilizer, farm equipment, & farm support services; knowledge linkages to LSU Agricultural Center)<br>*Outdoor sporting & recreation* (esp. hunting trips/guides, outdoor racing, ATV parts & accessories, 4WD parts & accessories, hunting supplies & tools, camps & recreational centers; knowledge base mostly informal)**<br>*Healthcare* (esp. rural health care, nursing care; knowledge linkages to ULM Pharmacy Research, LSUHSC Shreveport) |
| **Northwest Louisiana Regional Cluster Analysis**<br>Regional Technology Strategies, Inc., DADCO (Shreveport) and PRI (Baton Rouge), 2005. Based on 2002 employment security data, Dun and Bradstreet enterprise-level data, and interviews. Study was designed to complement Louisiana Vision 2020 plan. Region comprised of Bienville, Bossier, Caddo, Claiborne, De Soto, Lincoln, Natchitoches, Red River Sabine, and Webster parishes.<br>*Established clusters (competitive, mature, stabilizing).<br>**Emerging clusters (low scale and high growth). | *Oil & gas* (esp. extraction in region and East Texas, and pipeline distribution; knowledge linkages to Louisiana Tech, LA Basin Research Institute, LSU A&M Center for Energy Studies, ULL Energy Studies, TX Bureau of Economic Geology)*<br>*Forest products* (esp. raw & processed lumber; pulp, paper & paperboard; engineered wood products; knowledge linkages to LSU Agricultural Center, Louisiana Forest Products Development Center)*<br>*Gaming, entertainment and tourism* (esp. gaming, horseracing, sports, focused on Shreveport-Bossier area; knowledge linkages to CDC Business Incubator, SBDC)*<br>*Pharmaceuticals & life sciences* (esp. pharmaceutical product manufacture and human therapeutics; hospital sector as base of research and medical activity support; knowledge linkages to BPCC, LSUHSC Biotech, LSUHSC Health Care Administration, LSU-S Bioinformatics training, Gene Therapy Consortium, LA Tech Center for Biomedical Engineering)**<br>*Automotive industry supply chain* (esp. companies serving General Motors assembly facility; injection molding; quality control; knowledge linkages to out-of-region consultants and training professionals)** |

A couple of studies have been conducted relatively recently for southeast Louisiana and the New Orleans metropolitan area. While a direct comparison among those studies is limited by varying cluster definitions and methodologies, there are some general patterns. Regional Technology Strategies' (RTS) 2001 analysis for MetroVision identified established cluster specializations in New Orleans in food products, ship and boat building, aerospace, oil and gas, chemicals, freight transportation and logistics, and arts, entertainment and tourism. The 2001 RTS analysis also described areas of cluster growth potential—essentially industries and markets with good prospects for growth in the region given trends in entrepreneurial activity and R&D-oriented assets in area universities, the private sector, and federal space and defense installations. Those *potential* clusters included information technology, biotechnology, and environmental technologies. Ten of the clusters highlighted in the 2001 RTS study are also identified as clusters for Louisiana as a whole in *Louisiana 2020: 2003 Update*, and there is significant overlap with clusters targeted by JEDCO for Jefferson Parish.

While some of JEDCO's target clusters reflect Jefferson Parish's role as a retail and service center within the greater New Orleans area (e.g., retail trade, professional and technical services, and health care), the organization also identified clusters with a larger regional presence, including oil and gas mining, food products, transportation, and information technology (especially computer systems design).

Phase 1 of the current project also included an initial cluster analysis of the Katrina and Rita impact areas, particularly the New Orleans area and Southwest region. Because the time frame available for assessment was very short, the more intensive value chain approach could not be applied. The analysis instead incorporated existing studies and a pre-defined set of cluster data for the New Orleans metropolitan area from the Harvard Cluster Mapping Project. A copy of that preliminary analysis of clusters in the hurricane impact areas is reported in Appendix 2. The assessment uses those preliminary results, findings from the studies reported in Table 2, the results of the value chain analysis, and additional information from interviews and focus groups in Louisiana to identify a final set of Louisiana clusters.

## Results

The penultimate set of established and prospective industry clusters in Louisiana is reported in Table 3. The clusters represent the assessment of existing and emerging economic strengths in the state as a whole, some of which are concentrated in specific regions. Table 4 provides a breakdown of clusters by region. A few clusters are modest strengths in given regions but have a limited presence statewide. In most cases, where regional clusters differ from those listed in the final set identified for the state as a whole, it is because their underlying economic specialization is characterized in greater detail. Thus, in the Northeast, the arts, entertainment & tourism cluster is heavily based in outdoor recreation opportunities; in the Bayou, ecotourism is an important strength; and in the southeast, music and arts are particularly important assets.

**Table 3: Louisiana industry clusters**

| |
|---|
| **Established** |
| Oil, gas & energy |
| Food products |
| Lumber, wood products, & paper |
| Shipbuilding |
| Chemicals & chemicals-based products |
| Transportation & logistics, including maritime |
| Nonmetallic mineral products |
| Entertainment, arts & tourism |
| Fabricated metal goods |
| **Prospective** |
| Business services |
| Media |
| Health care |
| Life sciences |
| Automotive |
| Information technologies & services |
| Aerospace & aviation |
| Environmental technologies & services |
| Specialized construction equipment & services |

## Table 4: Louisiana Regional Industry Clusters

| Region | Established | Prospective |
|---|---|---|
| Southeast | Shipbuilding<br>Transportation & logistics<br>Oil, gas & energy<br>Entertainment, arts & tourism (tourism, music & arts)<br>Education & knowledge creation<br>Chemical products<br>Aerospace<br>Food products | Information technology (software & information services)<br>Environmental technologies & services<br>Life sciences<br>Media (film)<br>Specialized construction equipment & services |
| Capital | Oil, gas & energy<br>Chemicals & chemicals-based products<br>Forestry & wood products (wood products, paper)<br>Food products (sugar, animal processing)<br>Maritime<br>Fabricated Metals<br>Business services (security, insurance, legal)<br>Entertainment, arts & tourism (gaming) | Electronic instruments<br>Information technology |
| Bayou | Oil & gas (exploration, engineering services)<br>Shipbuilding (plus engineering services & fabricated metals)<br>Food products (seafood, confectionary products)<br>Transportation & logistics (maritime) | Entertainment, arts & tourism (tourism & ecotourism) |
| Acadiana | Oil & gas<br>Food products<br>Entertainment, arts & tourism (music, arts & culture)<br>Aerospace (aviation/air Transport, helicopters)<br>Transportation & logistics<br>Shipbuilding | Textile products<br>Nonmetallic minerals<br>Business services (insurance, legal)<br>Health care |
| Southwest | Oil, gas & energy (petrochemicals, exploration & services)<br>Entertainment, arts & tourism (gaming)<br>Agricultural products<br>Forestry & wood products | Aerospace |

| | | |
|---|---|---|
| Central | Lumber, wood products & paper<br>Oil, gas & energy (extraction)<br>Chemicals & chemicals-based products<br>Entertainment, arts & tourism (conventions)<br>Health care<br>Business services (back office)<br>Nurseries | Nonmetallic mineral mining & products<br>Fabricated metals<br>Transportation & logistics (trucking)<br>Technical consulting, services, R&D<br>Information technology (computer systems design & services)<br>Aviation (inter-regional)<br>Food products |
| Northeast | Lumber, wood products & paper (paper)<br>Chemicals & chemicals-based products (plastics)<br>Nonmetallic minerals (concrete)<br>Metalworking (structural metals)<br>Food products (meat processing) | Industrial machinery<br>Automotive (parts)<br>Transportation & logistics (trucking, warehousing)<br>Business services (insurance, credit intermediation)<br>Arts, entertainment & tourism (outdoor recreation)<br>Health care |
| Northwest | Oil, gas & energy<br>Forest products (Logging, veneer, paper)<br>Food products (meat processing)<br>Nonmetallic minerals (concrete, glass)<br>Metalworking (fabricated metals)<br>Entertainment, arts & tourism (gaming)<br>Media (film)<br>Automotive | Life sciences (medical equipment & supplies)<br>Transportation & logistics (trucking, warehousing)<br>Industrial machinery & equipment |

Some clusters are defined as established in one region but prospective in another. Media is one example. It has emerged so strongly in the Shreveport area that it is defined as established in the Northwest. Its contraction as an industry in New Orleans in the wake of the hurricanes caused it to be listed as prospective in that region. Media is a useful example in another respect. Its knowledge base is relatively stronger in the Southeast (particularly at the University of New Orleans) than in the Northwest. That serves to underscore that the findings in Tables 3 and 4 are focused on industrial strength at this stage of the analysis, not joint R&D and industrial strength. The question of R&D assets in Louisiana is the focus of the second major element of the research strengths assessment.

# Research Strengths Assessment

## Methods and Approach

The process of identifying the areas of greatest research strength in Louisiana incorporates multiple sources of information. The first step was a review of reports from organizations that list indicators of research output, productivity, and competitiveness among scientific and engineering disciplines and sub-disciplines. These include, for example, NSF data on annual total research expenditures, NSF and NIH competitive grants, industry-supported R&D expenditures, and graduate degrees awarded. The analysis also utilizes data from the Louisiana Board of Regents on awardees of the competitive Industrial Ties Research Subprogram grants over the last five years.

The second step was to examine the rankings of academic departments in Louisiana that combine subjective and objective indicators of research productivity such as the National Research Council's (NRC) reputational rankings of the quality of graduate school programs and faculty by discipline and sub-discipline, the U.S. News and World Report magazine's ranking of graduate school programs by discipline and sub-discipline, and the Academic Analytic's Faculty Scholarly Productivity Index of the Top Ten universities by discipline and sub-discipline based upon faculty publications and citations, recently published in the Chronicle of Higher Education.

The third step was to conduct searches of studies of scientific research and technology development outputs in Louisiana performed by other researchers. The results of this search provided a number of useful secondary sources, including a study performed by Professor Cherie Trumbach and colleagues at the University of New Orleans, Department of Management.[9]

The fourth step was to collect data on Small Business Innovation Research (SBIR) grants by sub-state region and by industry sector to help identify R&D strengths outside of the higher education sector, along with data from the U.S. Patent Office to provide indicators of research and technology development in industrial sectors (primarily) in the state, by sub-state region.

The fifth step was to examine information about self-assessed areas of research strength from the White Papers, submitted to the Board of Regents in November 2006 as part of Phase I by institutions of higher education (IHE) located within the hurricane impacted regions. The White Papers provide more detailed and up-to-date self-assessments of each IHE's competitive research strengths, since these are often more specialized niches that fall "under the radar screen" of the more broadly defined disciplines and sub-disciplines found in the national rankings described above. Since not all IHEs in Louisiana were requested to write and submit these White Papers, the research team examined the websites of all the universities located outside the hurricane impacted

---

9 Trumbach, Cherie Courseault, Sandra Hartman and Olof Lundberg, "Technology mining of Gulf Coast assets: Discovering regional assets for economic development," Department of Management, University of New Orleans, no date.

areas of the state to identify university research centers that indicate a high level of recent research activity.

Sixth, the research team received information from university administrators and research staff about university-based research assets from a site visit to New Orleans in January 2007 and a public hearing in new Orleans in February 2007 during Phase 1, site visits to several universities in early April 2007, and at a series of three focus groups held in New Orleans, Baton Rouge, and Shreveport in late April 2007.

Seventh, the team took into account the most recent advances in sharpening the focus of on-campus research efforts that could enhance economic development through the Regent's Post-Katrina Support Fund Initiative (P-KSFI). P-KSFI funds focus on disciplines identified as critical to Louisiana's economic development future and research competitiveness. In that regard, through its Primarily Research Subprogram (PRS) it funds targeted scientific projects which advance science at national and international levels, accelerate economic development, and lead to the establishment of nationally recognized centers. The first round of P-KSFI RPS awards should exceed $21 million and will be expended over a five-year period. P-KSFI also funds educational reforms that strengthen the scientific pipeline through its Primarily Education Subprogram (PES). For the purposes of this R&D assessment, the research team factored in three aspects of the P-KSFI PRS activity into its analysis. They were:

- The three eligible critical disciplines identified by the Board of Regents and specified in the P-KSFI PRS Request for Proposals: biological sciences, information technology, and materials science.
- The subject-area panel evaluations for proposals submitted in each of the three eligible discipline areas.
- The final report and funding recommendations of the P-KSFI RPS final review panel.

From the various sources of information, the team compiled a list of areas of R&D that showed up on at least one indicator of amount of research activity, on the relative ranking among all IHEs in the United States, or showed a large positive change in research activity or capacity within approximately the last five-to-ten -year period for which historical data were available. The team then looked to see if there was corroborating evidence of strength on more than one indicator.

In the eventual list of areas of greatest research capacity, some weight is assigned to those in which there is strength in more than one IHE within the state. This weighting is necessary because it is not likely that any one IHE has sufficient strengths across all critical elements—basic research, translational research, technology development and transfer, education and training for technicians as well as scientists and engineers—to lead to successful and sustainable technology-based economic development. Also, when there is strength in particular research areas shared among several IHEs, synergies that result from collaborative research endeavors are more likely to occur. Such collaborative projects and relationships between and among researchers in different IHEs help to "fill in" the gaps in building up the density and richness of the state's emerging knowledge infrastructure. There is mounting evidence in the literature on knowledge-based regional economies that the development of a dense knowledge infrastructure with multiple nodes consisting of research institutions, educational and training institutions, and intermediaries, and multiple connections among these nodes, is a critical success factor.

## Findings

The scan of the various national rankings of scientific and engineering disciplines and sub-disciplines within the colleges and universities in Louisiana indicates the presence of a number of highly nationally ranked disciplinary programs among several universities. LSU-Baton Rouge is ranked in the top 30 in external research funding in the fields of **agricultural sciences, biological sciences, other geosciences, oceanography, materials science/engineering, civil engineering, chemical engineering**, and **chemistry**. Tulane is ranked second nationally in research funding in the category **"other life sciences."** The reputational rankings provide further confirmation of these areas of excellence and also list several other nationally top 30 programs: **petroleum engineering** (LSU-Baton Rouge), **biomedical engineering** (Tulane), and **public health** (Tulane). Three programs at LSU-Baton Rouge are ranked by Academic Analytics in the national top ten using a faculty scholarly productivity index: **food sciences** (5$^{th}$), **kinesiology and exercise science** (3$^{rd}$), and **media studies/mass communications** (8$^{th}$). And although there are few if any economic development opportunities in foreign languages, it is worth noting that Tulane's French department was ranked 6$^{th}$ by Academic Analytics.

There are a number of other programs in Louisiana that are ranked outside the top 30 but within the top 80 nationally in terms of research funding, indicating substantial research capacity. These include **materials science/engineering** (Louisiana Tech), **computer science** (University of Louisiana Lafayette), **chemical engineering** (Tulane), **environmental engineering** (LSU-Baton Rouge), **mechanical engineering** (LSU-Baton Rouge), **mathematics and statistics** (Tulane, LSU-Baton Rouge), **physics and astronomy** (LSU-Baton Rouge), **medical sciences** (Tulane), **molecular genetics** (LSU Health Sciences-New Orleans), and **physiology** (Tulane).

While the national rankings, particularly in terms of amount of annual research funding, are important indicators of R&D competitiveness, they may hide more specialized areas of strength because of the use of aggregated categories. Digging down into the more detailed data on NSF, NIH, and BOR grants awarded to researchers in Louisiana's IHEs in recent years, it is apparent that there is substantial research capacity in several transdisciplinary research areas: **nanoscience and nanotechnology**, which is spread among several academic disciplines including materials science, mechanical engineering, chemistry, chemical engineering, and the medical sciences (Tulane, LSU Baton Rouge, Louisiana Tech, University of Louisiana Lafayette, University of New Orleans); **marine sciences and engineering** (LSU-Baton Rouge and University of New Orleans); **environmental sciences and ecology** (LSU Agricultural Center, LSU-Baton Rouge, University of New Orleans); and **oil and gas exploration and extraction** (LSU-Baton Rouge, University of Louisiana Lafayette.

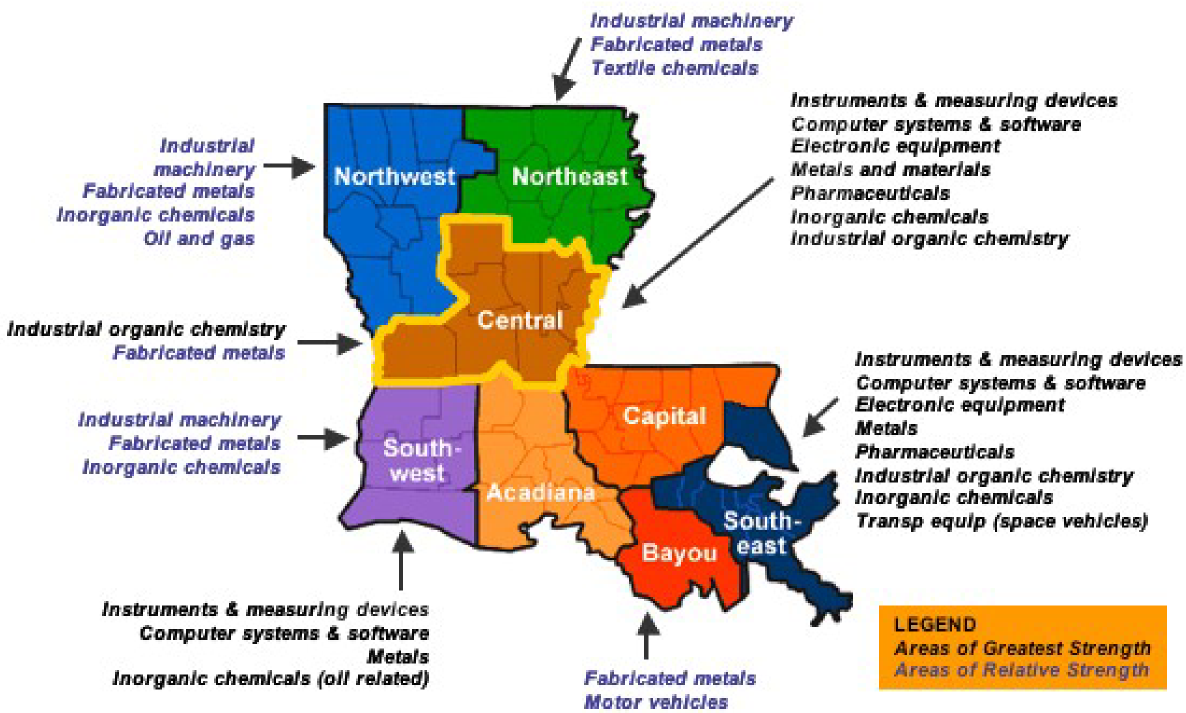
Trumbach et al.'s analysis of citations and patents in the I-10 corridor reveals a set of "strong research capabilities" that match well with the results of this analysis. Within Louisiana the areas of technology strength based upon citations include: **heat transfer, parallel processing systems, environmental engineering, soils, and thin films (**LSU-Baton Rouge); **biomedical engineering and nanostructured materials** (Tulane); **nanostructured materials, induction motors, thin films, and shipbuilding** (University of New Orleans); **forestry, wood products, plants** (LSU Agricultural Center); **superconductors and superconductivity** (Southern University Baton Rouge).

Within the broadly defined biomedical sciences, there is substantial research strength in **infectious diseases, vaccine development, and immunology** (Tulane, LSU Health Sciences-New Orleans, LSU Health Sciences-Shreveport, Xavier), **neurosciences** (LSU Health Sciences-New Orleans, LSU Health Sciences-Shreveport, Pennington Biomedical Research Center), **cancer research** (LSU Health Sciences-Shreveport, LSU-Baton Rouge); **peptide drugs** (Tulane, LSU Baton Rouge); **genetics and genomics, including stem cell research** (Tulane, LSU Health Sciences-New Orleans); and **environmental health sciences** (Tulane, Pennington Biomedical Research Center) .

The team also identified those university research programs that may not necessarily be highly ranked (in terms of research funding) at the current time, but whose rankings in funding or in NSF awards have substantially risen in the last eight years. These represent some of the potential and emerging areas of strength. Included here are Louisiana Tech's **chemistry, physics, electrical engineering, and computer science programs**, Northeast Louisiana University's **earth sciences**, **medical sciences** and **environmental biology** at the University of Louisiana Lafayette, and computation science.

There are also some islands of R&D capacity in Louisiana outside of universities in private industry. Using the number of Small Business Innovation Research grants awarded by the federal government as an indicator, there is a concentration of industry R&D in the Southeast region focused in **computer systems, electrical equipment, pharmaceuticals**, and **environmental technologies**. In the Capital region there is industry R&D activity focused in **metals, computers and electrical equipment**, and **pharmaceuticals**. Using the number of utility patents over the 2000-2005 period as another indicator of industry R&D capacity, the major industry sectors to which patents have been assigned are **scientific instruments** (Southeast, Capital, Acadiana), **fabricated metals** (Southeast, Capital, Acadiana), **construction and materials handling** (Southeast, Acadiana), **industrial machinery** (Capital, Acadiana, Southeast), **industrial organic chemistry** (Capital), **oil and gas** (Acadiana, Capital), **pharmaceuticals** (Southeast, Capital), and **rubber and plastics** (Southeast, Capital). A more complete description of the industry R&D activity by region can be seen in Figure 6.

Large corporate R&D labs include Exxon in **energy research,** Dow Chemical specializing in **polymer chemistry**, the Lockheed Martin Michoud specializing in **fuel tank design** for the space shuttle program, and Vickers Inc., specializing in fighter **aircraft engines**. Finally, there are several important federal government R&D labs in Louisiana: the U.S. Geologic Survey's **National Wetlands Research Center** in New Orleans, the U.S. Department of Agriculture's Southern Regional Research Center **(indigenous crop and plant research**), and the U.S. Navy's **National Biodynamics Lab.** A more complete description of the industry R&D activity by region can be seen in Figure 6.




## Figure 6. Regional industrial innovation and R&D strengths

The summary assessment of the areas of greatest R&D strengths uses categories of research areas (sub-disciplines) that come from the taxonomy that the National Research Council is using in its upcoming 2007 assessment of doctoral programs. While it is tempting to try to identify more narrowly defined areas of research, it is more prudent to use the broader NRC categories so as to take into account emerging (but presently unforeseen) related areas of investigation. There are several exceptions to the use of the newest NRC categories when the area of research is truly multi-disciplinary, for example cancer research or disaster management.

To summarize, the analysis reveals that Louisiana is fortunate to have a diverse set of scientific and engineering areas with substantial research capacity. Several of these stand out as being *highly nationally competitive* in particular universities and/or collectively across all IHEs and other R&D facilities in the state. These are shown in the upper half of Table 5 and labeled as Statewide R&D Strengths-Top Tier. There are other areas which are either presently strong, though not as yet top tier, or have shown recent significant upward movement in research capacity, that have the *potential* to become nationally centers of excellence in Louisiana. These are listed in the lower half of Table 5, labeled as Statewide R&D Strengths, Tier II.

**Table 5:**
**Statewide R&D Strengths**

| Areas of Strength | Leading Centers |
|---|---|
| **TOP TIER** | |
| Agricultural sciences<br>Food science<br>Plants & plants ecology<br>Forestry sciences | LSU Agricultural Center, LSU-BR, NW State, ULL, SRRC |
| Life sciences<br>Immunology and infectious diseases<br>Genetics and genomics (including stem cells)<br>Bioengineering<br>Peptides | LSU HS-N.O., LSU HS–Shreveport, Tulane, Pennington, Xavier, ULL |
| Materials science & materials engineering<br>Nanostructures<br>Thin films<br>Metallurgy | ULL, UNO, LSU-BR, Southern-BR, LaTech |
| Energy research (multidisciplinary)<br>Chemical engineering<br>Petroleum engineering<br>Materials science<br>Earth science<br>Mechanical engineering (emerging) | LSU-BR, ULL, Exxon R&D Lab |
| Chemistry & chemical engineering | LSU-BR, Tulane, Dow Chemical |
| Marine sciences/engineering | UNO, LSU-BR, Louisiana University Marine Consortium |
| Civil engineering | LSU-BR, LaTech |
| TIER II | |
| Environmental sciences<br>Wetlands ecology<br>Environmental engineering<br>Disaster/hazard prevention & mitigation<br>Civil engineering | UNO, LSU-BR, SE Louisiana, LSU Agr Ctr, ULL |
| Computer & information sciences | LSU-BR, ULL, UNO, LaTech |
| Life sciences<br>Cancer research<br>Neurosciences<br>Nutrition & health sciences<br>Environmental health sciences | LSU HS-N.O., Pennington, Tulane, LSU HS-Shreveport |

**Table 5:**
**Statewide R&D Strengths**

| Areas of Strength | Leading Centers |
| --- | --- |
| Physics & astronomy | LSU-BR |
| Mechanical engineering | LSU-BR, UNO, LaTech |

## The Match Between Industrial and R&D Strengths

The team arrived at the matches of Louisiana's industrial strengths and R&D strengths by first identifying the principal types and sources of R&D inputs (if any) for each identified area of industry strength, and then working in the opposite direction, looking at in which industry sectors knowledge outputs of each of the areas of R&D strength tend to get adopted. The two principal approaches and data sources for identifying these R&D-industry linkages are the national industry-occupation (I-O) matrix from the U.S. Bureau of Labor Statistics, and patent citation data. The I-O matrix shows which of the scientific and technical occupations are most important in a particular industry, and this information serves as a proxy for the kind of scientific knowledge used in each industry. The patent citation data show which scientific fields are the most important source of innovations that are adopted by industry. In practice the matches tend to be quite transparent, though the team relied upon the approach that utilizes the I-O data.

**Table 6: Joint Industrial and Research & Development Strengths in Louisiana**

| Established Industry | Established R&D (Top Tier) |
| --- | --- |
| Food products | Food sciences (Top tier) |
| Shipbuilding | Naval architecture (Top tier) |
| Oil, gas & energy | Chemistry & chemical engineering (Top tier)<br>Petroleum engineering (Top tier)<br>Earth sciences (Top tier) |
| Lumber, wood products | Forestry sciences (Top tier) |
| Chemicals & chemicals-based products | Chemistry & chemical engineering (Top tier) |
| Nonmetallic mineral products | Materials sciences (Top tier)<br>Civil engineering (Top tier) |
| **Prospective Industry** | **Established R&D (Top Tier and Tier II)** |
| Health care | Life sciences<br>Immunology/infectious diseases (Top tier)<br>Peptides (Top tier)<br>Genetics/genomics (incl. stem cells) (Top tier)<br>Cancer research (Tier II)<br>Neurosciences/neurobiology (Tier II)<br>Materials sciences (Top tier) |
| Life sciences | Life sciences<br>Genetics/genomics (Top tier)<br>Bioengineering (Top tier)<br>Neurosciences/neurobiology (Tier II) |
| Aerospace/aviation | Materials sciences (Top tier)<br>Physics/astronomy (Emerging)<br>Mechanical engineering (Tier II) |
| Automotive | Mechanical engineering (Tier II) |
| Information technology & services | Computer science<br>Optical networking (Tier II)<br>Information sciences (Emerging) |
| Specialized construction equipment & services | Civil engineering (Top tier)<br>Environmental sciences (Tier II) |
| Environmental technologies & services | Environmental sciences (Tier II)<br>Mechanical engineering (Tier II)<br>Civil engineering (Top Tier) |
| **Established Industry** | **Established R&D (Top Tier and Tier II)** |
| Transportation & logistics | Materials sciences (Top tier)<br>Mechanical engineering (Tier II)<br>Civil engineering (Top tier) |
| Fabricated metal goods | Mechanical engineering (Tier II) |
| **Established & Prospective Industry** | **Education Programs but No R&D Base** |
| Entertainment, arts & tourism (established) | Film studies<br>Music business |
| Media (prospective) | Film studies<br>Mass communications and media studies |
| Business services (prospective) | Business Administration<br>Law |

The matches of the separately identified industry and R&D strengths are shown in Table 6. The matches are organized by whether the industry strength is established or prospective, and whether the R&D strength is established, emerging, or prospective. As might be expected, there is only a moderate match between established industry clusters in Louisiana and the established R&D strengths, as shown below. Several of the strongest areas of research, including those in biomedical engineering, vaccine development and delivery, and genetics and gene therapy, do not at present have even moderate strengths in the region's economic base. Yet those are some of the areas where strength in research assets can, under the right conditions, induce company start-ups and/or firms to locate branches in the regions to take advantage of the presence of the associated research assets.

## Research Areas as Candidates for Statewide Targeted Investment

As discussed above, a portfolio approach to investment is recommended, as there is always uncertainty in trying to pick "winners." This is especially true in conditions like those facing the some of the hurricane-impacted regions of the state where recovery and development of the research assets within the IHEs depend upon many factors outside the control of those institutions.

In advising a portfolio strategy, some of the targeted research areas will be those that are already nationally competitive and are linked to existing strengths in the industrial economy. Another set would be clear areas of national competitiveness, but though not matched with existing mainstays in the state's economy, could stimulate a concentration and critical mass of start-up and entrepreneurial businesses in some technology-based sectors or clusters. Still a third set of research areas are those that presently are not that strong, but represent possible important targets of investment because of their ties to highly important sectors of the state economy.

Based upon this assessment of R&D and industry strengths in Louisiana, a case can be made for targeted investment in each of the following areas of research.

*Food sciences*. Strength in the food sciences is concentrated at **LSU-BR** and the **LSU Agricultural Center**, but it is an area in which there are potential complementary strengths in biotechnology and genetic research in other universities within the state. Food production is an important economic cluster in the state with excellent opportunity for growth in the value-added niches.

*Naval architecture and engineering* is an area of nationally competitive research strength concentrated largely at the **University of New Orleans**. It is recommended as a target because of the importance of the shipbuilding and water transportation sectors in the state's economy and several of its regions. There are very few universities with such programs, and Louisiana can capitalize on its competitive advantages in this area in terms of building increased shares of national and international markets for these kinds of services.

*Materials science* has strengths and significant external funding in several different domains and technology applications including metal oxides and polymers. Unlike some other research areas, strength and capacity are shared across a number of institutions including the **LSU-BR**, **University of Louisiana Lafayette**, **University of New Orleans**, **Louisiana Tech**, and **Southern University-Baton Rouge**. The relatively new area of nanoscience and nanotechnology has exciting technological applications for a number of industries and clusters of strength within the state.

Immunology and infectious diseases, genetics and genomics, peptide drugs, and bioengineering, but also neuroscience, cancer research, and environmental health research, are among the areas of greatest relative R&D strength within the state as a whole. Research strength and capacity are shared among **Tulane, LSU Health Sciences-N.O., LSU Health Sciences-Shreveport, Pennington, Xavier**, and the **University of Louisiana Lafayette**. Investments in these areas offer perhaps the best prospects for significantly stimulating the state's emerging biotechnology and pharmaceutical industries. There is a history of strong collaboration among university research centers across the state, and a number of the four-year colleges and universities as well as some of the community colleges have excellent capacity for contributing to the pipeline of trained workers in biotechnology and pharmaceuticals.

*Chemistry and chemical engineering* are highly nationally ranked at **LSU-BR** and at **Tulane** (chemical engineering). The sub-disciplines of analytical chemistry and industrial organic chemistry are particularly highly ranked. Chemistry and chemical engineering represent an important and strategic scientific base for a number of Louisiana's prominent industrial clusters including oil, gas, and energy, and biotechnology and pharmaceuticals, as well as for the chemicals and plastics cluster, itself. There is also substantial R&D capacity on the industry side including a **Dow Chemical** facility.

*Energy research* is a multidisciplinary area that encompasses *petroleum engineering*, and sub-disciplines within the *geosciences,* and the *marine sciences,* as well as other areas already described. These are all very strong areas of research—concentrated at **LSU-BR**, **University of Louisiana Lafayette**, and the **Exxon R&D** lab — and are clearly linked to one of the most important industry clusters in Louisiana.

*Computer and information sciences* is not *at present* as strong nationally as some other areas. Yet it is a strategically important area that is directly linked to the prospective cluster of information technology and services, but whose applications have technology development and commercialization potential in a large number of established and prospective sectors and clusters including bioinformatics, pharmaceuticals, environmental technologies, and aerospace and aviation. The universities with the most research capacity are **LSU-BR**, **University of New Orleans**, **Louisiana Tech**, and the **University of Louisiana Lafayette**. The state has made some key investments in supercomputing and other infrastructure to support this area becoming a national center of excellence.

*Civil engineering* has a national top-30 academic program at **LSU-BR** and also strength at **Louisiana Tech**. It is a discipline that encompasses a diverse set of technologies and potential economic applications. The most direct linkages to the leading industry clusters in the state are in environmental technologies, specialized construction equipment, transportation and logistics, and nonmetal mineral products.

*Environmental sciences and engineering*, like civil engineering, has a wide range of applications in the industry sectors and clusters important to the state's economy. Directly these include the environmental technologies and services and construction equipment and services clusters, but indirectly the oil, gas and energy sectors, food products, and forestry products. The research capacity in this area is spread among the **University of New Orleans**, **LSU-BR**, **LSU-Agricultural Center**, **Southeastern Louisiana University**, and the **University of Louisiana Lafayette**.

*Physics/astronomy* is another area in which present national rankings in research expenditures and Ph.D. degrees awarded do not reveal the extent of research capacity in particular sub-disciplines. The sub-discipline in which there is both strength and depth within the academic sector is astrophysics at **LSU-BR** and substantial industry R&D presence and close-by federal government facilities. The development of the state's prospective aerospace cluster into a key component of the state's economy would be aided and abetted by targeted investment in this sub-discipline.

*Mechanical engineering (as* distinct from materials science and engineering), is another area of research, while not being as highly ranked nationally as some others, has a heterogeneous range of potential technologies and applications that can be matched to an equally wide range of key industry sectors and clusters in Louisiana. The potential areas of application include aerospace, automotive, transportation and logistics, fabricated metal goods, and environmental technologies. The leading universities in mechanical engineering research are **LSU-BR**, the **University of New Orleans**, and **Louisiana Tech**.

While it is not difficult to identify these eleven areas as the leading candidates for targeted investment, it is quite difficult to select a subset of these and say, "this is the portfolio that offers the optimum return on investment." Based upon the R&D strengths and matches with the economic strengths in the state *at the present time*, the team recommends that investment in a specific subset of the **(1) life sciences (immunology and infectious diseases, genetics/genomics**, **peptide drugs, bioengineering**), **(2) food sciences**, **(3) materials sciences/engineering**, and **(4) chemistry/chemical engineering** are the best bets. It is important to remember, however, that both industry strengths, and particularly academic R&D strength, are highly fluid. Many factors that affect competitiveness and technology horizons and possibilities may very well change between June 2007 and the time when the overall structure, organizations, and funding will have been put in place for implementation of this plan. It is thus critical that the entity created through this planning initiative, or in its absence the Board of Regents, conduct a strategic review of academic competitiveness, technological horizons, and market opportunities at that time before making final decisions on research areas for targeted investment. It is important to note that it is assumed that the analytical capacity and management discipline required to make strategic, focused R&D investments will be a key design attribute of the organization and system that will be designed during the next stage of this effort.

In conclusion, this assessment indicates Louisiana has an array of areas of strong research capacity, including several that can be accurately described as national centers of excellence. A number of other areas have a good likelihood of becoming such centers. The areas of R&D strength exist primarily within the university sector, but there is also a substantial R&D base in industrial and federal government labs in selected research areas. For each of the identified areas of R&D strength, the analysis indicates how they are linked to industrial clusters that represent key strengths in Louisiana's economy. The analysis also discusses and qualifies several of the high priority R&D areas with specific market applications within a global market context (see Addendum 3).

Addenda to Appendix A:

(1) Supporting Tables

(2) Cluster Mapping Project New Orleans/
Southwest Region Profile

# Addendum 1: Supporting Tables

## Table A1.1: Detailed Benchmark Industry Trends, by Group

| | | | Core Industry | | | | | | | | Linked Industries | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Establishments | | Employment | | | | | | Establishments | | Employment | | | | | |
| | | | | | | | | | Pct Δ'02-'05 | | | | | | | | Pct Δ'02-'05 | |
| Industry | NAICS | Group | 2005 | Δ '02-'05 | 2005 | '02-'05 | LQ 2002 | LQ 2005 | State | US | 2005 | Δ '02-'05 | 2005 | '02-'05 | LQ 2002 | LQ 2005 | State | US |
| Basic chemical mfg | 3251 | BHT | 140 | 30 | 13,352 | -1,018 | 6.14 | 6.59 | -7.1 | -10.7 | 442 | -14 | 22,418 | -1,051 | 1.11 | 1.23 | -0.4 | -6.9 |
| Pharmaceutical & medicine mfg | 3254 | BHT | 17 | -8 | 510 | 97 | 0.10 | 0.13 | 23.5 | -1.8 | 19 | -8 | 1,001 | 225 | 1.31 | 2.05 | 35.3 | -11.0 |
| Industrial machinery mfg | 3332 | BHT | 36 | -1 | 674 | -77 | 0.42 | 0.41 | -10.3 | -6.2 | 631 | -30 | 12,544 | 105 | 0.49 | 0.53 | 1.6 | -3.5 |
| Computer & peripheral equipment mfg | 3341 | BHT | 5 | -2 | 39 | 7 | 0.01 | 0.01 | 21.9 | -17.6 | 5 | -2 | 39 | 7 | 0.00 | 0.00 | 0.0 | 0.0 |
| Communications equipment mfg | 3342 | BHT | 15 | -5 | 158 | 6 | 0.06 | 0.08 | 3.9 | -19.6 | 44 | 6 | 381 | 55 | 0.06 | 0.08 | 28.2 | -0.9 |
| Semiconductor & electronic component mfg | 3344 | BHT | 14 | -6 | 233 | -50 | 0.04 | 0.04 | -17.7 | -14.7 | 493 | -14 | 12,979 | 1,583 | 1.00 | 1.14 | 14.7 | 3.2 |
| Electronic instrument mfg | 3345 | BHT | 62 | 15 | 1,655 | 619 | 0.18 | 0.31 | 59.7 | -2.9 | 745 | -5 | 13,400 | -289 | 0.67 | 0.67 | -7.2 | -4.7 |
| Wire & cable mfg | 33592 | BHT | 1 | -1 | 1 | -35 | 0.10 | 0.00 | -97.2 | -15.5 | 16 | -5 | 128 | -112 | 0.32 | 0.22 | -37.7 | -6.9 |
| Aerospace product & parts mfg | 3364 | BHT | 16 | -12 | 2,600 | -346 | 0.46 | 0.43 | -11.7 | -2.7 | 170 | -13 | 7,691 | -297 | 0.53 | 0.59 | 1.0 | -5.8 |
| Software publishers | 5112 | BHT | 50 | -18 | 268 | -141 | 0.12 | 0.08 | -34.5 | -5.2 | 1,958 | 267 | 53,921 | 2,519 | 0.74 | 0.75 | 5.2 | 8.0 |
| Web publishing, broadcasting, ISPs & search portals | 51A | BHT | 143 | -5 | 856 | -173 | 0.34 | 0.32 | -16.8 | -8.8 | 377 | 9 | 5,714 | -315 | 0.46 | 0.50 | -2.8 | -7.2 |
| Data processing & related services | 5182 | BHT | 163 | 3 | 2,025 | 165 | 0.45 | 0.57 | 8.9 | -11.8 | 2,342 | 293 | 61,617 | 7,248 | 0.72 | 0.78 | 13.5 | 8.2 |
| Architectural & engineering services | 5413 | BHT | 1,748 | 16 | 19,621 | 137 | 1.13 | 1.11 | 0.7 | 5.7 | 4,052 | 309 | 63,446 | 1,968 | 0.79 | 0.78 | 4.4 | 8.6 |
| Computer systems design & related services | 5415 | BHT | 924 | 111 | 7,306 | 2,668 | 0.29 | 0.46 | 57.5 | 4.9 | 5,071 | 517 | 109,425 | 8,148 | 0.77 | 0.81 | 5.7 | 3.3 |
| Scientific R&D services | 5417 | BHT | 142 | 31 | 1,028 | -38 | 0.14 | 0.13 | -3.6 | 7.6 | 282 | 57 | 3,543 | 475 | 0.24 | 0.32 | 25.6 | -4.6 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Outpatient care, diagnostic labs & misc ambulatory health care | 621B | BHT | 775 | 74 | 11,555 | 525 | 1.03 | 0.99 | 4.8 | 13.2 | 863 | 51 | 12,849 | 393 | 0.20 | 0.19 | -9.3 | -1.6 |
| Petroleum & coal product mfg | 3241 | BMT | 112 | -42 | 9,199 | -758 | 6.06 | 6.11 | -7.6 | -5.4 | 727 | 163 | 16,925 | -265 | 0.57 | 0.62 | 6.8 | 1.6 |
| Resin, rubber & artificial fibers & filaments mfg | 3252 | BMT | 36 | -3 | 4,321 | -920 | 3.33 | 3.02 | -17.6 | -6.3 | 69 | -17 | 5,978 | -1,098 | 0.68 | 0.65 | -9.7 | -2.5 |
| Agricultural chemical mfg | 3253 | BMT | 31 | 2 | 2,526 | -622 | 5.17 | 4.65 | -19.8 | -8.0 | 139 | 13 | 4,546 | -978 | 0.87 | 0.82 | -15.0 | -6.7 |
| Paint, coating & adhesive mfg | 3255 | BMT | 19 | -8 | 695 | -15 | 0.72 | 0.77 | -2.1 | -5.7 | 157 | -49 | 8,047 | -786 | 1.29 | 1.31 | -9.5 | -8.1 |
| Soap, cleaning compound & toiletry mfg | 3256 | BMT | 28 | -3 | 692 | -50 | 0.44 | 0.46 | -6.7 | -6.2 | 87 | -16 | 4,642 | -38 | 0.74 | 0.83 | 0.3 | -7.9 |
| Printing ink mfg | 32591 | BMT | 5 | -1 | 39 | -56 | 0.53 | 0.23 | -58.9 | -4.0 | 23 | -6 | 1,146 | -610 | 1.43 | 1.09 | -33.4 | -10.0 |
| Explosives mfg | 32592 | BMT | 3 | 0 | 246 | 133 | 1.33 | 3.01 | 117.7 | -1.1 | 55 | 2 | 4,826 | -945 | 1.78 | 1.65 | -19.1 | -10.3 |
| Compound resins, film & misc chemical product mfg | 32599 | BMT | 61 | 15 | 1,035 | 50 | 0.76 | 0.89 | 5.1 | -6.9 | 628 | 193 | 7,764 | -683 | 0.63 | 0.58 | -9.8 | -0.3 |
| Agricultural, construction & mining machinery mfg | 3331 | BMT | 154 | -14 | 7,785 | -18 | 2.84 | 2.81 | -0.2 | 4.3 | 470 | -41 | 14,076 | -674 | 0.55 | 0.55 | -9.4 | -5.6 |
| Commercial & service machinery mfg | 3333 | BMT | 35 | -8 | 1,457 | -332 | 1.01 | 0.98 | -18.6 | -14.0 | 1,154 | 142 | 20,324 | 1,610 | 0.39 | 0.48 | 11.5 | -5.6 |
| HVAC & commercial refrigeration equipment mfg | 3334 | BMT | 17 | -2 | 782 | 358 | 0.19 | 0.38 | 84.4 | -7.9 | 167 | -14 | 7,605 | -162 | 0.85 | 0.89 | -7.1 | -8.8 |
| Metalworking machinery mfg | 3335 | BMT | 17 | -1 | 148 | -30 | 0.06 | 0.06 | -16.9 | -7.1 | 285 | -36 | 8,170 | -483 | 0.45 | 0.47 | -5.3 | -6.9 |
| Turbine & power transmission equipment mfg | 3336 | BMT | 12 | -2 | 102 | -93 | 0.14 | 0.08 | -47.7 | -2.8 | 232 | -25 | 8,056 | 289 | 0.39 | 0.44 | 5.0 | -6.0 |
| Pump & compressor mfg | 33391 | BMT | 23 | -9 | 557 | -100 | 0.87 | 0.80 | -15.2 | -5.3 | 220 | -33 | 7,402 | -398 | 0.72 | 0.76 | -4.2 | -6.0 |
| Material handling equipment mfg | 33392 | BMT | 16 | -18 | 313 | -871 | 1.07 | 0.31 | -73.6 | -4.8 | 277 | -49 | 8,113 | -1,308 | 0.62 | 0.64 | -5.3 | -5.9 |
| Misc machinery mfg | 33399 | BMT | 42 | -4 | 815 | 65 | 0.37 | 0.43 | 8.7 | -5.7 | 521 | -33 | 11,219 | 154 | 0.57 | 0.63 | 0.9 | -6.0 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Audio & video equipment mfg | 3343 | BMT | 5 | 3 | 78 | 6 | 0.12 | 0.18 | 8.3 | -21.8 | 512 | 169 | 3,087 | 828 | 0.23 | 0.33 | 37.6 | -2.5 |
| Magnetic media mfg & reproducing | 3346 | BMT | 17 | -4 | 47 | -78 | 0.10 | 0.04 | -62.4 | -14.0 | 1,297 | 161 | 15,721 | 609 | 0.44 | 0.48 | 4.6 | -3.1 |
| Electric lighting equipment mfg | 3351 | BMT | 10 | 3 | 163 | 56 | 0.11 | 0.20 | 52.3 | -15.4 | 114 | 17 | 5,644 | 402 | 0.48 | 0.58 | 6.7 | -9.1 |
| Household appliance mfg | 3352 | BMT | 7 | 1 | 145 | -48 | 0.14 | 0.13 | -24.9 | -11.6 | 776 | 7 | 12,987 | -1,249 | 0.56 | 0.55 | -8.6 | -4.2 |
| Electrical equipment mfg | 3353 | BMT | 23 | 0 | 951 | -112 | 0.44 | 0.47 | -10.5 | -13.0 | 77 | -16 | 2,244 | -105 | 0.29 | 0.31 | 0.5 | -3.5 |
| Battery mfg | 33591 | BMT | 1 | -2 | 217 | -51 | 0.64 | 0.59 | -19.0 | -8.4 | 83 | -1 | 2,791 | -195 | 0.33 | 0.34 | -5.3 | -7.3 |
| Wiring device mfg | 33593 | BMT | 0 | -1 | 0 | -3 | 0.00 | 0.00 | -100.0 | -15.6 | 37 | -5 | 640 | -124 | 0.16 | 0.14 | -15.9 | -1.9 |
| Misc electrical equipment mfg | 33599 | BMT | 3 | 0 | 77 | 49 | 0.06 | 0.17 | 175.0 | 1.6 | 223 | 75 | 7,369 | 1,519 | 1.74 | 2.33 | 25.2 | -3.5 |
| Motor vehicle mfg | 3361 | BMT | 7 | 4 | 3,235 | 860 | 0.64 | 0.97 | 36.2 | -6.6 | 103 | 8 | 6,119 | 1,798 | 0.13 | 0.21 | 48.2 | -7.7 |
| Motor vehicle parts mfg | 3363 | BMT | 42 | -7 | 1,940 | 816 | 0.11 | 0.21 | 72.6 | -6.8 | 53 | -14 | 2,283 | 746 | 0.15 | 0.13 | -16.9 | -7.6 |
| Railroad rolling stock mfg | 3365 | BMT | 3 | -1 | 31 | 10 | 0.07 | 0.08 | 47.6 | 23.5 | 39 | -12 | 1,413 | 158 | 0.58 | 0.70 | 12.0 | -3.7 |
| Ship & boat building | 3366 | BMT | 146 | 8 | 14,355 | -142 | 7.30 | 7.05 | -1.0 | 5.8 | 393 | -19 | 23,602 | -1,698 | 0.81 | 0.75 | -14.4 | -4.0 |
| Misc transportation equipment mfg | 3369 | BMT | 7 | 0 | 44 | -112 | 0.29 | 0.08 | -71.8 | 0.6 | 109 | -9 | 3,202 | -254 | 0.46 | 0.47 | -4.3 | -3.3 |
| Medical equipment & supplies mfg | 3391 | BMT | 152 | 14 | 848 | -122 | 0.23 | 0.21 | -12.6 | -1.6 | 1,135 | 50 | 20,406 | 281 | 0.66 | 0.71 | 2.1 | -3.3 |
| Telecommunications carriers & resellers | 517A | BMT | 709 | 64 | 12,688 | -542 | 0.82 | 0.95 | -4.1 | -15.3 | 714 | 63 | 12,749 | -545 | 0.07 | 0.11 | -4.7 | -36.2 |
| Specialized design services | 5414 | BMT | 219 | -3 | 749 | -66 | 0.48 | 0.43 | -8.1 | 5.3 | 2,195 | 56 | 14,540 | 4,315 | 0.40 | 0.55 | 46.6 | 8.7 |
| Management & technical consulting services | 5416 | BMT | 1,699 | 132 | 6,735 | 1,377 | 0.53 | 0.59 | 25.7 | 16.0 | 6,476 | 418 | 85,763 | 3,905 | 0.83 | 0.83 | 3.3 | 5.7 |
| Colleges, universities & junior colleges | 611A | BMT | 40 | 8 | 8,789 | -14 | 0.65 | 0.62 | -0.2 | 7.7 | 5,093 | 184 | 36,092 | -1,207 | 0.66 | 0.62 | -4.2 | 4.2 |
| Hospitals | 622 | BMT | 259 | 33 | 64,443 | 3,900 | 1.07 | 1.12 | 6.4 | 4.7 | 878 | 61 | 80,400 | 2,888 | 0.61 | 0.57 | -6.0 | 4.0 |
| Pharmaceutical & medicine mfg | 3254 | DL | 17 | -8 | 510 | 97 | 0.10 | 0.13 | 23.5 | -1.8 | 19 | -8 | 1,001 | 225 | 1.31 | 2.05 | 35.3 | -11.0 |
| Industrial machinery mfg | 3332 | DL | 36 | -1 | 674 | -77 | 0.42 | 0.41 | -10.3 | -6.2 | 631 | -30 | 12,544 | 105 | 0.49 | 0.53 | 1.6 | -3.5 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metalworking machinery mfg | 3335 | DL | 17 | -1 | 148 | -30 | 0.06 | 0.06 | -16.9 | -7.1 | 285 | -36 | 8,170 | -483 | 0.45 | 0.47 | -5.3 | -6.9 |
| Computer & peripheral equipment mfg | 3341 | DL | 5 | -2 | 39 | 7 | 0.01 | 0.01 | 21.9 | -17.6 | 5 | -2 | 39 | 7 | 0.00 | 0.00 | 0.0 | 0.0 |
| Communications equipment mfg | 3342 | DL | 15 | -5 | 158 | 6 | 0.06 | 0.08 | 3.9 | -19.6 | 44 | 6 | 381 | 55 | 0.06 | 0.08 | 28.2 | -0.9 |
| Semiconductor & electronic component mfg | 3344 | DL | 14 | -6 | 233 | -50 | 0.04 | 0.04 | -17.7 | -14.7 | 493 | -14 | 12,979 | 1,583 | 1.00 | 1.14 | 14.7 | 3.2 |
| Electronic instrument mfg | 3345 | DL | 62 | 15 | 1,655 | 619 | 0.18 | 0.31 | 59.7 | -2.9 | 745 | -5 | 13,400 | -289 | 0.67 | 0.67 | -7.2 | -4.7 |
| Software publishers | 5112 | DL | 50 | -18 | 268 | -141 | 0.12 | 0.08 | -34.5 | -5.2 | 1,958 | 267 | 53,921 | 2,519 | 0.74 | 0.75 | 5.2 | 8.0 |
| Computer systems design & related services | 5415 | DL | 924 | 111 | 7,306 | 2,668 | 0.29 | 0.46 | 57.5 | 4.9 | 5,071 | 517 | 109,425 | 8,148 | 0.77 | 0.81 | 5.7 | 3.3 |
| Scientific R&D services | 5417 | DL | 142 | 31 | 1,028 | -38 | 0.14 | 0.13 | -3.6 | 7.6 | 282 | 57 | 3,543 | 475 | 0.24 | 0.32 | 25.6 | -4.6 |
| Securities, commodity contracts, investments | 523 | AS | 926 | -95 | 4,115 | -69 | 0.38 | 0.39 | -1.6 | 0.7 | 1,016 | -87 | 4,463 | -12 | 0.25 | 0.29 | 19.6 | 3.4 |
| Funds, trusts & other financial vehicles | 525 | AS | 90 | 8 | 348 | 57 | 0.25 | 0.29 | 19.6 | 3.4 | 4,149 | 210 | 40,260 | -820 | 0.89 | 0.87 | -2.2 | 3.3 |
| Legal services | 5411 | AS | 4,023 | 152 | 19,512 | -665 | 1.31 | 1.25 | -3.3 | 4.8 | 6,709 | 158 | 62,259 | 271 | 0.88 | 0.90 | 2.2 | 3.5 |
| Architectural & engineering services | 5413 | AS | 1,748 | 16 | 19,621 | 137 | 1.13 | 1.11 | 0.7 | 5.7 | 4,052 | 309 | 63,446 | 1,968 | 0.79 | 0.78 | 4.4 | 8.6 |
| Specialized design services | 5414 | AS | 219 | -3 | 749 | -66 | 0.48 | 0.43 | -8.1 | 5.3 | 2,195 | 56 | 14,540 | 4,315 | 0.40 | 0.55 | 46.6 | 8.7 |
| Computer systems design & related services | 5415 | AS | 924 | 111 | 7,306 | 2,668 | 0.29 | 0.46 | 57.5 | 4.9 | 5,071 | 517 | 109,425 | 8,148 | 0.77 | 0.81 | 5.7 | 3.3 |
| Management & technical consulting services | 5416 | AS | 1,699 | 132 | 6,735 | 1,377 | 0.53 | 0.59 | 25.7 | 16.0 | 6,476 | 418 | 85,763 | 3,905 | 0.83 | 0.83 | 3.3 | 5.7 |
| Scientific R&D services | 5417 | AS | 142 | 31 | 1,028 | -38 | 0.14 | 0.13 | -3.6 | 7.6 | 282 | 57 | 3,543 | 475 | 0.24 | 0.32 | 25.6 | -4.6 |
| Advertising & related services | 5418 | AS | 518 | 30 | 3,242 | 181 | 0.50 | 0.55 | 5.9 | 0.7 | 1,208 | 30 | 6,328 | -26 | 0.63 | 0.59 | -6.3 | 3.5 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Management of companies & enterprises | 55 | AS | 562 | 105 | 20,737 | -1,692 | 0.96 | 0.89 | -7.5 | 2.8 | 5,873 | 323 | 54,199 | 158 | 0.78 | 0.84 | 5.9 | 1.6 |
| Accounting & bookkeeping services | 5412 | SBS | 1,858 | 21 | 9,705 | 835 | 0.76 | 0.84 | 9.4 | 2.1 | 2,957 | 297 | 14,179 | 2,307 | 0.53 | 0.75 | 49.0 | 8.6 |
| Misc professional & technical services | 5419A | SBS | 337 | 114 | 1,322 | 389 | 0.42 | 0.58 | 41.7 | 3.8 | 4,191 | 262 | 50,513 | 4,169 | 0.68 | 0.71 | 8.3 | 7.5 |
| Office administrative services | 5611 | SBS | 490 | 135 | 4,276 | 1,469 | 0.71 | 0.91 | 52.3 | 22.2 | 4,145 | 420 | 63,266 | 3,259 | 0.77 | 0.77 | 3.1 | 6.8 |
| Employment services | 5613 | SBS | 991 | 149 | 35,087 | 2,210 | 0.73 | 0.74 | 6.7 | 8.6 | 4,720 | 244 | 91,512 | -629 | 0.88 | 0.83 | -4.8 | 4.1 |
| Business support services | 5614 | SBS | 593 | -6 | 7,616 | -324 | 0.76 | 0.75 | -4.1 | 0.5 | 2,458 | 267 | 52,606 | 2,459 | 0.78 | 0.79 | 6.6 | 8.5 |
| Misc business support services | 5619 | SBS | 370 | -5 | 5,373 | -968 | 1.59 | 1.37 | -15.3 | 1.3 | 1,221 | 117 | 13,283 | 111 | 0.57 | 0.66 | 15.8 | 2.0 |
| Motion picture & video industries | 5121 | TA | 171 | 15 | 3,852 | 1,866 | 0.40 | 0.82 | 94.0 | -1.6 | 171 | 15 | 3,852 | 1,866 | 0.00 | 0.00 | 0.0 | 0.0 |
| Sound recording industries | 5122 | TA | 26 | -16 | 47 | -50 | 0.26 | 0.16 | -51.5 | -21.6 | 30 | -16 | 64 | -132 | 0.15 | 0.03 | -82.8 | -11.9 |
| Travel arrangement & reservation services | 5615 | TA | 228 | -54 | 1,883 | 16 | 0.53 | 0.62 | 0.9 | -11.6 | 875 | -99 | 8,648 | -332 | 0.49 | 0.54 | -4.9 | -9.6 |
| Performing arts companies | 7111 | TA | 85 | -2 | 490 | -311 | 0.48 | 0.32 | -38.8 | -6.4 | 194 | -4 | 955 | -559 | 0.74 | 0.46 | -34.8 | 8.2 |
| Spectator sports | 7112 | TA | 101 | -16 | 1,903 | -677 | 1.42 | 1.11 | -26.2 | -2.7 | 515 | 7 | 5,580 | -429 | 0.95 | 0.97 | 7.2 | 8.4 |
| Promoters, agents & celebrity managers | 711A | TA | 78 | 14 | 1,175 | 556 | 0.52 | 0.92 | 89.8 | 10.0 | 159 | 14 | 1,293 | 489 | 0.33 | 0.20 | -36.2 | 8.8 |
| Independent artists, writers, and performers | 7115 | TA | 81 | -1 | 118 | -67 | 0.33 | 0.20 | -36.2 | 8.8 | 470 | -43 | 2,939 | 299 | 0.44 | 0.53 | 14.9 | -2.1 |
| Museums, historical sites, zoos & parks | 712 | TA | 68 | 3 | 1,660 | 135 | 0.96 | 1.04 | 8.9 | 3.1 | 1,373 | 88 | 15,271 | -270 | 0.79 | 0.75 | -2.9 | 5.0 |
| Misc amusement, gambling & recreation industries | 713A | TA | 565 | 32 | 20,900 | -4,999 | 2.44 | 1.92 | -19.3 | 5.8 | 771 | 40 | 23,494 | -4,969 | 0.44 | 0.50 | 1.2 | -9.0 |
| Hotels & motels, including casino hotels | 721A | TA | 709 | 41 | 25,332 | 1,423 | 1.03 | 1.10 | 6.0 | 2.4 | 1,412 | 12 | 32,596 | 1,151 | 0.73 | 0.77 | -3.6 | -4.7 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Other accomodations, camps & boarding houses | 721B | TA | 131 | -39 | 775 | -190 | 0.79 | 0.65 | -19.7 | -0.4 | 241 | -37 | 2,295 | 174 | 0.33 | 0.47 | 31.5 | -5.5 |
| Software publishers | 5112 | IS | 50 | -18 | 268 | -141 | 0.12 | 0.08 | -34.5 | -5.2 | 1,958 | 267 | 53,921 | 2,519 | 0.74 | 0.75 | 5.2 | 8.0 |
| Web publishing, broadcasting, ISPs & search portals | 51A | IS | 143 | -5 | 856 | -173 | 0.34 | 0.32 | -16.8 | -8.8 | 377 | 9 | 5,714 | -315 | 0.46 | 0.50 | -2.8 | -7.2 |
| Data processing & related services | 5182 | IS | 163 | 3 | 2,025 | 165 | 0.45 | 0.57 | 8.9 | -11.8 | 2,342 | 293 | 61,617 | 7,248 | 0.72 | 0.78 | 13.5 | 8.2 |
| Pharmaceutical & medicine mfg | 3254 | H | 17 | -8 | 510 | 97 | 0.10 | 0.13 | 23.5 | -1.8 | 19 | -8 | 1,001 | 225 | 1.31 | 2.05 | 35.3 | -11.0 |
| Medical equipment & supplies mfg | 3391 | H | 152 | 14 | 848 | -122 | 0.23 | 0.21 | -12.6 | -1.6 | 1,135 | 50 | 20,406 | 281 | 0.66 | 0.71 | 2.1 | -3.3 |
| Offices of physicians, dentists & other health practitioners | 621A | H | 6,459 | 484 | 47,462 | 1,773 | 1.04 | 1.04 | 3.9 | 7.1 | 7,381 | 565 | 60,476 | 2,628 | 0.75 | 0.76 | 7.0 | 8.9 |
| Outpatient care, diagnostic labs & misc ambulatory health care | 621B | H | 775 | 74 | 11,555 | 525 | 1.03 | 0.99 | 4.8 | 13.2 | 863 | 51 | 12,849 | 393 | 0.20 | 0.19 | -9.3 | -1.6 |
| Hospitals | 622 | H | 259 | 33 | 64,443 | 3,900 | 1.07 | 1.12 | 6.4 | 4.7 | 878 | 61 | 80,400 | 2,888 | 0.61 | 0.57 | -6.0 | 4.0 |
| Basic chemical mfg | 3251 | BHT | 140 | 30 | 13,352 | -1,018 | 6.14 | 6.59 | -7.1 | -10.7 | 442 | -14 | 22,418 | -1,051 | 1.11 | 1.23 | -0.4 | -6.9 |
| Pharmaceutical & medicine mfg | 3254 | BHT | 17 | -8 | 510 | 97 | 0.10 | 0.13 | 23.5 | -1.8 | 19 | -8 | 1,001 | 225 | 1.31 | 2.05 | 35.3 | -11.0 |
| Industrial machinery mfg | 3332 | BHT | 36 | -1 | 674 | -77 | 0.42 | 0.41 | -10.3 | -6.2 | 631 | -30 | 12,544 | 105 | 0.49 | 0.53 | 1.6 | -3.5 |
| Computer & peripheral equipment mfg | 3341 | BHT | 5 | -2 | 39 | 7 | 0.01 | 0.01 | 21.9 | -17.6 | 5 | -2 | 39 | 7 | 0.00 | 0.00 | 0.0 | 0.0 |
| Communications equipment mfg | 3342 | BHT | 15 | -5 | 158 | 6 | 0.06 | 0.08 | 3.9 | -19.6 | 44 | 6 | 381 | 55 | 0.06 | 0.08 | 28.2 | -0.9 |
| Semiconductor & electronic component mfg | 3344 | BHT | 14 | -6 | 233 | -50 | 0.04 | 0.04 | -17.7 | -14.7 | 493 | -14 | 12,979 | 1,583 | 1.00 | 1.14 | 14.7 | 3.2 |
| Electronic instrument mfg | 3345 | BHT | 62 | 15 | 1,655 | 619 | 0.18 | 0.31 | 59.7 | -2.9 | 745 | -5 | 13,400 | -289 | 0.67 | 0.67 | -7.2 | -4.7 |
| Wire & cable mfg | 33592 | BHT | 1 | -1 | 1 | -35 | 0.10 | 0.00 | -97.2 | -15.5 | 16 | -5 | 128 | -112 | 0.32 | 0.22 | -37.7 | -6.9 |
| Aerospace product & parts mfg | 3364 | BHT | 16 | -12 | 2,600 | -346 | 0.46 | 0.43 | -11.7 | -2.7 | 170 | -13 | 7,691 | -297 | 0.53 | 0.59 | 1.0 | -5.8 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Software publishers | 5112 | BHT | 50 | -18 | 268 | -141 | 0.12 | 0.08 | -34.5 | -5.2 | 1,958 | 267 | 53,921 | 2,519 | 0.74 | 0.75 | 5.2 | 8.0 |

**Table A1.2: Core industries grouped into identified Louisiana clusters (employment location quotients > 1.10 highlighted)**

| | | Core Industry | | | | | | | | Linked Industries | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Establishments | | Employment | | | | | | Establishments | | Employment | | | | | |
| | | | | | | | | Pct Δ'02-'05 | | | | | | | | Pct Δ'02-'05 | |
| Industry | NAICS | 2005 | Δ '02-'05 | 2005 | Δ '02-'05 | LQ 2002 | LQ 2005 | State | US | 2005 | Δ '02-'05 | 2005 | Δ '02-'05 | LQ 2002 | LQ 2005 | State | US |
| **Aerospace** | | | | | | | | | | | | | | | | | |
| Aerospace product & parts mfg | 3364 | 16 | -12 | 2,600 | -346 | 0.46 | 0.43 | -11.7 | -2.7 | 170 | -13 | 7,691 | -297 | 0.53 | 0.59 | 1.0 | -5.8 |
| Electronic instrument mfg | 3345 | 62 | 15 | 1,655 | 619 | 0.18 | 0.31 | 59.7 | -2.9 | 745 | -5 | 13,400 | -289 | 0.67 | 0.67 | -7.2 | -4.7 |
| | | | | | | | | | | | | | | | | | |
| **Automotive** | | | | | | | | | | | | | | | | | |
| Motor vehicle mfg | 3361 | 7 | 4 | 3,235 | 860 | 0.64 | 0.97 | 36.2 | -6.6 | 103 | 8 | 6,119 | 1,798 | 0.13 | 0.21 | 48.2 | -7.7 |
| Motor vehicle parts mfg | 3363 | 42 | -7 | 1,940 | 816 | 0.11 | 0.21 | 72.6 | -6.8 | 53 | -14 | 2,283 | 746 | 0.15 | 0.13 | -16.9 | -7.6 |
| Motor vehicle body & trailer mfg | 3362 | 12 | -1 | 644 | 408 | 0.11 | 0.28 | 172.9 | 10.3 | 407 | -14 | 12,427 | 747 | 0.60 | 0.67 | 3.0 | -4.4 |
| | | | | | | | | | | | | | | | | | |
| **Business Services** | | | | | | | | | | | | | | | | | |
| Employment services | 5613 | 991 | 149 | 35,087 | 2,210 | 0.73 | 0.74 | 6.7 | 8.6 | 4,720 | 244 | 91,512 | -629 | 0.88 | 0.83 | -4.8 | 4.1 |
| Legal services | 5411 | 4,023 | 152 | 19,512 | -665 | 1.31 | 1.25 | -3.3 | 4.8 | 6,709 | 158 | 62,259 | 271 | 0.88 | 0.90 | 2.2 | 3.5 |
| Insurance agencies & brokerages | 5242 | 2,571 | 192 | 15,060 | 884 | 1.25 | 1.28 | 6.2 | 6.8 | 4,052 | 160 | 31,077 | 2,409 | 0.67 | 0.75 | 10.5 | 1.8 |
| Accounting & bookkeeping services | 5412 | 1,858 | 21 | 9,705 | 835 | 0.76 | 0.84 | 9.4 | 2.1 | 2,957 | 297 | 14,179 | 2,307 | 0.53 | 0.75 | 49.0 | 8.6 |
| Management & technical consulting services | 5416 | 1,699 | 132 | 6,735 | 1,377 | 0.53 | 0.59 | 25.7 | 16.0 | 6,476 | 418 | 85,763 | 3,905 | 0.83 | 0.83 | 3.3 | 5.7 |
| Insurance carriers | 5241 | 530 | 23 | 6,495 | -1,223 | 0.43 | 0.38 | -15.8 | -2.2 | 3,310 | 229 | 25,342 | -629 | 1.11 | 1.11 | 3.3 | 5.7 |
| Misc business support services | 5619 | 370 | -5 | 5,373 | -968 | 1.59 | 1.37 | -15.3 | 1.3 | 1,221 | 117 | 13,283 | 111 | 0.57 | 0.66 | 15.8 | 2.0 |
| Office administrative services | 5611 | 490 | 135 | 4,276 | 1,469 | 0.71 | 0.91 | 52.3 | 22.2 | 4,145 | 420 | 63,266 | 3,259 | 0.77 | 0.77 | 3.1 | 6.8 |
| Advertising & related services | 5418 | 518 | 30 | 3,242 | 181 | 0.50 | 0.55 | 5.9 | 0.7 | 1,208 | 30 | 6,328 | -26 | 0.63 | 0.59 | -6.3 | 3.5 |
| Misc professional & | 5419A | 337 | 114 | 1,322 | 389 | 0.42 | 0.58 | 41.7 | 3.8 | 4,191 | 262 | 50,513 | 4,169 | 0.68 | 0.71 | 8.3 | 7.5 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| technical services | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| **Chemicals & Chemicals-based Products** | | | | | | | | | | | | | | | | | |
| Basic chemical mfg | 3251 | 140 | 30 | 13,352 | -1,018 | 6.14 | 6.59 | -7.1 | -10.7 | 442 | -14 | 22,418 | -1,051 | 1.11 | 1.23 | -0.4 | -6.9 |
| Resin, rubber & artificial fibers & filaments mfg | 3252 | 36 | -3 | 4,321 | -920 | 3.33 | 3.02 | -17.6 | -6.3 | 69 | -17 | 5,978 | -1,098 | 0.68 | 0.65 | -9.7 | -2.5 |
| Plastics product mfg | 3261 | 112 | -4 | 3,594 | 56 | 0.38 | 0.42 | 1.6 | -4.9 | 318 | -16 | 7,854 | -1,647 | 1.18 | 0.94 | -28.6 | -7.0 |
| Agricultural chemical mfg | 3253 | 31 | 2 | 2,526 | -622 | 5.17 | 4.65 | -19.8 | -8.0 | 139 | 13 | 4,546 | -978 | 0.87 | 0.82 | -15.0 | -6.7 |
| Rubber product mfg | 3262 | 33 | 6 | 1,403 | 247 | 0.46 | 0.62 | 21.4 | -7.7 | 1,965 | -34 | 22,614 | -423 | 1.06 | 1.04 | -3.1 | 1.6 |
| Compound resins, film & misc chemical product mfg | 32599 | 61 | 15 | 1,035 | 50 | 0.76 | 0.89 | 5.1 | -6.9 | 628 | 193 | 7,764 | -683 | 0.63 | 0.58 | -9.8 | -0.3 |
| Paint, coating & adhesive mfg | 3255 | 19 | -8 | 695 | -15 | 0.72 | 0.77 | -2.1 | -5.7 | 157 | -49 | 8,047 | -786 | 1.29 | 1.31 | -9.5 | -8.1 |
| Explosives mfg | 32592 | 3 | 0 | 246 | 133 | 1.33 | 3.01 | 117.7 | -1.1 | 55 | 2 | 4,826 | -945 | 1.78 | 1.65 | -19.1 | -10.3 |
| | | | | | | | | | | | | | | | | | |
| **Entertainment, Arts & Tourism** | | | | | | | | | | | | | | | | | |
| Hotels & motels, including casino hotels | 721A | 709 | 41 | 25,332 | 1,423 | 1.03 | 1.10 | 6.0 | 2.4 | 1,412 | 12 | 32,596 | 1,151 | 0.73 | 0.77 | -3.6 | -4.7 |
| Misc amusement, gambling & recreation industries | 713A | 565 | 32 | 20,900 | -4,999 | 2.44 | 1.92 | -19.3 | 5.8 | 771 | 40 | 23,494 | -4,969 | 0.44 | 0.50 | 1.2 | -9.0 |
| Spectator sports | 7112 | 101 | -16 | 1,903 | -677 | 1.42 | 1.11 | -26.2 | -2.7 | 515 | 7 | 5,580 | -429 | 0.95 | 0.97 | 7.2 | 8.4 |
| Travel arrangement & reservation services | 5615 | 228 | -54 | 1,883 | 16 | 0.53 | 0.62 | 0.9 | -11.6 | 875 | -99 | 8,648 | -332 | 0.49 | 0.54 | -4.9 | -9.6 |
| Museums, historical sites, zoos & parks | 712 | 68 | 3 | 1,660 | 135 | 0.96 | 1.04 | 8.9 | 3.1 | 1,373 | 88 | 15,271 | -270 | 0.79 | 0.75 | -2.9 | 5.0 |
| Promoters, agents & celebrity managers | 711A | 78 | 14 | 1,175 | 556 | 0.52 | 0.92 | 89.8 | 10.0 | 159 | 14 | 1,293 | 489 | 0.33 | 0.20 | -36.2 | 8.8 |
| Performing arts companies | 7111 | 85 | -2 | 490 | -311 | 0.48 | 0.32 | -38.8 | -6.4 | 194 | -4 | 955 | -559 | 0.74 | 0.46 | -34.8 | 8.2 |
| Independent artists, writers, and performers | 7115 | 81 | -1 | 118 | -67 | 0.33 | 0.20 | -36.2 | 8.8 | 470 | -43 | 2,939 | 299 | 0.44 | 0.53 | 14.9 | -2.1 |
| | | | | | | | | | | | | | | | | | |
| **Food Products** | | | | | | | | | | | | | | | | | |
| Animal slaughtering & processing | 3116 | 74 | -8 | 5,032 | -448 | 0.77 | 0.75 | -8.2 | -2.9 | 148 | -25 | 6,669 | -157 | 0.89 | 1.08 | 21.6 | 3.4 |
| Suger & confectionary | 3113 | 46 | -5 | 2,910 | 105 | 2.35 | 2.85 | 3.7 | -11.7 | 130 | -7 | 5,586 | -214 | 1.10 | 1.03 | -10.7 | -1.5 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| product mfg | | | | | | | | | | | | | | | | | |
| Soft drink & ice mfg | 31211 | 41 | 7 | 1,808 | -637 | 1.58 | 1.34 | -26.1 | -10.5 | 85 | 18 | 3,368 | -666 | 0.42 | 0.45 | -1.8 | -5.0 |
| Seafood product mfg | 3117 | 75 | 2 | 1,668 | -240 | 3.17 | 2.99 | -12.6 | -4.3 | 122 | -5 | 1,863 | -320 | 2.68 | 2.06 | -29.1 | -4.9 |
| Seasoning & dressing mfg | 31194 | 15 | -1 | 1,600 | 620 | 2.58 | 3.80 | 63.3 | 14.0 | 406 | 5 | 8,005 | 561 | 0.51 | 0.52 | -0.9 | -1.2 |
| Coffee & tea mfg | 31192 | 19 | 10 | 801 | 80 | 4.13 | 4.35 | 11.1 | 8.8 | 559 | 29 | 8,054 | -1,154 | 0.45 | 0.41 | -14.5 | -2.7 |
| Grain & oilseed milling | 3112 | 19 | 2 | 558 | 9 | 0.64 | 0.68 | 1.6 | -2.1 | 883 | 91 | 11,491 | -526 | 0.70 | 0.70 | -4.7 | -1.5 |
| Misc food mfg | 31199 | 14 | -14 | 261 | -318 | 0.79 | 0.34 | -54.9 | 7.6 | 117 | 10 | 6,319 | 336 | 0.81 | 1.02 | 12.1 | -7.5 |
| Fishing | 1141 | 47 | -8 | 195 | -80 | 2.68 | 2.06 | -29.1 | -4.9 | 12,039 | 621 | 170,188 | -6,640 | 1.55 | 1.43 | -3.7 | 7.9 |
| Animal food mfg | 3111 | 19 | -5 | 194 | -203 | 0.56 | 0.30 | -51.1 | -4.6 | 133 | -11 | 3,529 | -762 | 1.15 | 1.07 | -14.4 | -4.5 |
| Textile bag & canvas mfg | 31491 | 28 | -1 | 347 | -181 | 1.31 | 0.83 | -34.3 | 7.3 | 245 | 60 | 7,551 | 1,382 | 3.25 | 4.54 | 27.7 | -5.6 |
| | | | | | | | | | | | | | | | | | |
| **Healthcare** | | | | | | | | | | | | | | | | | |
| Hospitals | 622 | 259 | 33 | 64,443 | 3,900 | 1.07 | 1.12 | 6.4 | 4.7 | 878 | 61 | 80,400 | 2,888 | 0.61 | 0.57 | -6.0 | 4.0 |
| Offices of physicians, dentists & other health practitioners | 621A | 6,459 | 484 | 47,462 | 1,773 | 1.04 | 1.04 | 3.9 | 7.1 | 7,381 | 565 | 60,476 | 2,628 | 0.75 | 0.76 | 7.0 | 8.9 |
| Outpatient care, diagnostic labs & misc ambulatory health care | 621B | 775 | 74 | 11,555 | 525 | 1.03 | 0.99 | 4.8 | 13.2 | 863 | 51 | 12,849 | 393 | 0.20 | 0.19 | -9.3 | -1.6 |
| Veterinary services | 54194 | 407 | 27 | 3,566 | 321 | 0.97 | 0.99 | 9.9 | 11.2 | 1,224 | 89 | 15,821 | 923 | 0.64 | 0.65 | 5.2 | 6.8 |
| | | | | | | | | | | | | | | | | | |
| **Information Technologies** | | | | | | | | | | | | | | | | | |
| Computer systems design & related services | 5415 | 924 | 111 | 7,306 | 2,668 | 0.29 | 0.46 | 57.5 | 4.9 | 5,071 | 517 | 109,425 | 8,148 | 0.77 | 0.81 | 5.7 | 3.3 |
| Data processing & related services | 5182 | 163 | 3 | 2,025 | 165 | 0.45 | 0.57 | 8.9 | -11.8 | 2,342 | 293 | 61,617 | 7,248 | 0.72 | 0.78 | 13.5 | 8.2 |
| Web publishing, broadcasting, ISPs & search portals | 51A | 143 | -5 | 856 | -173 | 0.34 | 0.32 | -16.8 | -8.8 | 377 | 9 | 5,714 | -315 | 0.46 | 0.50 | -2.8 | -7.2 |
| Software publishers | 5112 | 50 | -18 | 268 | -141 | 0.12 | 0.08 | -34.5 | -5.2 | 1,958 | 267 | 53,921 | 2,519 | 0.74 | 0.75 | 5.2 | 8.0 |
| Semiconductor & electronic component mfg | 3344 | 14 | -6 | 233 | -50 | 0.04 | 0.04 | -17.7 | -14.7 | 493 | -14 | 12,979 | 1,583 | 1.00 | 1.14 | 14.7 | 3.2 |
| Communications equipment mfg | 3342 | 15 | -5 | 158 | 6 | 0.06 | 0.08 | 3.9 | -19.6 | 44 | 6 | 381 | 55 | 0.06 | 0.08 | 28.2 | -0.9 |
| | | | | | | | | | | | | | | | | | |
| **Life Sciences** | | | | | | | | | | | | | | | | | |
| Scientific R&D services | 5417 | 142 | 31 | 1,028 | -38 | 0.14 | 0.13 | -3.6 | 7.6 | 282 | 57 | 3,543 | 475 | 0.24 | 0.32 | 25.6 | -4.6 |
| Medical equipment & supplies mfg | 3391 | 152 | 14 | 848 | -122 | 0.23 | 0.21 | -12.6 | -1.6 | 1,135 | 50 | 20,406 | 281 | 0.66 | 0.71 | 2.1 | -3.3 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pharmaceutical & medicine mfg | 3254 | 17 | -8 | 510 | 97 | 0.10 | 0.13 | 23.5 | -1.8 | 19 | -8 | 1,001 | 225 | 1.31 | 2.05 | 35.3 | -11.0 |
| | | | | | | | | | | | | | | | | | |
| **Media** | | | | | | | | | | | | | | | | | |
| Radio & television broadcasting | 5151 | 132 | -12 | 4,113 | -22 | 1.23 | 1.29 | -0.5 | -1.7 | 132 | -12 | 4,113 | -22 | 0.00 | 0.00 | 0.0 | 0.0 |
| Motion picture & video industries | 5121 | 171 | 15 | 3,852 | 1,866 | 0.40 | 0.82 | 94.0 | -1.6 | 171 | 15 | 3,852 | 1,866 | 0.00 | 0.00 | 0.0 | 0.0 |
| Sound recording industries | 5122 | 26 | -16 | 47 | -50 | 0.26 | 0.16 | -51.5 | -21.6 | 30 | -16 | 64 | -132 | 0.15 | 0.03 | -82.8 | -11.9 |
| | | | | | | | | | | | | | | | | | |
| **Nonmetallic Mineral Products** | | | | | | | | | | | | | | | | | |
| Cement & concrete product mfg | 3273 | 146 | 37 | 3,489 | -1,142 | 1.46 | 1.09 | -24.7 | 3.9 | 930 | 43 | 29,403 | -573 | 1.60 | 1.77 | 2.2 | -5.0 |
| Glass & glass product mfg | 3272 | 20 | 6 | 1,894 | 441 | 0.84 | 1.31 | 30.4 | -13.5 | 119 | 14 | 5,733 | 844 | 0.54 | 0.67 | 11.7 | -7.8 |
| Misc nonmetallic mineral product mfg | 3279 | 41 | -5 | 456 | -519 | 0.98 | 0.45 | -53.2 | 5.7 | 251 | -77 | 6,911 | -1,338 | 0.96 | 0.93 | -11.3 | -6.0 |
| Clay product & refractory mfg | 3271 | 35 | -8 | 273 | -288 | 0.57 | 0.33 | -51.3 | -13.6 | 208 | -53 | 5,896 | -151 | 0.62 | 0.69 | 2.5 | -5.1 |
| Lime & gypsum product mfg | 3274 | 8 | 0 | 88 | -242 | 1.26 | 0.34 | -73.3 | 2.2 | 380 | 61 | 16,448 | 1,219 | 1.93 | 2.34 | 9.8 | -6.6 |
| | | | | | | | | | | | | | | | | | |
| **Oil, Gas & Energy** | | | | | | | | | | | | | | | | | |
| Oil & gas extraction | 211 | 1,454 | -44 | 41,039 | -2,249 | 10.78 | 9.05 | -5.2 | 16.5 | 1,454 | -44 | 41,039 | -2,249 | 0.00 | 0.00 | 0.0 | 0.0 |
| Architectural & engineering services | 5413 | 1,748 | 16 | 19,621 | 137 | 1.13 | 1.11 | 0.7 | 5.7 | 4,052 | 309 | 63,446 | 1,968 | 0.79 | 0.78 | 4.4 | 8.6 |
| Petroleum & coal product mfg | 3241 | 112 | -42 | 9,199 | -758 | 6.06 | 6.11 | -7.6 | -5.4 | 727 | 163 | 16,925 | -265 | 0.57 | 0.62 | 6.8 | 1.6 |
| Agricultural, construction & mining machinery mfg | 3331 | 154 | -14 | 7,785 | -18 | 2.84 | 2.81 | -0.2 | 4.3 | 470 | -41 | 14,076 | -674 | 0.55 | 0.55 | -9.4 | -5.6 |
| Power generation & supply | 2211 | 210 | -42 | 6,924 | -80 | 1.18 | 1.30 | -1.1 | -7.4 | 485 | -51 | 20,526 | 453 | 0.71 | 0.74 | 4.1 | 3.9 |
| Pipeline transportation | 486 | 170 | -4 | 2,488 | 394 | 3.56 | 4.89 | 18.8 | -10.7 | 1,181 | 70 | 17,848 | 371 | 1.79 | 1.86 | -0.1 | -0.9 |
| Water, sewage and other systems | 2213 | 231 | 21 | 1,338 | 31 | 1.97 | 2.18 | 2.4 | -4.5 | 12,249 | 607 | 130,193 | 1,081 | 1.22 | 1.17 | 0.8 | 7.8 |
| Natural gas distribution | 2212 | 95 | 10 | 1,125 | -153 | 0.81 | 0.79 | -12.0 | -6.7 | 269 | 5 | 3,625 | 199 | 2.36 | 3.25 | 16.4 | -12.9 |
| Nonmetallic mineral mining & quarrying | 2123 | 64 | -48 | 1,106 | -540 | 1.05 | 0.70 | -32.8 | 4.3 | 360 | -61 | 14,261 | -378 | 2.79 | 2.97 | 1.2 | -1.8 |
| Coal mining | 2121 | 3 | -4 | 256 | -1 | 0.25 | 0.26 | -0.4 | 1.2 | 164 | -45 | 8,504 | 150 | 2.60 | 2.65 | 1.9 | 3.2 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Misc electrical equipment mfg | 33599 | 3 | 0 | 77 | 49 | 0.06 | 0.17 | 175.0 | 1.6 | 223 | 75 | 7,369 | 1,519 | 1.74 | 2.33 | 25.2 | -3.5 |
| | | | | | | | | | | | | | | | | | |
| **Shipbuilding** | | | | | | | | | | | | | | | | | |
| Ship & boat building | 3366 | 146 | 8 | 14,355 | -142 | 7.30 | 7.05 | -1.0 | 5.8 | 393 | -19 | 23,602 | -1,698 | 0.81 | 0.75 | -14.4 | -4.0 |
| Misc fabricated metal product mfg | 3329 | 102 | -15 | 4,775 | -207 | 1.22 | 1.27 | -4.2 | -4.9 | 700 | 157 | 10,152 | 442 | 0.28 | 0.32 | 13.7 | 0.2 |
| Architectural & structural metals mfg | 3323 | 191 | -11 | 4,527 | -620 | 0.94 | 0.85 | -12.0 | 0.3 | 281 | -4 | 9,219 | -285 | 0.99 | 1.21 | 7.7 | -8.9 |
| Boiler, tank & shipping container mfg | 3324 | 45 | -5 | 1,532 | -109 | 1.24 | 1.26 | -6.6 | -4.6 | 126 | -12 | 5,288 | -448 | 0.99 | 0.94 | -8.3 | -1.2 |
| Coated, engraving & heat treating metals | 3328 | 52 | -5 | 981 | -118 | 0.53 | 0.51 | -10.7 | -2.5 | 230 | 15 | 5,240 | -2,376 | 1.61 | 1.16 | -34.6 | -6.5 |
| Alumina & aluminum mfg | 3313 | 10 | -2 | 911 | -606 | 1.39 | 0.93 | -39.9 | -7.7 | 28 | -7 | 1,305 | -844 | 0.54 | 0.35 | -37.7 | 0.3 |
| Steel product mfg from purchased steel | 3312 | 6 | -3 | 670 | 346 | 0.38 | 0.84 | 106.8 | -3.8 | 103 | -5 | 2,269 | 653 | 0.29 | 0.39 | 23.8 | -6.6 |
| Iron & steel mills & ferro alloy mfg | 3311 | 12 | 1 | 471 | 52 | 0.28 | 0.37 | 12.4 | -11.3 | 35 | -10 | 1,293 | 27 | 0.62 | 0.67 | -3.0 | -6.6 |
| Foundries | 3315 | 10 | -5 | 343 | -41 | 0.16 | 0.15 | -10.7 | -7.0 | 622 | -12 | 7,287 | -454 | 0.61 | 0.60 | -5.6 | -1.5 |
| Nonferrous metal mfg, except aluminum | 3314 | 7 | -1 | 202 | -89 | 0.26 | 0.21 | -30.6 | -11.0 | 14 | -4 | 375 | -84 | 0.09 | 0.10 | 3.0 | -3.8 |
| | | | | | | | | | | | | | | | | | |
| **Transportation & Logistics** | | | | | | | | | | | | | | | | | |
| Water transportation | 483 | 1,201 | 45 | 27,930 | -855 | 3.50 | 3.27 | -3.0 | 7.2 | 2,133 | 15 | 51,240 | -2,220 | 0.99 | 1.00 | -5.5 | -3.3 |
| Truck transportation | 484 | 1,865 | -34 | 18,263 | -739 | 1.03 | 0.98 | -3.9 | 3.9 | 1,884 | -27 | 18,520 | -757 | 0.26 | 0.28 | -6.5 | -9.5 |
| Warehousing & storage | 493 | 231 | 43 | 5,461 | -667 | 0.87 | 0.70 | -10.9 | 14.4 | 4,590 | 167 | 40,382 | -1,940 | 0.84 | 0.81 | -3.5 | 2.8 |
| Air transportation | 481 | 105 | 1 | 2,946 | -282 | 0.42 | 0.44 | -8.7 | -11.0 | 1,356 | -79 | 27,312 | -2,443 | 1.79 | 1.71 | -8.1 | -0.7 |
| Rail transportation | 482 | 3 | 3 | 690 | 685 | 1.04 | 96.15 | 1370 0.0 | 53.7 | 1,246 | -74 | 25,696 | -2,532 | 2.01 | 1.79 | -11.4 | 2.5 |
| | | | | | | | | | | | | | | | | | |
| **Wood, Lumber & Paper** | | | | | | | | | | | | | | | | | |
| Pulp, paper & paperboard mills | 3221 | 26 | -9 | 6,668 | 552 | 2.68 | 3.54 | 9.0 | -15.0 | 141 | -44 | 11,301 | 538 | 0.87 | 0.97 | -0.3 | -7.8 |
| Veneer, plywood & engineered wood product mfg | 3212 | 36 | -16 | 4,352 | -1,151 | 3.45 | 2.66 | -20.9 | 5.8 | 164 | -15 | 7,840 | -988 | 0.63 | 0.72 | 4.9 | -5.7 |
| Converted paper product mfg | 3222 | 57 | 2 | 3,903 | -200 | 0.78 | 0.85 | -4.9 | -9.4 | 145 | -19 | 12,365 | 487 | 1.28 | 1.64 | 8.8 | -12.0 |
| Forestry and logging | 113 | 506 | -44 | 3,388 | -98 | 3.35 | 3.55 | -2.8 | -5.3 | 513 | -58 | 7,384 | -240 | 1.22 | 1.26 | -3.4 | -3.5 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sawmills & wood preservation | 3211 | 71 | 2 | 2,611 | 561 | 1.23 | 1.63 | 27.4 | -0.6 | 76 | 1 | 2,742 | 577 | 0.41 | 0.49 | 13.9 | -1.5 |
| Millwork | 32191 | 42 | -9 | 675 | 12 | 0.32 | 0.32 | 1.8 | 4.5 | 83 | -7 | 3,182 | 49 | 0.91 | 1.09 | 1.5 | -13.1 |
| Wood container & pallet mfg | 32192 | 24 | 1 | 502 | 107 | 0.47 | 0.65 | 27.1 | -4.7 | 84 | 4 | 2,872 | 671 | 1.02 | 1.38 | 31.2 | 0.1 |
| | | | | | | | | | | | | | | | | | |
| **Other Core Industries (sorted by 2005 employment)** | | | | | | | | | | | | | | | | | |
| Construction | 23 | 10,147 | 559 | 118,455 | 18 | 1.28 | 1.22 | 0.0 | 8.7 | 10,584 | 593 | 124,725 | -1,278 | 0.64 | 0.53 | -17.1 | 4.2 |
| Monetary authorities & depository credit intermediation | 52A | 1,789 | -37 | 24,057 | -1,337 | 1.05 | 1.00 | -5.3 | 2.4 | 6,720 | 446 | 50,911 | -662 | 0.70 | 0.70 | 2.6 | 5.8 |
| Management of companies & enterprises | 55 | 562 | 105 | 20,737 | -1,692 | 0.96 | 0.89 | -7.5 | 2.8 | 5,873 | 323 | 54,199 | 158 | 0.78 | 0.84 | 5.9 | 1.6 |
| Real estate | 531 | 3,305 | 117 | 13,469 | -58 | 0.72 | 0.69 | -0.4 | 7.4 | 3,796 | 252 | 17,745 | 1,403 | 0.67 | 0.88 | 51.9 | 20.0 |
| Telecommunications carriers & resellers | 517A | 709 | 64 | 12,688 | -542 | 0.82 | 0.95 | -4.1 | -15.3 | 714 | 63 | 12,749 | -545 | 0.07 | 0.11 | -4.7 | -36.2 |
| Nondepository credit intermediation & related | 522A | 2,161 | 461 | 10,590 | -20 | 0.81 | 0.72 | -0.2 | 16.8 | 5,212 | 427 | 57,862 | -2,017 | 0.91 | 0.89 | -4.1 | 0.8 |
| Investigation & security services | 5616 | 428 | 6 | 9,765 | -977 | 1.06 | 0.99 | -9.1 | 0.9 | 1,925 | 290 | 49,689 | 2,624 | 0.73 | 0.76 | 9.9 | 9.5 |
| Colleges, universities & junior colleges | 611A | 40 | 8 | 8,789 | -14 | 0.65 | 0.62 | -0.2 | 7.7 | 5,093 | 184 | 36,092 | -1,207 | 0.66 | 0.62 | -4.2 | 4.2 |
| Business support services | 5614 | 593 | -6 | 7,616 | -324 | 0.76 | 0.75 | -4.1 | 0.5 | 2,458 | 267 | 52,606 | 2,459 | 0.78 | 0.79 | 6.6 | 8.5 |
| Civic, social & professional organizations | 813B | 875 | 5 | 6,201 | 75 | 0.52 | 0.55 | 1.2 | -1.5 | 2,910 | 76 | 28,706 | -1,679 | 0.80 | 0.76 | -7.2 | 0.9 |
| Misc educational services | 611B | 679 | 77 | 5,484 | -524 | 0.99 | 0.81 | -8.7 | 14.5 | 2,688 | 363 | 51,668 | 2,866 | 0.74 | 0.77 | 7.9 | 7.7 |
| Couriers & messengers | 492 | 206 | 6 | 5,444 | 819 | 0.59 | 0.72 | 17.7 | -1.0 | 3,952 | 423 | 48,223 | -2,208 | 1.20 | 1.07 | -6.6 | 7.8 |
| Newspaper, book & directory publishers | 5111 | 239 | 23 | 4,952 | -27 | 0.51 | 0.55 | -0.5 | -6.0 | 1,723 | 259 | 37,195 | -665 | 0.85 | 0.85 | -1.9 | 1.0 |
| Securities, commodity contracts, investments | 523 | 926 | -95 | 4,115 | -69 | 0.38 | 0.39 | -1.6 | 0.7 | 1,016 | -87 | 4,463 | -12 | 0.25 | 0.29 | 19.6 | 3.4 |
| Transit & ground passenger transportation | 485 | 209 | 13 | 3,787 | -290 | 0.79 | 0.73 | -7.1 | 3.4 | 993 | -15 | 13,314 | -1,437 | 0.46 | 0.44 | -10.7 | -3.9 |
| Printing & related support activities | 3231 | 371 | -13 | 3,536 | -447 | 0.41 | 0.41 | -11.2 | -8.8 | 983 | 120 | 9,567 | -1,281 | 0.39 | 0.38 | -12.1 | -7.4 |
| Machine shops & threaded product mfg | 3327 | 276 | -4 | 3,212 | -36 | 0.74 | 0.70 | -1.1 | 7.9 | 347 | -18 | 4,453 | -494 | 0.25 | 0.21 | -27.0 | -9.1 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bakery product mfg | 3118 | 96 | -16 | 2,523 | -119 | 0.65 | 0.67 | -4.5 | -4.9 | 478 | -22 | 11,052 | -724 | 0.76 | 0.74 | -6.6 | -1.6 |
| Grantmaking & social advocacy organizations | 813A | 277 | 11 | 2,470 | -403 | 0.73 | 0.65 | -14.0 | 0.0 | 3,537 | 245 | 63,751 | -599 | 0.76 | 0.75 | -0.3 | 5.3 |
| Crop production | 111 | 344 | 7 | 1,943 | -183 | 0.50 | 0.45 | -8.6 | 4.4 | 521 | 8 | 7,790 | -1,151 | 0.65 | 0.63 | -14.2 | -8.3 |
| Jewelry & silverware mfg | 33991 | 18 | -9 | 1,785 | 208 | 2.28 | 3.08 | 13.2 | -13.4 | 20 | -13 | 1,807 | 158 | 0.40 | 0.15 | -69.4 | -12.8 |
| Commercial & service machinery mfg | 3333 | 35 | -8 | 1,457 | -332 | 1.01 | 0.98 | -18.6 | -14.0 | 1,154 | 142 | 20,324 | 1,610 | 0.39 | 0.48 | 11.5 | -5.6 |
| Household & institutional furniture mfg | 3371 | 197 | 8 | 1,292 | 15 | 0.23 | 0.25 | 1.2 | -4.7 | 522 | -2 | 15,263 | -2,477 | 0.76 | 0.72 | -15.1 | -7.5 |
| Dairy product mfg | 3115 | 13 | -8 | 1,050 | -182 | 0.65 | 0.60 | -14.8 | -3.7 | 35 | -13 | 1,493 | -258 | 0.43 | 0.42 | -14.6 | -11.0 |
| Photographic services | 54192 | 263 | -27 | 1,028 | -106 | 0.98 | 0.92 | -9.3 | -0.4 | 759 | -32 | 4,874 | -295 | 0.76 | 0.69 | -4.7 | 8.1 |
| Electrical equipment mfg | 3353 | 23 | 0 | 951 | -112 | 0.44 | 0.47 | -10.5 | -13.0 | 77 | -16 | 2,244 | -105 | 0.29 | 0.31 | 0.5 | -3.5 |
| Cut & sew apparel mfg | 3152 | 47 | -36 | 895 | -1,848 | 0.71 | 0.33 | -67.4 | -28.1 | 837 | -51 | 10,912 | -2,900 | 0.79 | 0.78 | -9.5 | -6.0 |
| Misc mfg | 33999 | 58 | 13 | 841 | 294 | 0.28 | 0.47 | 53.7 | -6.3 | 242 | -21 | 10,895 | 786 | 0.62 | 0.75 | 5.1 | -10.0 |
| Misc machinery mfg | 33399 | 42 | -4 | 815 | 65 | 0.37 | 0.43 | 8.7 | -5.7 | 521 | -33 | 11,219 | 154 | 0.57 | 0.63 | 0.9 | -6.0 |
| Sign mfg | 33995 | 95 | 29 | 803 | 247 | 0.58 | 0.80 | 44.4 | 7.6 | 252 | 22 | 5,088 | -326 | 0.44 | 0.44 | -11.8 | -9.3 |
| HVAC & commercial refrigeration equipment mfg | 3334 | 17 | -2 | 782 | 358 | 0.19 | 0.38 | 84.4 | -7.9 | 167 | -14 | 7,605 | -162 | 0.85 | 0.89 | -7.1 | -8.8 |
| Other accomodations, camps & boarding houses | 721B | 131 | -39 | 775 | -190 | 0.79 | 0.65 | -19.7 | -0.4 | 241 | -37 | 2,295 | 174 | 0.33 | 0.47 | 31.5 | -5.5 |
| Specialized design services | 5414 | 219 | -3 | 749 | -66 | 0.48 | 0.43 | -8.1 | 5.3 | 2,195 | 56 | 14,540 | 4,315 | 0.40 | 0.55 | 46.6 | 8.7 |
| Soap, cleaning compound & toiletry mfg | 3256 | 28 | -3 | 692 | -50 | 0.44 | 0.46 | -6.7 | -6.2 | 87 | -16 | 4,642 | -38 | 0.74 | 0.83 | 0.3 | -7.9 |
| Industrial machinery mfg | 3332 | 36 | -1 | 674 | -77 | 0.42 | 0.41 | -10.3 | -6.2 | 631 | -30 | 12,544 | 105 | 0.49 | 0.53 | 1.6 | -3.5 |
| Fruit & vegetable product mfg | 3114 | 25 | 11 | 609 | -210 | 0.31 | 0.26 | -25.6 | -7.1 | 153 | -16 | 10,454 | -281 | 0.95 | 1.02 | -0.7 | -4.3 |
| Pump & compressor mfg | 33391 | 23 | -9 | 557 | -100 | 0.87 | 0.80 | -15.2 | -5.3 | 220 | -33 | 7,402 | -398 | 0.72 | 0.76 | -4.2 | -6.0 |
| Misc textile product mills | 31499 | 25 | -4 | 543 | 93 | 0.67 | 0.97 | 20.7 | -14.5 | 94 | -55 | 1,741 | -2,040 | 0.53 | 0.26 | -64.0 | -24.2 |
| Sporting & athletic goods mfg | 33992 | 22 | -2 | 394 | -58 | 0.52 | 0.55 | -12.8 | -15.0 | 78 | 7 | 3,001 | 71 | 0.94 | 1.09 | 5.2 | -5.9 |
| Funds, trusts & other financial vehicles | 525 | 90 | 8 | 348 | 57 | 0.25 | 0.29 | 19.6 | 3.4 | 4,149 | 210 | 40,260 | -820 | 0.89 | 0.87 | -2.2 | 3.3 |
| Material handling equipment mfg | 33392 | 16 | -18 | 313 | -871 | 1.07 | 0.31 | -73.6 | -4.8 | 277 | -49 | 8,113 | -1,308 | 0.62 | 0.64 | -5.3 | -5.9 |
| Cable & other program distribution | 5175 | 39 | -2 | 258 | -754 | 0.81 | 0.22 | -74.5 | -3.4 | 39 | -2 | 258 | -754 | 0.00 | 0.00 | 0.0 | 0.0 |
| Curtain and linen mfg | 31412 | 35 | -9 | 256 | -29 | 0.33 | 0.41 | -10.2 | -24.0 | 55 | -12 | 516 | -148 | 0.16 | 0.15 | -31.4 | -25.1 |
| Office furniture & fixtures mfg | 3372 | 21 | 0 | 219 | 20 | 0.10 | 0.12 | 10.1 | -11.2 | 445 | -9 | 10,957 | -1,186 | 0.67 | 0.66 | -10.1 | -6.2 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Battery mfg | 33591 | 1 | -2 | 217 | -51 | 0.64 | 0.59 | -19.0 | -8.4 | 83 | -1 | 2,791 | -195 | 0.33 | 0.34 | -5.3 | -7.3 |
| Mobile home, wood building and misc wood mfg | 32199 | 22 | -14 | 206 | -213 | 0.29 | 0.15 | -50.8 | -4.4 | 431 | 7 | 7,069 | -1,378 | 0.50 | 0.45 | -14.5 | -3.4 |
| Electric lighting equipment mfg | 3351 | 10 | 3 | 163 | 56 | 0.11 | 0.20 | 52.3 | -15.4 | 114 | 17 | 5,644 | 402 | 0.48 | 0.58 | 6.7 | -9.1 |
| Metalworking machinery mfg | 3335 | 17 | -1 | 148 | -30 | 0.06 | 0.06 | -16.9 | -7.1 | 285 | -36 | 8,170 | -483 | 0.45 | 0.47 | -5.3 | -6.9 |
| Textile & fabric & fabric finishing mills | 3133 | 8 | 0 | 146 | -14 | 0.14 | 0.17 | -8.8 | -24.0 | 19 | -11 | 846 | -411 | 0.62 | 0.49 | -36.2 | -15.5 |
| Household appliance mfg | 3352 | 7 | 1 | 145 | -48 | 0.14 | 0.13 | -24.9 | -11.6 | 776 | 7 | 12,987 | -1,249 | 0.56 | 0.55 | -8.6 | -4.2 |
| Spring & wire product mfg | 3326 | 18 | 1 | 143 | -59 | 0.21 | 0.18 | -29.2 | -15.9 | 22 | -3 | 282 | -53 | 0.10 | 0.11 | 4.5 | -2.2 |
| Fabric mills | 3132 | 6 | -1 | 141 | -49 | 0.09 | 0.10 | -25.8 | -28.9 | 94 | -51 | 8,108 | -1,123 | 1.08 | 1.24 | -11.9 | -20.7 |
| Accessories & other apparel mfg | 3159 | 8 | -4 | 135 | -118 | 0.69 | 0.48 | -46.6 | -20.4 | 81 | -45 | 1,584 | -1,875 | 0.66 | 0.42 | -54.8 | -26.0 |
| Other leather & allied product mfg | 3169 | 7 | -5 | 111 | -73 | 0.67 | 0.56 | -39.7 | -25.9 | 18 | -11 | 381 | -52 | 0.11 | 0.15 | 8.4 | -22.8 |
| Turbine & power transmission equipment mfg | 3336 | 12 | -2 | 102 | -93 | 0.14 | 0.08 | -47.7 | -2.8 | 232 | -25 | 8,056 | 289 | 0.39 | 0.44 | 5.0 | -6.0 |
| Non-paper office supplies mfg | 33994 | 7 | -4 | 87 | -14 | 0.25 | 0.29 | -13.9 | -24.1 | 123 | -25 | 6,115 | -794 | 0.98 | 0.96 | -11.5 | -7.0 |
| Snack food mfg | 31191 | 5 | 3 | 86 | 19 | 0.11 | 0.14 | 28.4 | 0.2 | 46 | 5 | 1,698 | -275 | 0.70 | 0.65 | -15.4 | -6.4 |
| Audio & video equipment mfg | 3343 | 5 | 3 | 78 | 6 | 0.12 | 0.18 | 8.3 | -21.8 | 512 | 169 | 3,087 | 828 | 0.23 | 0.33 | 37.6 | -2.5 |
| Forging & stamping | 3321 | 5 | -3 | 75 | -81 | 0.10 | 0.05 | -51.9 | -1.9 | 148 | -13 | 3,704 | -338 | 0.73 | 0.71 | -6.6 | -1.6 |
| Breweries | 31212 | 4 | -2 | 74 | 17 | 0.15 | 0.21 | 29.8 | -5.5 | 27 | -7 | 1,169 | -30 | 0.70 | 0.71 | -4.1 | -2.8 |
| Magnetic media mfg & reproducing | 3346 | 17 | -4 | 47 | -78 | 0.10 | 0.04 | -62.4 | -14.0 | 1,297 | 161 | 15,721 | 609 | 0.44 | 0.48 | 4.6 | -3.1 |
| Misc transportation equipment mfg | 3369 | 7 | 0 | 44 | -112 | 0.29 | 0.08 | -71.8 | 0.6 | 109 | -9 | 3,202 | -254 | 0.46 | 0.47 | -4.3 | -3.3 |
| Printing ink mfg | 32591 | 5 | -1 | 39 | -56 | 0.53 | 0.23 | -58.9 | -4.0 | 23 | -6 | 1,146 | -610 | 1.43 | 1.09 | -33.4 | -10.0 |
| Computer & peripheral equipment mfg | 3341 | 5 | -2 | 39 | 7 | 0.01 | 0.01 | 21.9 | -17.6 | 5 | -2 | 39 | 7 | 0.00 | 0.00 | 0.0 | 0.0 |
| Flavoring syrup & concentrated mfg | 31193 | 4 | 2 | 33 | 19 | 0.09 | 0.23 | 135.7 | -7.3 | 56 | 4 | 2,234 | 395 | 0.63 | 0.79 | 20.6 | -1.1 |
| Railroad rolling stock mfg | 3365 | 3 | -1 | 31 | 10 | 0.07 | 0.08 | 47.6 | 23.5 | 39 | -12 | 1,413 | 158 | 0.58 | 0.70 | 12.0 | -3.7 |
| Leather & hide tanning & finishing | 3161 | 4 | 3 | 29 | 21 | 0.07 | 0.33 | 262.5 | -25.1 | 4 | 3 | 29 | 21 | 0.00 | 0.00 | 0.0 | 0.0 |
| Hunting & trapping | 1142 | 7 | -8 | 18 | -27 | 0.91 | 0.68 | -60.0 | -45.3 | 351 | -1 | 1,961 | -210 | 0.50 | 0.45 | -8.6 | 4.4 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cutlery & handtool mfg | 3322 | 5 | 0 | 18 | -59 | 0.09 | 0.02 | -76.6 | -13.9 | 315 | 62 | 10,700 | 1,012 | 1.03 | 1.25 | 11.1 | -5.8 |
| Doll, toy & game mfg | 33993 | 6 | 1 | 16 | -33 | 0.15 | 0.07 | -67.3 | -21.2 | 309 | -5 | 5,101 | -265 | 0.72 | 0.74 | -4.4 | -4.0 |
| Fiber, yarn & thread mills | 3131 | 4 | 2 | 10 | -8 | 0.02 | 0.01 | -44.4 | -20.9 | 12 | 2 | 147 | -51 | 0.07 | 0.07 | -23.9 | -21.5 |
| Mattress mfg | 33791 | 5 | -3 | 9 | -57 | 0.16 | 0.02 | -86.4 | 1.4 | 74 | -10 | 1,547 | 235 | 0.23 | 0.34 | 23.4 | -14.3 |
| Metal ore mining | 2122 | 3 | 0 | 7 | -35 | 0.11 | 0.02 | -83.3 | 2.5 | 723 | 112 | 11,444 | 65 | 0.90 | 0.91 | 0.9 | 2.1 |
| Wineries | 31213 | 1 | 0 | 6 | -7 | 0.04 | 0.01 | -53.8 | 26.4 | 5 | 0 | 582 | 159 | 0.64 | 1.01 | 40.5 | -7.6 |
| Apparel knitting mills | 3151 | 2 | -8 | 6 | -128 | 0.19 | 0.01 | -95.5 | -26.4 | 57 | -48 | 1,247 | -1,949 | 0.66 | 0.36 | -59.5 | -24.6 |
| Carpet & rug mfg | 31411 | 2 | 0 | 4 | 1 | 0.00 | 0.01 | 33.3 | -9.6 | 38 | -4 | 858 | 190 | 0.29 | 0.42 | 28.4 | -9.8 |
| Tobacco mfg | 3122 | 1 | 0 | 2 | -9 | 0.02 | 0.01 | -81.8 | -21.6 | 534 | 174 | 5,812 | 744 | 0.46 | 0.54 | 14.9 | 0.0 |
| Wire & cable mfg | 33592 | 1 | -1 | 1 | -35 | 0.10 | 0.00 | -97.2 | -15.5 | 16 | -5 | 128 | -112 | 0.32 | 0.22 | -37.7 | -6.9 |
| Blind & shade mfg | 33792 | 4 | 3 | 1 | -3 | 0.01 | 0.00 | -75.0 | -8.4 | 84 | -15 | 2,569 | -297 | 0.51 | 0.51 | -10.3 | -7.3 |
| Animal production | 112 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.0 | 413 | 26 | 3,718 | 424 | 0.91 | 0.96 | 12.9 | 9.6 |
| Distilleries | 31214 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.0 | -0.3 | 32 | 5 | 1,194 | 328 | 0.53 | 0.81 | 37.9 | -6.4 |
| Footwear mfg | 3162 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.0 | -15.1 | 29 | -7 | 495 | 9 | 0.22 | 0.27 | 1.9 | -15.0 |
| Hardware mfg | 3325 | 2 | 1 | 0 | -4 | 0.01 | 0.00 | -100.0 | -15.3 | 13 | -1 | 293 | 42 | 0.05 | 0.07 | 18.6 | -7.9 |
| Wiring device mfg | 33593 | 0 | -1 | 0 | -3 | 0.00 | 0.00 | -100.0 | -15.6 | 37 | -5 | 640 | -124 | 0.16 | 0.14 | -15.9 | -1.9 |

# Addendum 2: Cluster Mapping Project New Orleans/Southwest Region Profile

Data from the Cluster Mapping Project (CMP) at the Harvard Institute for Strategy and Competitiveness provide additional insight into the New Orleans metro area's economic strengths, weaknesses, and specializations. The cluster definitions in the CMP database were developed by Michael Porter and are designed as national "templates," or groups of related industries that can be used more or less generically to profile trends in different regions and baseline them to national trends. The templates were defined from a state-by-state analysis of the location patterns of different industries: they are essentially groups of sectors in shared markets that tend to co-locate geographically. There are 41 CMP traded cluster templates and 10 natural resource-based cluster templates. Both types of clusters are comprised of industries that tend to be export-oriented rather than local-serving, whether the exports are domestic (to other U.S. regions) or international. The employment data in the CMP system are from the U.S. Census Bureau's *County Business Patterns* annual series (dated 2004). All results therefore pre-date Katrina and Rita.

The CMP data indicate that the New Orleans metro area economy is specialized in 9 of 41 traded clusters: aerospace vehicles and defense, chemical products, education and knowledge creation, entertainment, fishing and fishing products, hospitality and tourism, oil and gas products and services, power generation and transmission, and transportation and logistics (see Table A2.1). Power generation and transmission is relatively small compared to the others and consists primarily of electricity service. Two additional clusters of note are water transportation, a natural resource-based cluster that is also a clear specialization closely tied to transportation and logistics, and processed food. The New Orleans processed food cluster is about average in size according to the CMP information. In southeast Louisiana, however, processed food activity is linked strongly to fishing and seafood. While the fishing cluster itself is small, together the processed foods and fishing and seafood clusters are a substantial presence in New Orleans and southeast Louisiana. In 2004, the New Orleans MSA was ranked 1$^{st}$ in the U.S. (in terms of total employment) in water transportation, 3$^{rd}$ in oil and gas products and services, 17$^{th}$ in chemical products, 17$^{th}$ in fishing and fishing products, 20$^{th}$ in transportation and logistics, 22$^{nd}$ in hospitality and tourism, and 34$^{th}$ in education and knowledge creation.

Table A2.1

**New Orleans Region Cluster Profile**

Harvard Cluster Mapping Project Definitions & Data (location quotients greater than or equal to 1.25 highlighted)

| | | New Orleans-Metairie-Kenner MSA | | | | |
|---|---|---|---|---|---|---|
| | | Employment | | | Pct Chng Emp, '01-'04 | |
| Cluster Name | | 2000 | 2004 | 04 LQ | Region | US |
| Traded Clusters | Aerospace Engines | 0 | 0 | 0.00 | 0.0 | -21.5 |
| | Aerospace Vehicles and Defense | 3,750 | 1,770 | 1.25 | -52.8 | -19.0 |
| | Agricultural Products | 656 | 924 | 0.72 | 40.9 | 4.7 |
| | Analytical Instruments | 774 | 629 | 0.23 | -18.7 | -26.5 |
| | Apparel | 1,042 | 668 | 0.45 | -35.9 | -72.1 |
| | Automotive | 1,109 | 1,045 | 0.19 | -5.8 | -17.7 |
| | Biopharmaceuticals | 348 | 154 | 0.12 | -55.7 | 6.6 |
| | Building Fixtures, Equipment & Services | 1,271 | 1,137 | 0.38 | -10.5 | -1.8 |
| | Business Services | 14,450 | 17,294 | 0.83 | 19.7 | -3.1 |
| | Chemical Products | 5,676 | 4,888 | 2.90 | -13.9 | -16.1 |
| | Communications Equipment | 283 | 253 | 0.21 | -10.6 | -62.7 |
| | Construction Materials | 183 | 163 | 0.20 | -10.9 | -12.0 |
| | Distribution Services | 6,316 | 5,390 | 0.65 | -14.7 | -8.4 |
| | Education and Knowledge Creation | 15,325 | 15,655 | 1.24 | 2.2 | 18.3 |
| | Entertainment | 9,919 | 11,368 | 2.14 | 14.6 | 8.5 |
| | Financial Services | 10,484 | 11,103 | 0.73 | 5.9 | 1.6 |
| | Fishing and Fishing Products | 540 | 450 | 2.11 | -16.7 | -10.7 |
| | Footwear | 12 | 2 | 0.02 | -83.3 | -56.0 |
| | Forest Products | 305 | 278 | 0.17 | -8.9 | -10.2 |
| | Furniture | 297 | 239 | 0.17 | -19.5 | -26.8 |
| | Heavy Construction Services | 11,847 | 8,086 | 1.02 | -31.7 | -9.4 |
| | Heavy Machinery | 551 | 529 | 0.34 | -4.0 | -21.1 |
| | Hospitality and Tourism | 22,022 | 23,060 | 1.90 | 4.7 | 2.7 |
| | Information Technology | 424 | 391 | 0.13 | -7.8 | -27.4 |
| | Jewelry and Precious Metals | 489 | 271 | 0.55 | -44.6 | -18.4 |
| | Leather and Related Products | 256 | 182 | 0.32 | -28.9 | -6.2 |
| | Lighting and Electrical Equipment | 315 | 70 | 0.07 | -77.8 | -41.8 |
| | Medical Devices | 135 | 353 | 0.21 | 161.5 | -1.2 |
| | Metal Manufacturing | 2,465 | 2,001 | 0.38 | -18.8 | -24.1 |
| | Motor Driven Products | 205 | 167 | 0.11 | -18.5 | -25.9 |
| | Oil and Gas Products and Services | 12,079 | 12,154 | 6.68 | 0.6 | 6.3 |
| | Plastics | 1,424 | 845 | 0.25 | -40.7 | -18.0 |
| | Power Generation and Transmission | 1,845 | 1,533 | 1.25 | -16.9 | -9.3 |
| | Prefabricated Enclosures | 156 | 90 | 0.07 | -42.3 | -20.8 |
| | Processed Food | 5,056 | 5,842 | 0.95 | 15.5 | -3.9 |
| | Production Technology | 557 | 594 | 0.24 | 6.6 | -25.3 |
| | Publishing and Printing | 2,216 | 1,810 | 0.42 | -18.3 | -20.3 |
| | Sporting, Recreational & Children's Goods | 130 | 120 | 0.28 | -7.7 | -16.6 |
| | Textiles | 109 | 59 | 0.05 | -45.9 | -46.4 |
| | Tobacco | 21 | 18 | 0.11 | -14.3 | -25.2 |
| | Transportation and Logistics | 24,296 | 20,326 | 2.78 | -16.3 | -3.6 |
| Natural Endowment Clusters | Agricultural Products | 61 | 60 | 0.91 | -1.6 | -3.5 |
| | Coal Mining | 100 | 40 | 0.11 | -60.0 | -2.5 |
| | Combination Energy Services | 19 | 13 | 0.93 | -31.6 | -9.5 |
| | Fertilizers | 195 | 10 | 0.14 | -94.9 | -6.8 |
| | Forestry and Primary Wood Processing | 162 | 139 | 0.12 | -14.2 | -15.0 |
| | Livestock Processing | 78 | 14 | 0.01 | -82.1 | -0.7 |
| | Metal Mining | 60 | 10 | 0.04 | -83.3 | -31.9 |
| | Nonmetal Mining | 121 | 31 | 0.10 | -74.4 | -4.4 |
| | Water Supply | 72 | 101 | 0.64 | 40.3 | 7.0 |
| | Water Transport | 2,100 | 2,037 | 25.21 | -3.0 | 1.0 |

Source: Cluster Mapping Project Database, Harvard Institute for Strategy and Competitiveness.

Table A2.2 reports sub-cluster employment and trends in the CMP clusters with largest relative presence in the area, excluding processed foods, fishing, water transportation, and power generation and transmission. Three of the clusters in Table A2.2 are comprised of just one or two key sub-industries (e.g., space vehicles in aerospace, intermediate chemicals and gases in chemical products, entertainment venues and related services in entertainment). Four clusters have a moderate to high level of diversity of sub-cluster activity: hospitality and tourism, oil and gas products and services, transportation and logistics, and education and knowledge generation. A strong case can be made that the New Orleans entertainment cluster is inextricably linked with the hospitality and tourism clusters. In that case, chemical products and aerospace vehicles are the least diverse of the key clusters in Table A2.2.

Technology-oriented clusters are poorly represented in New Orleans in 2004, according to the CMP data. To better understand the mix of technology employment in the area, and particularly to investigate whether aggregation is obscuring underlying strengths, Table A2.3 reports sub-cluster information for each CMP technology cluster. It is clear that the technology sector is underdeveloped in New Orleans, even at the sub-cluster level, at least when measured using *County Business Patterns* employment data. The most significant activity is in automotive (automotive components), analytical instruments (process instruments), production technology (especially fabricated plate work and process equipment subsystems and components), and information technology (software). In biopharmaceuticals—a cluster with an estimated 154 employees in 2004—most employment is in health and beauty products and containers rather than biopharmaceutical products.

It is important to realize that not only are published secondary data dated, but they provide little insight into entrepreneurial activity. *County Business Patterns*, like most federal economic series, excludes sole proprietorships. That is a serious omission in an analysis investigating knowledge-based clusters like information technology, biotechnology, and environmental technologies and services. While it is clear that technology-based economic development in New Orleans is modest, what cannot be easily determined is whether there is appreciable business start-up activity—either pre- or post-Katrina/Rita—that would suggest nascent or emerging economic strengths that dovetail with the mix of R&D assets in the region's higher education institutions.

The findings of studies by RTS in 2001 and by JEDCO, both of which utilize information beyond published economic series, provide the strongest evidence for information technology (IT) as an emerging cluster, if the latter is defined as small but showing evidence of entrepreneurial growth. However, for two reasons, the greatest opportunities for growth in information technology within the New Orleans area lie in software and information services rather than equipment and hardware manufacturing. First, nationwide growth in the two core IT hardware industries—computers and communications equipment—is stagnant and is expected to remain so for some time. The computer and communications equipment sectors are continuing to consolidate following overexpansion in the 1990s and the subsequent 2000/2001 recession. In addition, many IT hardware companies are offshoring as much of their production as possible to control labor costs in an industry that is becoming increasingly commoditized and price-driven. Second, New Orleans' base of IT activity is principally in information services and specialized software. Both the CMP data and a recent extensive IT strategic planning effort undertaken for the New Orleans area by MetroVision bear this out. The latter found that the area's IT-related activity is skewed heavily toward data processing and computer related services when compared against a national benchmark.[10] The MetroVision planning exercise collected both industry and firm level data, finding substantially more activity and locally based competition in IT services. It also described key linkages between the specialized software, and programming and information services industries in the region and other New Orleans clusters, particularly shipbuilding, petroleum exploration, and transportation and logistics.

A second emerging cluster is environmental technologies and services. The 2001 RTS study highlighted the cluster, finding linkages to coastal management and pollution abatement activities in the region, as well as the petroleum exploration and refining industries. Environmental technologies and services activities are not easily discerned in the CMP data because the relevant companies are most often classified in sectors that CMP assigns to the business services cluster (i.e., engineering services and professional and technical services). Table A2.4 breaks down the CMP business services cluster into sub-clusters. The size of the engineering services industry in New Orleans is roughly average, but its employment growth over the 2000-2004 period exceeded U.S. trends (7.7 versus 5.2 percent). Also outpacing U.S. growth were the computer programming,

Table A2.4

**Business Services Cluster/Subcluster Presence in New Orleans**

Harvard Cluster Mapping Project Definitions & Data

| | New Orleans-Metairie-Kenner MSA | | | | |
|---|---|---|---|---|---|
| | Employment | | | Pct Chng Emp, '01-'04 | |
| **Cluster Name** | **2000** | **2004** | **'04 LQ** | **Region** | **US** |
| **Business Services** | **14,450** | **17,294** | **0.83** | **19.7** | **-3.0** |
| Management Consulting | 3,510 | 7,116 | 1.27 | 102.7 | 7.8 |
| Engineering Services | 3,803 | 4,096 | 1.04 | 7.7 | 5.2 |
| Computer Programming | 1,992 | 2,340 | 0.51 | 17.5 | -10.9 |
| Professional Organizations and Services | 2,244 | 1,162 | 0.55 | -48.2 | -17.1 |
| Computer Services | 905 | 975 | 0.39 | 7.7 | 22.0 |
| Facilities Support Services | 446 | 670 | 1.00 | 50.2 | 25.9 |
| Photocopying | 940 | 515 | 1.50 | -45.2 | -14.8 |
| Marketing Related Services | 359 | 280 | 0.34 | -22.0 | -19.0 |
| Laundry Services | 94 | 78 | 1.25 | -17.0 | -5.9 |
| Online Information Services | 157 | 61 | 0.27 | -61.1 | -72.2 |

Source: Cluster Mapping Project Database, Harvard Institute for Strategy and Competitiveness.

management consulting, and laundry services sub-clusters.

---

10 Strategic Action Plan, Information Technology and e-Commerce Cluster, MetroVision (New Orleans, 2001).

Together, these various sources of evidence are suggestive of four broad types of cluster strengths in the New Orleans area: 1) large and established clusters; 2) smaller established clusters that are significant specializations but lack underlying diversity in the mix of cluster components; 3) emerging or entrepreneurial clusters, which have not attained any critical mass but show signs of growth; 4) and potential clusters, whose promise lies principally outside of the present mix of industries and businesses in the area. Biopharmaceuticals and biotechnology are categorized as the latter. While the 2001 study by RTS identified some entrepreneurial activity in biotechnology, it found that the growth of the industry in New Orleans mostly depends on the success or failure of efforts to develop and blend bioscience research, development, and technology transfer activities in the region's universities.

The following summarizes the findings of the RTS team with respect to industrial strength in the four categories in New Orleans. Also included are the findings from the 2005 study of industry clusters in Southwest Louisiana, including Lake Charles.

**Table A2.5:**
**Summary of Industrial Strengths**

| New Orleans Area | Southwest Louisiana |
|---|---|
| **Established (Large) Clusters** | |
| Ship building<br>Transportation & logistics (including water transportation)<br>Oil and gas exploration, products and services<br>Entertainment, hospitality and tourism<br>Education and knowledge creation | Petrochemicals & refining<br>Oil and gas exploration, products and services<br>Gaming, hospitality & tourism |
| **Established (Small) Clusters** | |
| Chemical Products<br>Aerospace Vehicles<br>Processed Food Products (including fishing and seafood) | Agriculture & forest products |
| **Emerging/Entrepreneurial Clusters** | |
| Information technology (primarily software & info services)<br>Environmental technologies and services | Aerospace & aviation |
| **Potential Clusters** | |
| Biotechnology and biopharmaceuticals | |

# Appendix B: Fostering University Technology Development and Commercialization: A Strategic and Tactical Analysis of R&D Elements

## Introduction and Organization

This report, prepared by Regional Technology Strategies (RTS) of Carrboro, North Carolina, under contract to the Louisiana Board of Regents and the Louisiana Recovery Authority, is one piece of a larger, multiphase effort to design and implement a comprehensive system throughout Louisiana for increasing research and development capacity, developing scientific and technological competitive advantage on an on-going basis, and then building a system that can translate that capacity an advantage into new Louisiana companies, new markets for existing Louisiana companies, and new, high-quality jobs. The science and technology-based economic development process is dynamic and complex, but the goal is straightforward: more wealth in Louisiana communities and more opportunities for all of Louisiana's citizens.

The first product of this effort was a comprehensive assessment of the academic research strengths currently existing and emerging in Louisiana. The objective was to put the State of Louisiana in an improved position to effectively target investments to expand existing strengths or develop new or emerging areas of science and technology as economic development assets. The *Louisiana R&D and Technology Assessment* (Appendix A of this report) provides a detailed analysis of academic research and development (R&D) strengths by discipline, performer, location, institutional affiliation, sector, commercialization potential, and funding sources. It also summarizes emerging knowledge industries and clusters, and their potential intersects with the university R&D community. Its final section identifies eleven university R&D areas as strong candidates for targeted investment and then presents four from this list as the highest priority targets based on match-ups with current strengths within the economy.

This report is the second product, with the goal of providing additional analytical background and lay the foundation for the R&D and technology strategic and operational plan for Louisiana. It is composed of a series of white papers that shift the unit of analysis from an exclusive focus at the level of institutions and clusters of industrial activities to understanding operational and contextual issues that are more germane to technology transfer and commercialization.

By emphasizing strategic issues and opportunities as well as tactical, program-level directions, this report lays the groundwork for the recommendations pertaining to the creation of the Louisiana Innovation Alliance. It also reflects the unanimous conclusion of the RTS team that one of the major stumbling blocks for the state in gaining R&D prominence and a corresponding growth in high-wage technology jobs is in the development of effective ways for the various players in the university technology scene to work together in a seamless manner across regional, political, and institutional interests. We have coined the term *One Louisiana* to encompass that necessary mindset and set of needed behavioral and structural changes. Our clients in the state can use that terminology or not, but they definitely need to implement the vision behind it, as articulated in this and in following reports.

The focus of this overall effort is on identifying those actions, structures, and approaches that can boost the capacity of Louisiana's universities to develop and commercialize technology-based intellectual property, thus fueling the growth and competitiveness of Louisiana's existing enterprises and the startup of new ones. It is important to recognize, however, that this effort must take place in the context of the traditional university mission and roles of scholarship, teaching, and research. No plan for developing university technology resources and capacity can succeed unless it makes use of strategies that further the university's institution-wide mission as well as its technology goals.

## Structure

Reflecting these conclusions, the current report is structured into the following sequence of white papers:

The first paper addresses head-on the issues involved in technology development and technology commercialization in One Louisiana**.** This involves an extensive analysis on *Enhancing University Technology Transfer.* This paper will be followed by a consideration of several issues that potentially impact the processes of technology development and technology commercialization. These include an analysis on *Fostering a Culture of Technology Entrepreneurship*, another on *The Scientific Talent Base in One Louisiana* and a fourth on *Enabling University Technology Commercialization in One Louisiana: External Infrastructure and Networks*. The argument advanced in these papers is that success in technology development and commercialization is heavily dependent on systems, organizations and activities that are outside the narrow domain of the university-based technology transfer office and function per se. Such systems include: a supportive organizational mindset and cultural assumptions; the continuous infusion of talented and inventive people working in university R&D; and robust alliances with private and public organizations involved in business development.

The final component of this report will be a paper on *Maintaining Policy and Program Continuity***.** As any student of state-level policy initiatives to foster regional technology economies has observed, the landscape is strewn with abandoned, or never-started or re-branded programs.

## Benchmarking Approach

This report incorporates some comparative "benchmarking" as a vehicle for better understanding the current situation in and future opportunities for Louisiana. These consist of two complementary approaches: (1) quantitative performance benchmarking, where feasible; and (2) best practice benchmarking.

### Performance Benchmarking

Where feasible this report presents quantitative performance benchmarks for Louisiana as well as a small group of comparison states and/or academic institutions within those states. These have been selected as representing environments that can provide useful comparative information for Louisiana stakeholders. All of them have made great strides, relatively recently, to move to high-wage technology-based economies from a prior status that looked much like Louisiana does now. They include:

*Arizona*. This is a state that has large territory and a rapidly growing population, and that has experienced significant recent progress in growing a knowledge economy.

*Colorado*. This mountain state has over the past few decades been able to build a high-wage knowledge economy rooted in information technology and the life sciences, an evolution in which public universities have played a key role.

*Florida*. This southeastern state has significantly enhanced the research prominence of its flagship universities, and has also focused them more directly on technology-based, entrepreneurial development.

*Georgia.* This state, particularly in some of its public policy initiatives, has become one of the South's poster locations as having arrived as a technology-intensive regional economy.

*North Carolina.* This is a state that rivals Georgia as a success story, but compares well to Louisiana in terms of where it started a few decades ago. Its Research Triangle Park is an icon of university-industry cooperation in the South.

### Best Practice Benchmarking

For each of the components to be discussed below, there is a growing knowledge base on best practices and enabling policies that contribute to more defined, quantitative outcomes. Much of this literature is based on case-based materials, particularly documenting what exemplary states and university organizations are doing that seems to be working to their advantage. Several of the RTS team members have contributed to this body of knowledge. These informative examples are not drawn exclusively from the experiences of the five states mentioned above, and the team has looked more widely to identify and describe various novel approaches. Nonetheless, it should be emphasized that "best practices" do not always travel well from one venue to another, and cannot be plunked down intact into a Louisiana setting. The recommendations for implementing LIA (presented in the main body of this document) reflect ways in which useful approaches from elsewhere can be adopted in or adapted for Louisiana.

# White Paper #1: Enhancing University Technology Transfer in One Louisiana

Building a Louisiana economic development strategy that is based on technology development and technology commercialization can only occur if there are strong, competent, and entrepreneurial university technology transfer programs in the state. Moreover, because this functional need is concentrated at a small number of state-based campuses, it is critical that the technology transfer functions at those institutions be first class. There is also much merit in addressing this issue through the lens of the "One Louisiana" metaphor. That is, while there will inevitably be competition among the state's research universities in doing technology transfer, there is also great potential to build on scientific complements among institutions and to build partnerships that span the state.

Given the several hundred years of history that have shaped the modern American university, technology transfer is a relatively recent function. The post-World War II decades saw a huge increase in federal funding for university research, with total federal R&D spending in the academic sector rising from $1.47 billion (current dollars) in 1970 to $23.89 billion in 2005. This change corresponded to the establishment of the current major civilian R&D agencies (e.g., National Science Foundation, National Institutes of Health) as well as the parallel rapid growth of defense-related R&D agencies (e.g., Office of Naval Research, Department of Energy, Defense Advanced Research Projects Agency) coterminous with the cold war. Worth noting because of its relevance to Louisiana research assets, the National Institutes of Health spent $518 million in academic R&D in 1970 and $15.78 billion in 2005, by far accounting for the largest (66 percent) share of current federal R&D spending in universities[11].

Along with the rapid growth of federal funding of academic research during the 1960s and 1970s, it soon become apparent that many research thrusts and findings had obvious marketplace potential. During that era, however, federal law proscribed universities' freedom to patent and license inventions, with virtually all-emerging intellectual property being controlled by the federal agencies funding the work. This situation changed in 1980 with the passage of Public Law 96-517, the Bayh-Dole Act, which gave universities the right to patent and license technologies emerging from federally funded research, with several key provisions including that faculty inventors would benefit from licensing royalties or other revenues.

---

11 National Science Board, National Science Foundation. 2006 Science and Engineering Indicators. Washington DC: U.S. Government Printing Office, 2006. Appendix table 5-6.

This legislation transformed the role of universities in the rapidly emerging technology-based economy of the 1980s and 1990s. Prior to 1983 only 27 technology transfer programs had been started in U.S. universities; since then more than 200 universities and medical facilities receiving federal money have followed. In the most recent survey of the Association of University Technology Managers,[12] based on data from 228 participating institutions, it was reported that in 2005 17,582 invention disclosures were received from researchers, 3,278 new patents were issued, 4,932 new licenses were signed, 628 spin-off companies were created (5,731 since 1980), and 28,349 licenses were still active and in force.

Despite this considerable growth in technology transfer outcomes over a relatively narrow timeframe, many U.S. universities still do not perform the function in a consistently effective manner, and fewer yet have program revenues that significantly exceed program costs. Nonetheless, this is a mandated activity by federal law, and is typically addressed by a combination of on-campus services and outsourced assistance.

On the positive side, there are a number of exemplary cases of highly effective university technology transfer functions that not only have positive cash flow but also play a significant role in fostering a technology-based economy in their region and state. They tend to perform all aspects of the technology transfer function consistently well, are robustly linked to regional networks of technology industry, and occasionally strike it rich (for both the institution, the inventor and the region) on some meteoric start-up or lucrative license. They also do it in ways that reinforce the traditional priorities of the university—research, scholarship, public service, and instruction. Matching this level of excellence is one goal of the strategic and tactical recommendations that will be made regarding technology transfer in the overall Plan.

## Characteristics of a Quality Technology University Transfer Function

Despite the relatively recent arrival of technology transfer as a permanent component of university life, a relatively robust literature has developed on its key ingredients. This overview will summarize that work into several domains:

(1) Staffing;

(2) Standard policies and procedures;

---

12 Association of University Technology Managers. AUTM U.S. Licensing Survey, FY 2005: A Survey Summary of Technology Licensing (and Related) Performance for U.S. Academic and Nonprofit Institutions and Technology Investment Firms. Bostrom D. and Tieckelmann, R. (Eds.). Northbrook, IL: 2007.

(3) External linkages;

(4) Supportive culture;

(5) Organization structure;

(6) Intellectual property and legal support;

(7) Marketing; and

(8) Specialized entrepreneurial services.

## 1. Staffing

Typically, the technology transfer office is a component of the chief research officer's domain, and the head thereof reports to either a vice-president or vice chancellor of research. Ideally, that office head should have a sufficiently prestigious title (i.e., an associate vice chancellor for technology transfer) as well as authority that will enable programmatic access to colleges, departments, and centers across the university. Moreover, the office director must be knowledgeable of and experienced in the craft of technology transfer, as well as being adept at "networking" and in publicly articulating the mission and vision of the function. It would be difficult to overestimate the importance of getting the right person in this position.

Staff qualifications and staff density vary widely across universities. Optimally, the latter should correspond to a ratio of professional staff to annual research expenditures. Among the most productive institutions, that typically works out to around one professional licensing staff per $30M of research expenditures. If, however, the office and the university have aspirations to devote considerable effort to fostering deals involving startups, then the staffing ratio may need to become richer. If staffing gets leaner from this level it tends to have an impact on productivity, particularly in areas such as invention disclosures, which is a good proxy for "deal flow" in the university setting. Data from the 2005 survey of the Association of University Technology Managers (AUTM) are informative:

**Table B1:**
**Staffing Levels' Influence on Patent Creation**

| University | $ Millions/Staff Member | Patents/$10 Million |
|---|---|---|
| University of Massachusetts | $ 31.3 M | 4.5 |
| Mississippi State University | $ 59.6 M | 2.8 |
| Michigan Technology University | $20.5 M | 12 |
| University of Arizona | $132.5 M | 2 |

The relation between staffing intensity and productivity metrics is by no means axiomatic, and the staffing ratios themselves are also influenced by the extent to which the office takes on ancillary responsibilities such as managing industry-university research contracts and partnerships. Ideally, the ratio of invention disclosures—the entry point of the "pipeline"—to research should be one disclosure for every $2 million of research, or better.

At least as important as staff size are staff credentials. As much as possible, office professional staff should have a graduate degree in a field of science, preferably at the doctoral level. It is also helpful if some staff members have both a graduate degree in a science and a law background. Every staff member will be dealing with issues of intellectual property law; having some staff members who are legally credentialed as well can be a plus. Elaborating on the note above in terms of staff size, a greater emphasis on new ventures and startups in the office will demand that some staff are credentialed in this area. Here experiential credentials are perhaps more important than academic ones—actually having been part of a successful company launch. Moreover, some office productivity indicators—such as startups per $10 million of research—are much more responsive to the skill mix rather than just the head count. Many university offices do okay on invention disclosures, but awful on entrepreneurial outcomes, such as startup survival and growth. In addition, all of these metrics are influenced by the culture of the institution, reward systems and leadership priorities as well.

There is considerable discussion in the university technology transfer field on whether staff should be compensated in a typical salary format, or have some fraction of compensation tied to performance of the office. The latter is often easier to do if the office is not part of the formal structure of the university, but housed in a linked corporation. There are arguments on both sides, which will not be resolved in this report; either approach can be used as part of an effective technology development strategy for Louisiana.

## 2. Internal Policies and Procedures

This is an area in which offices too often get rhetorically hijacked by campus or system corporate counsel. Ideally, policies should be stated in simple positive language ("written in English"), studded with examples and FAQs, and available in a variety of formats—on the office website, discussed in briefing sessions that every new faculty member receives, and as handouts to office visitors—both professors and potential industry partners. Obscure and legalistic documentation is a turnoff for customers. In fact, offices should develop a mentality of thinking of "customers" wherein faculty members are the internal customers and industry leaders are the external customers, both to be treated with respect and care.

Similarly, office procedures should be presented to faculty and industry customers as an easily understood "process map" including how long each step in the process is likely to take, contact persons and communication links between the office and its clients. Moreover, the procedural map should represent how things actually work in the technology transfer office, rather than the plan or vision for how they are intended to work that may not be fully realized in practice. Again, these should also be communicated to faculty and industry clients in a variety of formats. Forms should be easy to fill out and preferably available online for direct entry (and also linked to the office database system).

In terms of office operations and work management, there are a variety of case management software products, one of which should be used and adopted religiously. Systems are needed to assist in the management of incoming intellectual property (disclosures, patent committee reviews, patent applications) as well as licensee relations (milestones, royalty payments, etc.). These process-monitoring tools are an important and often-neglected capacity.

Finally, an important internal management practice—as well as a vehicle to speak to its public constituencies—is for the technology transfer office to systematically and quantitatively "benchmark" its own productivity. That is, it should keep track of and compile quantitative data on its invention disclosures, staffing, patent filings, patents issued, licenses (new and in place), royalty and equity income, start-ups launched and the elapsed time for these steps to be transacted. One important use of such data is to compare (using raw data normalized by research scope, such as annual expenditures) office productivity to that of leaders in the field. The AUTM survey referenced earlier is an annual national survey that reports out aggregate and institution-specific data to AUTM's member institutions, as well as making the information available in very readable reports to the public. Participating is a "must-do" for any credible and professional technology transfer office, and in fact there is near 100 percent involvement on the part of universities that are national performance leaders in technology transfer.

## 3. External Linkages

A technology transfer function can have up-to-date organizational structure, staffing, policies and internal procedures and still be mediocre in terms of its level of performance, simply because it is not actively, effectively and routinely engaging its customers and partners. These customers and partners are found both on-campus and in the larger business community.

As noted elsewhere in this report, the average faculty member is not highly informed about or invested in technology patenting and commercialization. This is why the base rate of invention disclosures on a campus is often low and frequently confined to a small cohort of repeat inventors. The way to change this is to develop working linkages between the technology transfer office and the departments, centers and laboratories where science and technology happens. There are a number of ways that this can be accomplished. For example, technology transfer staff should periodically hold short workshops on IP and the commercialization process for faculty members and do it in ways so as to insure good attendance and high interest.[13] On a more routine and informal basis, technology transfer staff members should periodically "walk and talk" the labs, developing relationships with key investigators and discussing the invention potential of new research. Office newsletters, online or hard copy, can be very effective in alerting research faculty to the work and successes of the office.

This pattern of outreach should be adapted to potential customers and partners in the business community as well. In an accompanying section of the paper, the "soft infrastructure" that supports university technology transfer is described. This of course includes potential licensees, but also angel and VC investors, business consultants, incubator managers and various economic development officials. It is important that the technology transfer office be a participant in external events and gatherings, as well as reciprocate by organizing its own on-campus events to keep external stakeholders aware of opportunities in the university. The use of newsletters catered to industry partners can be very helpful. The office website should feature current events and success stories.

One "external" linkage that seems to be an asset for many highly productive technology transfer offices is actually internal to the university community: the presence of a prominent entrepreneurship center and/or degree programs and specializations. Most frequently these are part of a business school program or fielded in conjunction with a college of engineering. They can be an asset to the technology transfer office in two important ways: (1) they are often a source of talented MBA or MS candidates who can work in or with the office to evaluate the commercial potential of faculty inventions and participate in a business planning process; and (2) the presence and visibility of these programs often is "culture-building" and raises the general campus awareness about the

---

13 Tornatzky, L. Changing Academic Cultures: An Experimental Intervention. Paper presented at ORSA/TIMS Joint National Meeting, San Francisco, CA, November 2-4, 1992.

entrepreneurship process. It is not a coincidence that some of the more lucrative Stanford technology startups in recent years have had recent graduates in major roles.

## 4. Enabling Culture

Technology transfer functions tend to be more effective and productive when their role and mission is championed and acclaimed across the campus, and successful faculty participants in the technology transfer process are similarly acknowledged and rewarded. This is not directly a technology transfer responsibility, but a wise office head will try to make it happen. There are many examples of how this works. A supportive chancellor or president can point out (in speeches and writings) the important role that technology transfer and participating faculty are playing in community and economic improvement. (It is even better if he/she demonstrates the sincerity of these words by taking concrete steps to support these functions and allocate resources toward them.)

An annual innovation acknowledgment dinner—attended by senior campus officials and state political leaders, and covered by the print and electronic media—can award plaques (or cash) to mark the important role being played by campus inventors. Astute and supportive deans can give some degree of acknowledgment in unit mission and vision statements. The main web page for the campus can have a clear link to technology transfer accomplishments, including derivative links to the websites of startup companies based on university inventions. This list can go on, but the point is simple: Any activity that conflicts, or is perceived to conflict with the primary missions of a research university—research and teaching—needs some special treatment and acknowledgment to bring it under the tent of cultural approval.

This area of activity cannot be emphasized too much. In most universities, a relatively small fraction of faculty members are ever involved in technology transfer to the point of filing an invention disclosure and possibly moving along the patenting, commercialization path. Correspondingly, if by "cultural" interventions a few more investigators are lured into the technology transfer fold, it ends up being a significant percentage increase in overall faculty involvement in invention and potential commercialization opportunities for the institution. Unfortunately, these training, outreach, and cultural change activities are too often seen as "extras" in an understaffed office and thus neglected.

There is also the threat of cultural "disablement" when institutional leadership changes, and office budgets flatten or decrease as the word goes out that technology commercialization is not high on the mission agenda. There are several cases of technology transfer offices whose performance has dramatically dropped following changes in a chancellor, a chief research officer, or an office head. This can be a very fragile business, but a strong and stable supportive culture can make it less so.

## 5. Organization Structure

Though many claim to be thoroughly unified, the large heterogeneous research university is generally a mélange of disciplinary traditions, intellectual fiefdoms, and unique approaches to the practice of science and the path of technology development. One important design consideration is how the technology transfer function should be structured to serve this diversity most effectively. The basic argument is between, in effect, a branch office structure and a tightly centralized function that encompasses system-wide coordination.

The former typically involves autonomous or semi-autonomous offices each of which is attached to a large academic unit (e.g., a medical school) and is also subject to some modest degree of coordination with a central office. In effect, however, the technology transfer professionals work for the organizational unit to which they are assigned and have an actual or de facto reporting relationship to the dean or administrative director in place in that setting.

An alternative approach is to have a strong central office, reporting to senior university or system leadership (e.g., a chief research officer), albeit with technology transfer staff therein having portfolio responsibilities for an area of academic activity, such as life sciences or engineering or physical sciences. Often, the portfolio managers will spend a significant fraction of their work week in an adjunct office located among their client college or center and/or "walking the halls" away from central office proper. However, home base is in the central office.

The modal opinion in the field is that the centrally structured function is the most efficacious in the long term. Maintaining a strong central office structure has several distinct advantages as opposed to a system of functionally separate entities. For one, it is much easier to maintain continuity of policies and practices across fairly unique discipline-based customers if there is one main office that reinforces and enforces those policies and practices. A single point of initial contact also helps external corporate customers trying to figure out how to engage a complex university system. Second, and probably more important, is that a single primary (and highly visible) office can provide leadership and rewards that will build an entrepreneurial culture among the faculty and unit administrators. The best way to increase technology transfer volume and outcomes is to simply increase the deal flow (e.g., invention disclosures) from a growing number of more involved faculty. Cultural support is key in that process. Finally, maintaining fully functional unit-specific offices is inherently wasteful of human resources. It all takes time; time better spent doing the hard day-to-day work of moving technology to the marketplace.

## 6. Intellectual Property and Legal Support

The processes of technological innovation and technology transfer are inherently intermingled with federal and state statute and constitutional law, agency regulations, contracts and agreement and the management of interactions between the technology transfer office, faculty inventors and potential industry partners. As noted above, it is useful for staff members in the technology transfer office to have formal and/or on the job training in relevant law, along with scientific credentials. Thus part of the legal underpinnings of the office is carried around in the heads of staff, who are in turn supported by legal professionals outside of the office.

One key design feature of the technology transfer function concerns where those attorneys sit, how their services are acquired and managed and how much flexibility the technology transfer office should have in these processes. The prevailing "best practice" opinion on this issue is fairly clear. It is generally recommended that the corporate counsel for a university is not the right office to handle issues of patenting and licensing. These are legal specializations that are, moreover, often specific in their application to different areas of science and technology. Thus there are some firms that are very good at IP and licensing issues involving software; there are others that are excellent in terms of drug discovery and medical devices; and so on. In order for the technology transfer office to best serve both inventors and industry partners it must have the flexibility to engage law firms wherever they can be found and in terms of their specialized expertise.

These are not simply issues of tidy outsourcing; operating this way increases the productivity and economic outcomes of the technology transfer. Thus in one study[14] of 27 universities conducted in the early 1990s, but still arguably valid, it was found that those universities that pursued a multi-vendor strategy in engaging IP law firms—looking nationally and competitively for the best provider for the case at hand—realized greater licensing revenues and more issued patents.

## 7. Marketing

Just as an office that doesn't effectively engage faculty members will see diminished disclosures, so too an office that doesn't effectively engage with potential licensees and partners in the private sector will post disappointing figures on licenses, revenues and viable startup companies. Successful marketing presupposes that office staff have devoted significant effort to assessing both the patent and commercial potential of a disclosure. Ideally, the answers should be in the affirmative, before marketing proceeds.

---

14 Waugaman P, Tornatzky L. and Vickery B. Best Practices for University-Industry Technology Transfer: Working with External Patent Counsel. Research Triangle Park, NC: Southern Growth Policies Board, 1994.

Part of that assessment also involves defining the nature of the licensing relationship that is sought—whether exclusive or non-exclusive, fields of use, geographic exclusivity and so on. The office also needs to assess whether the best transfer play is to license the technology to a currently existing company (or companies), or to try to develop a startup enterprise to exploit a non-incremental, radical invention. In many cases, the office may decide to turn the invention back to the inventor for his/her disposition. Ideally, offices should spend money on patenting and marketing inventions that have robust IP potential in compelling and large applications. In some cases, high-prestige faculty members have pressured an office to actively market an invention of dubious commercial promise. It is very difficult and resource wasting to obligate the office to actively market a large number of "dogs," while not spending enough energy and money on the relatively few technologies of great potential.

Some essential marketing strategies and tactics:

- Make sure that information about technologies available for licensing is as complete and up-to-date as possible (without being disclosing), conveyed in excellent and compelling language (as well as graphics of various sorts) and is focused more on applications and markets than on the fine details of the underlying science. A great office needs a great website.
- Use both rifle-shot and broad-based marketing strategies. For the former, the office (often working with the inventor) can develop a short list of potential licensees who might be approached on a one-to-one basis. The office might also try to present technology through targeted mailings. Finally, any respectable office should have a user-friendly web site that enables potential licensees to search by categories of science and obtain current information about available technologies.
- Events and gatherings can be helpful. The university tech transfer office should be a visible participant and/or principal in regional networking and information-sharing groups (e.g., a regional or state technology council). On an annual basis, the university—or in partnership with state-based institutions—may choose to host a nationally marketed research and technology promotional event. These can include presentations and demonstrations by researchers, presentations by university-industry cooperative project or center teams, and demonstrations and forums on emerging technologies available for licensing.

As per the previous section, it goes without saying that few of these approaches can be successfully achieved in a thinly staffed office unless there are monies to outsource the ancillary activities.

## 8. Specialized Entrepreneurial Services

From the perspective of technology-linked regional economic development, the successful launching and nurturing of start-up companies based on university technology is a critical function. Notice that the previous statement was not couched as "licenses to startups," nor as accommodating the desires of faculty entrepreneurs who want to start part-time or "lifestyle" companies. Those institutions that do well as launching and nurturing startups based on faculty invention invest significantly in people, resources, time, and policies and practices to enable this to happen. These could include the following and others:

- Office staff members who have direct experience in launching a company;
- Deal structures that involve due diligence on company development milestones (e.g., prototype development, rounds of investments);
- A willingness to forgo front end royalty and reimbursement of patenting expenses in exchange for equity participation and downstream cost recovery;
- Insistence on a defensible business plan prior to doing a deal, with particular attention to the credentials of the founding team and a specification of a development plan and deliverables;
- The development of lasting and extensive working relationships with community-based private sector business services and partners (e.g., angel investors); and
- Participation in and/or leadership of entrepreneurial networking and practice-sharing organizations (e.g., venture forums), both on-campus and off.

The point is that when the office "does a startup" it is not just doing a deal at a single point in time; it is committing to a long process that precedes the deal and continues for several years thereafter. This is a relationship, not an event; the framing question that drives university participation should be: Is it a viable company or isn't it? And if the answer is "maybe," the office needs to be willing to bring the resources to bear to make that a "yes," or, if that effort doesn't pan out, to have the discipline to walk away from the deal.

This is also an area of technology commercialization activity that is difficult to pull off with a consistent degree of excellence in a two- or three-person office. Too much expertise and person-days, over long periods of time, are involved. This is why "startups launched" is not a very useful metric in evaluating the performance of this aspect of technology transfer practice, and which in turn is one shortcoming of the AUTM survey which takes that approach. It is much more important to be able to document company growth in revenues and in milestones reached such as cash flow break-even, valuation, liquidity events, and employment growth. Remaining in the home state of the institution is also a desired outcome in terms of regional economic development aspirations, but is not something that should ever be mandated.

## Benchmarking University Technology Transfer in Louisiana

Benchmarking the relative performance of Louisiana universities in terms of current technology transfer outcomes is next to impossible. The simple fact is that most of such comparisons need to be based on periodic survey data collected by the Association of University Technology Managers (AUTM), and Louisiana universities have not been consistent participants therein. In the most recent AUTM report, for example, [15] only data from Tulane, the LSU Ag Center, and the LSU Health Science Center (NO) was reported, and LSU-HSC only reported invention disclosures and license income. Just looking at those two indices, in terms of comparable data from the comparison states,[16] some light can be shed on the state's performance.

Thus in terms of invention disclosures per $1 million of research expenditures, the ranking was:

**Table B2:**
**Invention Disclosures in Louisiana and Comparison Institutions**

| Institution | Invention Disclosures Per $1 Million Of Research Expenditures |
|---|---|
| Arizona State | 1.0 |
| North Carolina State University | .75 |
| Georgia Institute of Technology | .66 |
| University of Florida | .62 |
| LSU Agricultural Center | .56 |
| Tulane | .34 |
| University of North Carolina | .33 |
| University of Georgia | .31 |
| University of Colorado | .28 |
| Florida State University | .23 |
| Colorado State University | .21 |
| University of Arizona | .21 |

*A LSU/HSC index was impossible to compute based on data in the AUTM table.

A second index that was computed is essentially a ROI measure, dividing licensing revenues by total research expenditures. Thus the ranking was:

15 Association of University Technology Managers. AUTM U.S. Licensing Survey, FY 2005. Op. Cit., 2007.

16 AZ, CO, FL, GA NC

**Table B3:**
**Licensing Revenues in Louisiana and Comparison Institutions**

| Institution | ROI Measure: Dividing Licensing Revenues By Total Research Expenditure |
|---|---|
| University of Florida | 3.1% |
| LSU Agricultural Center | 2.6% |
| Tulane | 2.2% |
| University of Colorado | 1.7% |
| Arizona State University | 0.75% |
| Florida State University | 0.4% |
| North Carolina State University | 0.37% |
| Georgia Institute of Technology | 0.35% |
| University of North Carolina | 0.2% |
| Colorado State University | 0.18% |
| University of Georgia | 0.12% |
| University of Arizona | 0.1% |

Clearly, on this metric two Louisiana universities are doing quite well.

A 2006 study[17] by the Milken Institute reported data on two additional metrics, albeit still derived from AUTM data sets. One was a composite index of technology transfer and commercialization, that combined information on patents issued, licenses executed, licensing income and startups, based on AUTM data from the 2000-2004 period.

**Table B4:**
**Milken Technology Transfer Composite Index Rank**

| University | Index Rank |
|---|---|
| Georgia Institute of Technology | 11th |
| North Carolina State University | 20th |
| University of North Carolina | 25th |
| University of Georgia | 27th |
| Arizona State University | 43rd |
| Florida State University | 49th |
| University of Arizona | 83rd |
| Tulane | 105th |
| Louisiana State University | Unranked |
| University of Louisiana | Unranked |

A second index cited in the Milken report may shed additional light. This focused on biotech patenting (a primary focus of the overall report) and involved another composite

[17] DeVol, R. and Bedroussian, A. Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization. Santa Monica, CA: Milken Institute, 2006.

index that reflected patenting volume, a current impact score, a science linkage score, and a tech cycle time score. In effect, this is akin to a "pipeline" measure of an institution's patent position in a field of science. Since the raw data for this index were derived from patenting statistics and not AUTM data there was a wider coverage of institutions, with rankings on 424 schools worldwide.

**Table B5:**
**Milken Biotech Patenting Index Rank**

| University | Index Rank |
|---|---|
| University of Florida | 33rd |
| University of North Carolina | 41st |
| University of Georgia | 51st |
| North Carolina State University | 69th |
| University of Colorado | 75th |
| Georgia Institute of Technology | 143rd |
| Tulane | 157th |
| Florida State University | 251st |
| Louisiana Technology University | 279th |
| Colorado State University | 339th |

Based on this interesting index, with incomplete coverage of Louisiana schools, the picture suggests a performance level that is respectable but not world beating.

The most complete benchmarking analysis[18] of the LSU system campuses was reported by Carla Fishman in 2005 (though necessarily somewhat dated). The study was based on FY 2003 AUTM data and compared the system as a whole to national norms, as well as noting differences across the six campuses. Some of the findings of note:

- The LSU system during FY2003 had an invention disclosure rate that exceeded the national average at that point in time. The rate across the campuses ranged from a high of 0.67 disclosures per $1 million of research to a low of 0.12, with four of the campuses lower than 0.44 per $1 million.
- The LSU system during FY 2003 exceeded the national average in terms of the rate of licenses to start-up companies. As noted above, there are built-in shortcomings to this measure, as were pointed out by Ms. Fishman in the report.
- Overall, the LSU system had staffing ratios that were "within the national averages." However, there were disparities between the campuses in staffing patterns.

18 Fishman, C. Report to the LSU System on Technology Transfer Incentives. March 1, 2005.

- The LSU system had a lower rate of licenses executed per licensing staff (FTE) than did national comparison schools.
- It was concluded that for the most part "the campus offices are leanly staffed."

Clearly it is very difficult to get a comprehensive picture of technology transfer performance benchmarks in Louisiana because of inconsistent and incomplete reporting over the last several years. This does indicate an important practice benchmark result: If Louisiana wants to attain excellence in technology development and technology commercialization it needs to devote the resources and enforce the discipline of "keeping score" on relevant measures and metrics, particularly the AUTM survey.

There is one additional benchmark statistic that speaks directly to how the state's university technology development and technology commercialization strategy should be directed. Thinking through the statistics above, and the previous characterization of optimal office functioning, it would seem that licensing to an established company versus going the startup route are merely tactical choices faced by technology transfer offices. If one is trying to maximize state-based economic development, however, it is important to consider the "economic geography" of technology transfer choices. If, for example, a state is blessed with a high concentration of R&D-intensive industry, then it will probably be possible in a given case to *either* license to an established in-state company *or* launch a state-based startup, depending upon the most promising applications of the technology. In a state like Louisiana, however, there is a very different licensing opportunity structure. Consider the analysis[19] below, derived from National Science Foundation data, looking at the ratio of industry R&D to academic R&D nationally, among several comparison states, and in Louisiana.

**Table B6:**
**Ratio of Industry to Academic R&D in Louisiana and Comparison States**

| Geographic Venue | Ratio |
|---|---|
| U.S. as a whole | 4.9 |
| Louisiana | 0.56 |
| California | 8.79 |
| Colorado | 4.95 |
| Arizona | 4.22 |
| North Carolina | 3.17 |
| Florida | 2.63 |
| Georgia | 1.79 |

These data strongly suggest that a technology development and technology

[19] National Science Foundation/Division of Science Resources Statistics. Science and Engineering (S&E) State Profiles. (www.nsf.gov/statistics/nsf063314/)

commercialization strategy in Louisiana will be hard-pressed if it assumes that there is a large cohort of established "receptor" firms that can take university inventions to market. This is particularly apparent when one examines university versus industry federal funding patterns. The three major federal funding agencies in Louisiana R&D are the Department of Health and Human Services, Department of Defense, and Department of Agriculture. Disaggregated by major categories of performer, it looks like this:

**Table B7:
Federal R&D Funding Sources & Allocations**

| Funder | University | Industry | Fed Lab |
|---|---|---|---|
| HHS | $ 146.69 M | $ 1.05 M | $ 2.05 M |
| DOD | $ 18.94 M | $ 97.76 M | $ 41.31 M |
| AG | $ 11.65 M | $ 0 M | $ 35.13 M |

These data suggest that there are certain limitations in pursuing a primary strategy in Louisiana of licensing to state-based R&D companies, and that these are built into the structure of the state economy. Simply put, in those areas in which the universities have significant research expertise—the life sciences—there are relatively fewer partners and candidate licensees in Louisiana than there are in other states. This structure will not change in the near term, although parallel cluster studies conducted in this project suggest that there are emerging private sector strengths that complement academic strengths in certain areas of science.

## National Promising Practice Examples

Following are descriptions of a small number of institutions that embody a number of interesting program features, as opposed to disembodied "best practices."

### *University of Florida*

The University of Florida ranked 5$^{th}$ in the Milken Institute Technology Transfer and Commercialization index, and looked very good in terms of the 2005 AUTM statistics (e.g., 13 startups; $40.3 M in licensing income), and its numbers have continued to climb. Much of this progress has happened over the past 10 years, during which time the office staff tripled and became more focused on entrepreneurial-oriented technology transfer. Within that period, a new high-energy office head was hired who had been doing a very credible job at another major southern university. He was brought to Florida, in turn, by a chief research officer who clearly understood the power of technology-based economic development, himself being a longtime member of the Southern Technology Council. The office has one of the best and most accessible websites in the country, with comprehensive descriptions of available technologies and a very clear "roadmap" for a would-be faculty inventor. An extensive online slide presentation describes the history of U.S. technology transfer, key intellectual property concepts, performance metrics for the office, and how the faculty member can access its services. The office also has an operating relationship with the 40,000-square foot Sid Martin Biotech wet-lab incubator, which includes intensive mentoring of resident startups. There is also a working relationship with the Emergent Growth Fund, a local angel investment network, and the Inflexion Fund, which is a seed and early-stage VC group.

### *Stanford University*

The university ranks 4th on the Milken overall Technology Transfer and Commercialization index, and has been one of the most prominent programs in the U.S. for decades. The office website (http://otl.stanford.edu) is one of the most comprehensive and educational of any top-100 university, and constitutes a virtual short course about the field of university technology transfer. In fact, one can purchase a 4-hour DVD that provides a detailed description of Office of Technology Licensing (OTL) operations and history, including key agreements and guidelines. In the resources section of the website are a wide range of informative links and associated documents.

Stanford has been extraordinarily successful in both licensing to established companies and in fostering startups. It has taken equity positions in more than 100 startups over the years, and has accrued significant liquidity event revenues (e.g., Google). Interestingly, Stanford's prowess in technology transfer is likely more attributable to the slow and steady but relentless evolution of a robust entrepreneurial culture than to a deliberate strategic plan. The historic cultural center of gravity on campus in terms of technology commercialization has been in the College of Engineering, with origins of many Silicon Valley iconic companies traceable to Stanford engineering graduates and professors (e.g., Hewlett-Packard). Over the past 15 years, there has been a greater shift to biomedical inventions. Not surprisingly, there are many informal and formal links between OTL and entrepreneurs, angel networks and VC's in the area. In effect, Santa Clara County (e.g., Silicon Valley) is a vast world-class network of these resources—and Stanford, both as an institution and through its graduates, has done much to build it. Nonetheless, it is useful to get some historic perspective on all this. Silicon Valley has not always been Silicon Valley; it is within the memory of current or former residents when apricots were one of the primary high value products coming out of the area!

### *Georgia Institute of Technology*

Georgia Tech was also given high ranks on the Milken Institute overall index of technology transfer and commercialization, as well as ranking 4th in the Startups Score. Georgia Tech officials claim that more than 50 companies have been created since 1990 based on university technology, and in the 2005 AUTM survey they reported 9 startups and $4,478,516 in license income. The Georgia Research Alliance (GRA), perhaps the national exemplar for a statewide technology-based, university-linked economic development initiative, has tremendously helped the success of Georgia Tech in technology commercialization. Through GRA, Georgia Tech has in place 17 endowed Eminent Scholars (out of 51 that GRA currently supports statewide). These individuals, with nationally-prominent expertise in key disciplines—as well as significant industry and/or entrepreneurial experience—have provided a significant boost to both university research revenues as well as invention disclosures, patents and startups. The latter has also benefited from GRA support of the statewide network of Advanced Technology Development Centers (ATDCs), which are technology business incubators. One of the oldest and largest is located adjacent to Georgia Tech, and another (Emtech Bio) is a joint initiative between Emory and Georgia Tech in the biosciences. To fill out the investment portfolio of GRA, several National Centers for Innovation and Research have been built and staffed around the state, although primarily in the greater Atlanta area. Those involving Georgia Tech include the Institute for Bioengineering and Bioscience, the Center for Behavioral Neuroscience, the Packaging Research Center, and the Southeast Collaboratory for Biomolecular NMR. These centers provide Georgia Tech scientists with first class laboratory facilities and equipment, resulting in large infusions of federal grant monies as well as downstream intellectual property. It is important to note that although GRA has been particularly important for Georgia Tech, it works with the entire network of Alliance universities, including public and private institutions.

### *University of Utah*

Like Louisiana, Utah is a smaller population state with limitations on industry R&D assets, state-based capital, and management expertise. Nonetheless, the University of Utah has been nationally prominent for a number of years in technology transfer, with a particular tilt toward new ventures, a notable accomplishment given its location. It was 14th in the Milken Institute overall index of technology transfer and commercialization. In the 2005 AUTM survey it was 19th in commercialization revenues ($16 million) and 13th in licensing revenues per research expenditures. Utah reported 6 startups in the 2005 AUTM survey and claims 20 startups in 2006. The Utah Research Foundation operates an interesting funding program that assists startups based on University of Utah technologies. A startup can apply for a Virtual Incubator Project (VIP) credit, of up to $50K, which must be matched by the company and spent at the university for R&D services. No overhead is charged for these transactions, which makes them particularly attractive to startups. Interestingly, the University of Utah website has links to information summaries on university-linked startup companies, sending a powerful cultural message to faculty members, alumni and students. Historically the campus leadership has been a strong supporter of the office and its role in fostering state economic development, and the office in turn has strong ties to business development assets in the Salt Lake metro area. Among these are various business incubators, workforce development programs and networking organizations.

## Strategic Recommendations

This paper's implications for strategic and tactical recommendations in the technology transfer area are based on three contributory lines of information and reasoning: (1) an analysis of the strengths and weaknesses of technology transfer activities across the primary research institutions in the state—particularly their strengths and weaknesses; (2) an analysis of how to most effectively leverage modest but growing university research strengths, in the context of a state that has not developed particular strengths in industry-conducted research; and (3) what can be learned from national university leaders in the technology transfer performance.

## *Toward a One Louisiana Strategy for Technology Transfer*

Based on this analysis, the primary strategic goals that need to be addressed in an operational plan include:

- To attain a uniformly high level of excellence and responsiveness across the state in terms of how technology transfer and commercialization works;
- To remove as much as possible existing inefficiencies produced by system or campus policies, structures and practices;
- To develop management and data systems that will permit continuous improvement of university technology development and commercialization;
- To foster the "cultural" and mindset underpinnings of a robust statewide technology transfer system;
- To focus on improving those technology transfer approaches that are likely to have the most near-term positive impacts on growing wealth and opportunity in Louisiana;
- To promote inter-campus cooperation in technology development and technology commercialization;
- To link different aspects of the overall plan for the state such that seemingly disparate elements such as Scientific Talent Base and Technology Commercialization can be approached in a synergistic manner; and
- To develop approaches in the plan that recognize that Louisiana is a small state, with modest assets and a relatively few number of technology transfer options, and that working together, across regions, venues and organizations, makes sense.

# White Paper #2: Fostering a Culture of Technology Entrepreneurship

Small businesses and entrepreneurs are, and always have been, a key element of the Louisiana economy. As the state strives to both recover from Hurricanes Katrina and Rita, as well as build a high-wage, more knowledge-intensive economic structure, this fact needs to be a central focus of its work.

The *2007 State New Economy Index*[20] illustrates the challenge. On its multi-factor index of how well the state is doing in the "new economy," Louisiana places 44th among the 50 states. That is, it does not match well in terms of individual measures such as the number of highly trained professionals, scientists and engineers, and high tech jobs. It does have a modest showing in a few metrics that are more closely tied to entrepreneurial endeavors, including ranking:

- 26th in IPOs;
- 30th in general entrepreneurial activity (business starts); and
- 33rd in "gazelle jobs."

Where the state's placement really drops is in more technology-related measures. Louisiana is:

- 49th in the level of industry R&D;
- 48th in the state's online population;
- 48th in the fraction of high-tech jobs in the economy; and
- 48th in venture capital.

One interpretation of such data is that the state—particularly in cooperation with its college and university strengths—should focus particular attention on its entrepreneurial economy and try to move it toward technology-linked highly paid jobs. One way to do this would be to become better at technology commercialization, particularly the launch and growth of new ventures based on university technology.

There is another role that could be played by the state's colleges and universities, but here focused on the recovery and strengthening of the existing population of small companies. Louisiana has historically had a stock of very creative and entrepreneurial

---

20 Atkinson, R. D. and Correa, D. K. The 2007 New Economy Index. Washington, DC: The Information Technology and Innovation Foundation, February 2007.

small companies which, if not in high technology, have nonetheless made huge economic contributions in a range of industries. Here the challenge is somewhat different for universities: they can play an educational, outreach, and extension role to enable that cohort of companies to re-engineer themselves, and be smarter and more technologically adept in whatever market they serve. A New Orleans-based conference[21] held not too long after the storms stressed this exact theme.

Nonetheless, the premises of this initiative and the RTS plan are that there needs to be a significant increase in technology-based technology entrepreneurship from the state's universities. There are three fundamental things that universities should do in this context:

1. They can develop greater performance in and by their technology transfer offices, by developing technology ventures, through a mix of new staffing patterns, and improving policies and practices. These issues have been addressed in the white paper entitled ***Enhancing University Technology Transfer.***

2. They can work more closely with the informal network of private, public, and non-profit organizations that can lend vital services or assets that will make technology venturing more successful. These issues have been addressed in the white paper that focuses on ***External Infrastructure and Networks.***

3. They can work to develop their internal organizational cultures and associated belief systems such that the core work of the technology transfer office—commercializing inventions—can be more effectively conducted and supported. That challenge is addressed in this paper.

## The Culture Issue

Those universities—and regions—that have succeeded in commercializing technology or in fostering more technologically clever companies in traditional industries tend to look at the world a little differently. They have different assumptions and perspectives on the world, which are expressed and acted upon in business, government, and the non-profit settings. In a word, they have different cultures. It is noteworthy that in the recent series of community discussions facilitated in Louisiana by RTS, the notion of a somehow aberrant or risk-averse culture was one of the most frequently mentioned obstacles to realizing a technology-based economy in the state.

---

21 U.S. Small Business Administration, The Ewing Marion Kauffman Foundation, The Public Forum Institute, The Urban Entrepreneur Partnership. Entrepreneurship: The Foundation for Economic Renewal in the Gulf Coast Region. Proceedings of the April 11, 2006 Conference, New Orleans, LA.

It is useful to first develop some understanding of what is meant by this term, how it manifests itself in the university environment, and how it relates to the issue of developing a technology strategy for Louisiana.

## Conceptions of Group and Organizational Culture

Following from Edgar Schein,[22] who has written widely in this area, one can define a group's culture as:

> …A pattern of shared basic assumptions that was learned by a group…and that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel….

There are many examples of how "shared assumptions" can either foster or hinder technology commercialization in the university. Although cultural assumptions or beliefs are rarely discussed, they are strongly held when challenged, and those pertaining to technology entrepreneurship can be seen as intrusive and conflicting. For example:

- *Assumptions about the nature of work.* In the normal world of academia, work is defined as scholarship, research, and instruction, usually done in a thoughtful and measured manner. The work and decision patterns in a fast-moving startup company may be seen as foreign and hostile—so too, the faculty member who gets involved therein.
- *Assumptions and beliefs about what is truth or evidence.* In normal science, truth is defined by the paradigms of the disciplines and the norms of the research publication. Truth or evidence in the context of a startup may be much more qualitative, approximate or "good enough." Illustratively, the patents that may form the basis of a technology enterprise (in which a faculty member may be become deeply involved) are typically not seen by academic peers as embodying truth in the same manner as a peer-reviewed journal article.
- *Assumptions about legitimate communication patterns*. In the world of scholarship and research, communication patterns are very precise, measured and often drawn out. In the entrepreneurial world communication is much more attuned to norms of trust, engagement, speed, and directness.
- *Assumptions about time, schedules, and deadlines*. In the entrepreneurial world time is critical and non-adherence to deadlines may mean betting the company. In the world of the academic scientist working on a grant, the typical plan of work may be flexible and iterative and milestones adjusted as the work unfolds over a period of years.

---

22 Schein, E. H. Organizational Culture and Leadership. 3rd edition. San Francisco, CA: Jossey-Bass, 2004.

- *Assumptions about reward and punishment.* For the academic, the key reward is recognition and acclaim in his/her college of peers, often followed by the acquisition of resources to continue one's work; in the entrepreneurial startup, rewards and punishment have more to do with tangibles and financial outcomes, as well as the earned esteem of the immediate launch team.

To the extent feasible, therefore, a state strategy to foster technology development and technology commercialization must address cultural assumptions concerning entrepreneurial venturing and its apparent conflict with established academic norms. The most significant challenge is ***not*** to attack or demean those established academic norms, but to articulate strategies and tactics that both support the historic priorities of the university while at the same time support the enhancement of technology development and technology commercialization.

Even when such assumptions in the university are rarely articulated, there tends to be unspoken knowledge and acceptance of them. They are very hard to change, as are their articulated manifestations—values, norms, beliefs, goals and missions, and their rationales. Ultimately, many of these assumptions and associated values and norms get formalized into rules, policies, procedures, structures, and processes that are almost always written down or otherwise transformed into organizational artifacts.

All this has serious implications for developing and in particular implementing new state strategies to foster technology development and technology commercialization. Too often, change strategies focus exclusively on organizational policies and practices that may either encourage or inhibit technology commercialization, recommend new "best practices" or policies to replace what doesn't seem to work, resulting in a new solution that doesn't take hold in a sustainable manner and produce desired outcomes. This outcome is inevitable when too little attention has been paid to addressing the underlying norms, values, and assumptions in universities that sustain the old ways of doing business.

## Growing an Academic Culture for Technology Entrepreneurship

The gist of the argument is that aspects of organizational culture are a hugely important factor in supporting—or inhibiting—the development and commercialization of new technology in the university environment. If not addressed, it is the torpedo that will sink any technology entrepreneurship strategy, and inhibit the work of an otherwise well conceived technology transfer office. Nonetheless, there are activities and actions that are nominally separate from the technology transfer function, but which can defuse or mitigate the obstacles posed by an organizational culture not attuned to change and risk.

What is the new or revised cultural message? It is that technology development and technology commercialization do not replace the traditional emphases on scholarship, research, and teaching in the university, but that they are critically important adjuncts of these functions. As evidence, if one looks systematically at the careers of academics who have been highly successful in commercializing their research, they also tend to be in the top tier of their discipline on more traditional criteria. They are driven, however, to see their science move into applications, and the commercialization of science is often the most effective route to widespread dissemination. In the words of Maurice Ralph Hilleman, who had an illustrious career as a microbiologist at Merck and the Walter Reed Army Institute of Research—and who also was involved in the development of nearly 40 vaccines that saved countless lives world wide:

> "Goddamnit, science has to produce something useful. That's the payback to society for support of the enterprise."[23]

## *The Role of Culture Leaders*

All members of an organization are not equivalent in their ability to either sustain or shift a set of cultural norms, values, assumptions, practices, and policies. Some individuals have position power and are the controllers of resources (i.e., dean, vice-president for research, department chair, CEO) and can guide the agenda and nature of discussion within the organization and begin to challenge key assumptions underlying established policies and practices. If, over a period of time, the incumbents in such positions come to be of a positive like mind around the issues of technology development and commercialization, the organizational culture can begin to change. What this means is that over a relatively short period of time—five to ten years—getting people who support technology development and technology commercialization into positions of leadership will do much to transform the policy and practice environment. Moreover, as these individuals begin to rotate out of their positions of authority—and are replaced by others of a like mind on these cultural assumptions—the supportive culture then becomes stable and institutionalized.

## *The Potential for Tipping a Culture*

The most important aspects of entrepreneurial culture are in people's heads, not written down on paper. At critical points in a career (e.g., graduate school), science and technology professionals become imprinted on key assumptions, beliefs, and values. Henceforth they carry those cognitive and affective structures from one job to the next, and once in a job they try to execute their beliefs—and convince others to do the same thing. Ergo, the easiest way to positively tip a culture—such as a university—along the lines of being more entrepreneurial about technology development and commercialization, is to get the right heads in the right chairs. A vocal, articulate

---

23 Collins, H. The Man Who Saved Your Life—Maurice Hilleman—Developer of Vaccines for Mumps and Pandemic Flu. The Philadelphia Enquirer, August 30, 1999.

minority can slowly tip an organization's culture, and hence its practices, behaviors, policies and outcomes. A fascinating recent study[24] of the technology transfer performance of departments in two nationally prominent medical schools found that a key predictor of invention related activity (e.g., disclosures) was the number of department chairs and faculty members who had graduate degrees from Stanford—a widely acknowledged national leader in research, technology development and technology commercialization. Thus the "right heads" shifted the culture in the right direction.

There is also a potential for "negative tipping" a university culture in terms of entrepreneurship. That is, a university may go along for several years with good-to-excellent technology transfer performance (particularly regarding startups)—then things begin to change. There is a new president, a new head of the technology transfer office, a new provost, a new corporate counsel (or any combination of these) who is very risk-averse and less interested in technology development and commercialization. Things then start to go sour in terms of technology transfer emphasis and performance. The subtle—or explicit—messages go out that these functions are not at the forefront of the university's mission and priorities. Recovery can take years.

## *The Power of Intellectual Engagement Around Culture*

Since the strategic plan and program that will emerge from this project will be primarily focused on universities, it would be useful to enlist them in addressing the culture issues raised here. On their best days, universities are very good at organizing lengthy and involved but often-productive discussions about difficult problems. They are capable of having such discussions around their technology agenda and its potential conflicts with the underlying academic culture of its primary mission (though some institutions may need external or internal stimulation and support to make these discussions happen). This kind of discussion may accompany a relatively infrequent campus-wide strategic planning effort. It may also be associated with the launch of a major development campaign or a state-based initiative (e.g., how are we going to spend the money that we may receive?). It may also be associated with a negative tilt in campus events such as a budget crisis or negative scrutiny by state government. The point is that any of these precipitating events may lead to a very fruitful discussion of "Who are we? What is our role in state economic development? What do we feel about entrepreneurial faculty and programs?" and so on.

24 Bercovitz, J. and Feldman, M. Academic entrepreneurs: social learning and participation in university technology transfer. Unpublished paper, Fuqua School of Business, Duke University, 2003.

### *Entrepreneurial Education and Training*

One of the most rapidly growing areas of specialization in U.S. business schools is that of entrepreneurial studies (or its equivalent). It is now prominent in both undergraduate and graduate curricula, with growing ties to colleges of engineering and other science-based disciplines. While this phenomenon may represent little more than a blip in students' preference polls, there are other aspects of the trend that suggest that deeper changes in university culture and epistemology may be involved. For example, entrepreneurial studies are driven by the nature of the phenomenon, rather than the traditional tendency of business schools to be organized around business disciplines. The programs also tend to emphasize a learn-by-doing tilt with activities such as business plan competitions, National Collegiate Inventors and Innovators Alliance e-projects, and a growing number of MBA and undergraduate business majors getting involved in start-ups before leaving school. The Kauffman Foundation's "Kauffman Campuses Initiative" has the explicit goal of making entrepreneurship a "college-wide experience." The University of North Carolina at Chapel Hill is one of the eight inaugural Kauffman Campuses, with a proposal that was particularly attractive to the Foundation because it presented an entrepreneurial education program housed in the College of Arts and Sciences, rather than confined to the business school only. This upholds the goal, widely shared through the entrepreneurship development community and articulated in the Kauffman Foundation's program, of making entrepreneurship something that is relevant to everyone, not only to business leaders.

Another important culture-changing element of the entrepreneurial studies phenomenon is the links to other disciplines and colleges within the institution, to technology commercialization offices serving faculty inventors, as well as to the technology entrepreneurial world outside (see Educators Corner at Stanford, http://edcorner.stanford.edu, for a glimpse of these overlapping worlds). Another trend that accompanies the new degree and specialization programs is the launch of entrepreneurial centers or institutes, which are typically a mix of research, advocacy, and direct involvement in entrepreneurial support services. The point is that these activities—while primarily "educational" in nature and student-focused—also have important impacts on the culture of faculty members and university leadership.

## Benchmarking Academic Culture: The Problem

As described above, much of the important phenomenology of organizational culture is not easily recoverable via quantitative or structured methodologies. Since much of it is embedded in rarely spoken assumptions or inchoate ideas, it can only be understood via laborious ethnography and subtle observations.

In addition, the case has been made here that organizational culture in its most influential and richest form is a very "local" phenomenon. In the academic context, it is more likely to be played out at the research team or department level than in an academic senate or a provost's advisory committee. This context makes it difficult to impossible to examine at a state or regional level. One can look at state indicators of the rate of technology-based startups or other forms of commercialization outcomes, and also at statewide initiatives to foster "entrepreneurialism." More detailed and ultimately more useful information, however, will be found in the culture milieu in and around research institutions themselves.

## *Entrepreneurial University Cultures: Indicators and Examples*

This section focuses on "cultural reinforcing" activities among a small group of universities that are very good indeed at commercializing technology through the startup mechanism. The focus is particularly on the recent Milken Institute analysis of university technology transfer and commercialization, and focus on the top-20[25] public and private U.S. institutions in terms of startup performance. Various activities are identified—primarily outside the confines of the technology transfer office per se, but that arguably help in campus excellence in and acceptance of entrepreneurial technology commercialization. These include:

- Entrepreneurial educational programs and centers that "get out the word;"
- Public events hosted by the university that celebrate technology entrepreneurship;
- Networking activities and organizations affiliated with the university;
- Entrepreneurial competitions;
- Awards and acknowledgments of technology entrepreneurship;
- Speeches and communications by university leaders that give credence to technology entrepreneurship; and
- Facilities and operations (outside technology transfer per se) that are dedicated to technology entrepreneurship.

**MIT.** Not surprisingly, MIT ranks first on the overall Milken index and also 1st on the Startups Score. Entrepreneurship is endemic in the culture of MIT, and people talk in terms of culture. If one types "MIT entrepreneurial programs" into a search engine the number of hits is phenomenal. They span the gamut[26]—clubs, the nationwide MIT forums, entrepreneurial awards, entrepreneurial competitions, a world class Entrepreneurial Center, training and seminar programs for startup executives and

---

25 In the Milken report the University of California is treated as a single institution. It is actually made up of many institutions, and each campus has quite distinct cultures. It was eliminated. So was University of British Columbia, given the distinct differences in Canadian fiscal and governance practices.

26 See Dunn, K. The Entrepreneurial Ecosystem. Technology Review. September, 2005.

technology transfer officials, the Cambridge-MIT Institute to foster UK entrepreneurship, and on and on. One important part of all this is that MIT people talk comfortably about their entrepreneurial culture—something that adds significant value to the institution.

**Cal Tech.** A long-time center of technology startups, Cal Tech ranks 2nd on the Startup Score index of the Milken rating scheme, despite a student body of only 900 undergraduates and 1200 graduate students. The relative emphasis on entrepreneurship is strong, starting at the top. The president, Dr. Jean-Lou Chameau, is a vocal advocate of entrepreneurial careers and activities, and built much of Georgia Tech's prominence in that area while Provost there. A number of organizations and groups carry on the message. There is a Caltech Enterprise Forum, modeled after the MIT forum, which meets regularly with speakers directly involved in tech startups and related activity. There is an active student Entrepreneurs Club and coursework and seminars around the topic. Pasadena Entretec, a non-profit that is independent of the university but located on campus, is a source of advice for budding entrepreneurs. The Caltech Industrial Relations Center also provides seminars with technology-based companies, and is a host of the Venture Forum. Caltech and the renowned Art Center College of Design in Pasadena were supported by the NSF Partnership for Innovation program to create entrepreneurship fellowships oriented toward developing startup business skills.

**Stanford.** In an illustration of the institution's cultural influences and practices, Stanford's current president launched a company while an Associate Professor during a sabbatical year, then went on to be a department chair, then dean. Few blinked, and this is a normal part of the culture. Many professors play roles in Valley startups; few leave the university. Entrepreneurial education programs are strong and nationally prominent, and located primarily in the College of Engineering. The Stanford Technology Ventures Program has a portal to much that is happening on campus in entrepreneurship (http://stvp.stanford.edu/ ) and the Educators Corner link (http://edcorner.stanford.edu/) is a national resource for entrepreneurship education. For example, there are several hundred video clips of prominent entrepreneurs holding forth on every aspect of tech venturing—available to anyone, and widely used by Stanford students. There are several student-oriented or discipline-oriented "networking" organizations promoting technology entrepreneurship. They include: The Stanford Medical Device Network, The Stanford Entrepreneurship Network, and the Center for Entrepreneurial Studies at the Graduate School of Business.

**University of Florida.** The university's technology transfer performance is in the top five on the Milken overall index as well as being an excellent performer in the startup domain. The work of the technology transfer office is buttressed by a number of culture-building programs and activities. On campus the Integrated Technology Ventures (ITV) program is a cooperative effort of the college of engineering and the business school, and provides students with a virtual venturing experience via a two-semester integrated product and process design course. There is also an M.S. in Entrepreneurship program, as well as minors, certificates and concentrations therein. At a state level, the 4th annual Florida Tech Transfer Conference was held by the Florida Research Consortium, involving all the state research institutions—an event that was both operationally useful and cultural-proclaiming.

**Brigham Young University.** BYU ranks 4th on the Startup score of the Milken rankings. In addition to its strong, startup-oriented technology transfer office, entrepreneurship themes are present throughout the institution. The Center for Entrepreneurship has been ranked 12th in a national survey of such program, and given plaudits for its hands-on emphasis. The latter is enabled by a network of Entrepreneurial Founders (now more than 140), each of whom commit to a minimum gift of $15K plus annual sustaining contributions. More importantly, the founders assist in classroom teaching, mentor students in starting their own business, and host or arrange internships. This emphasis on entrepreneurship goes beyond the business school. In the Department of Electrical and Computer Engineering, the second objective of the degree program is to prepare graduates to "obtain industry employment, *engage in technology-based entrepreneurship*, or complete further study in postgraduate programs." (Emphasis added.)

**University of Minnesota.** The University of Minnesota (Twin Cities) is a huge campus (40,000+ students) that has gotten very good at launching companies out of faculty inventions, and matched this with a wide variety of instructional and outreach programs that serve to build a robust culture of entrepreneurship. UM ranked 6th on the overall Milken index. The Carlson School of Management, and the Gary S. Holmes Center for Entrepreneurship, anchors much of the curricular offerings. For example, the Entrepreneurship in Action class gives teams of students up to $15,000 to conceive, launch, and operate a real business. In the law school, the Kommerstad Center for Business Law and Entrepreneurship offers a specialization in intellectual property law and related topics. The Minnesota Cup supports a competition to identify the state's newest innovative business ideas. A Food Entrepreneur Assistance Program assists food manufacturing entrepreneurs on issues of successfully launching a food product business. In the Institute of Technology, engineering students benefit from a new endowed Chair in Engineering Entrepreneurship. And so it goes, program by program, gradually changing the culture of what had been a very traditional Big 10 university.

**University of Michigan.** Michigan has never considered itself a very traditional Big 10 school, but rather a competitor for national or world standing, and justifiably so given its top-5 rank in research expenditures. In the last 8-10 years, however, it has grown its entrepreneurial technology transfer heft, accompanied by other culture-changing programs on campus. Michigan ranked 9th overall and 8th on the Startup Score in the Milken index. The major ancillary culture and curricular-building activities occur in the Ross School of Business and the associated Zell-Lurie Institute for Entrepreneurial Studies. The Institute not only serves business students, but also students and programs within the College of Engineering and the Medical Center. A large curriculum of entrepreneurial courses is offered as well as ancillary activities such as student competitions. Major events include the annual Entrepalooza and the Michigan Growth Capital Symposium. There is a High-Tech Club and an Entrepreneur and Venture Club. Students in the MBA program run the Wolverine Venture Fund (WVF), and the Dare-to-Dream grant program offers $10K awards to students pursuing business ideas while taking their degree. A Michigan Business Challenge offers awards of up to $100K in business plan competition. Business students are actively encouraged to launch their own firms while in school, and on the Institute website there is a list of 42 companies that were recently started by students.

**University of Utah.** Students and student-oriented programs help to build interest, participation, and culture. The Tech Titans statewide competition encourages students to submit business ideas and plans. A major in Entrepreneurship operates in the Eccles School of Business, and the new Pierre Lassonde Venture Development Center (supported by a recent $13.25 million gift) involves students from business, engineering and the sciences in vetting faculty inventions to be commercialized through the technology transfer office. The University sponsors an Edison Showcase, which is a large networking type of event, that spotlights university inventors and inventions, and awards. The University also participates in Opportunity Quest, a campus-wide business plan competition (with cash prizes) as well as the statewide Entrepreneur Challenge, which is similar albeit with larger cash awards.

## Strategic Recommendations

The thrust of this white paper is to illustrate those universities that have very successful technology development and technology commercialization track records also are engaged in a rich menu of entrepreneurial activities elsewhere on campus. While it is difficult to sort out causality here—did technology transfer success contribute to culture-building curricula, or vice versa—nonetheless the linkage is quite robust. The causality most likely flows both ways. The implications for the strategies recommended in the overall Plan are:

- To attend to cultural issues at every campus that will be a player in technology transfer and commercialization;
- To insure that programs and expenditures under the Plan that are primarily focused on enhancing the R&D talent base, or research performance, are also configured so as to contribute to the growth of an entrepreneurial culture;
- To creatively strengthen the entrepreneurial programs that already exist among Louisiana's universities;
- To promote learning from others on how to do this;
- To foster partnering and collaboration in culture-building curricula and activities;
- To enable greater understanding of entrepreneurial concepts and activities—and their potential for Louisiana—among university leadership;

- To encourage hiring strategies—particularly in leadership positions—that enhance an entrepreneurial mindset and culture;
- To establish cooperative programs with the private sector to develop "technopreneurs" and nurture a new class of Louisiana science- and technology-based growth company managers; and
- To connect to the private sector in ways that promote an entrepreneurial culture within the universities while advancing private sector interests.

# White Paper #3: The Scientific Talent Base in One Louisiana: Recruiting, Retaining, Growing

This paper focuses primarily on the university-based scientific talent base in Louisiana. It is not in the purview of the state to influence the hiring of scientific manpower in the private sector or their management of those assets. Nonetheless, to the extent that university-based science assets can be enhanced in key areas of interest to Louisiana corporations, those follow-on private investments should increase as well.

Given the strategic focus on technology development and technology commercialization of the Plan, it essential that approaches to building the scientific talent base in Louisiana are compatible with those goals. Moreover, given that most of the programmatic initiatives will be focused on the university environment, it is also desirable that enhancements to the academic science talent base be "twofers." That is: individuals who are productive, national exemplars in their field of science, but also people who are likely to be involved in industry partnerships, technology development, and technology transfer and are entrepreneurial in their orientation.

All things considered, there are relatively few options to increase the research and technological productivity of the talent base. They all boil down to combinations of smart recruitment, domain targeting, organizational innovations, nurturing, and building the local pipeline. Later in this paper some national best practices will be presented. First, however, several performance and input indicators will be presented.

## Benchmarking Scientific Talent Base: Performance and Inputs

There are several ways in which the quality of a state's academic scientific manpower can be assessed, particularly so that comparable metrics can be developed for other states. In order to capture the comparative picture for Louisiana, the RTS team has identified five other states[27] that are at least above the median on most indices of scientific talents. For each of the following indices, these states taken together will constitute a comparison group for understanding Louisiana's situation.

One way is to look at relative performance of schools in terms of garnering research funding from the federal government or from other sources, including the private sector

27 Arizona, Florida, Georgia, North Carolina, Colorado.

as well as the feasibility of plowing back into the research and development revenues from endowments.

Another perspective on the scientific talent base can be gained by looking at the "raw material" in terms of human resources—how many, how prominent, how nationally esteemed, and the like. It is well established that a small minority of researchers tend to perform a large fraction of the prominent science. To the extent that an institution or state is able to attract, develop, and retain such individuals, it will do much better in terms of outcomes.

In addition, the quality of the student body—both graduate students and undergraduates—is a useful metric. Institutions that turn out more Ph.D.s are likely to be more prominent in research and scholarship. Moreover, the quality of the undergraduate student body in terms of the fraction of Merit Scholars or high SAT scores will give an indication of the quality of the raw material that is being "processed," hopefully some of which will remain within the state after graduation and contribute to the economy. In this context it is important to look at best practices to attract and retain young people with talent.

A very useful approach to benchmarking these issues has been developed by the Center for Measuring University Performance, formerly at the University of Florida and now at Arizona State University (http://mup.asu.edu/index.html). Focusing on the national population of research universities (all universities performing more than $20 million in annual federal research expenditures), they have developed a composite ranking formula derived from individual measures such as:

- Total research
- Federal research
- Endowment assets
- Annual giving
- National Academy members
- Faculty awards
- Doctorates granted
- Postdoctoral appointees
- SAT/ACT range

The compelling advantage of this approach is that it provides comparative institutional metrics; one minor disadvantage is that it provides little insight into departmental excellence. Nonetheless, the data are useful for the current purposes.

The Center has assembled several ranked lists. One is a list of 51 universities that rank in the top 25 on at least one of the nine measures.[28] A second list is composed of the 37 institutions that rank 26-50 on at least one of the nine measures.[29]

Among schools from the comparison states the following made it to the 1-25 list (in rank order):

- Duke University
- University of North Carolina
- University of Florida
- University of Colorado

The following schools from the comparison states made it to the 26-50 list:

- North Carolina State University
- Georgia Institute of Technology
- Arizona State University
- University of Georgia
- University of Colorado Health Sciences Center

No Louisiana institution made it to either overall list, although Tulane did make it to the 26-50 list among private research universities.

It is instructive to look at some of the indicators where Louisiana universities placed in these rankings, most of which are from the 2004 time period.

- In National Academy Membership: the LSU Baton Rouge campus ranked 143rd; LSU-HSC ranked 196th; Tulane ranked 109th.
- In Faculty Awards: LSU-Baton Rouge ranked 74th; LSU-HSC ranked 153rd; Tulane ranked 87th.
- In doctorates awarded: LSU-Baton Rouge ranked 71st; LSU-HSC ranked 333rd; Tulane ranked 119th.
- In SAT scores: LSU-Baton Rouge ranked 275th; Tulane ranked 59th.
- In National Merit and Achievement Scholars: Tulane ranked 48th, LSU Baton Rouge ranked 59th; and Louisiana Tech ranked 180th.
- In number of post-docs: LSU Baton Rouge ranked 74th and Tulane ranked 111th.

28 The Top American Research Universities, 1-25

29 The Top American Research Universities, 26-50

Not surprisingly, the universities' rankings on the scope of research performed lagged as well. Clearly Louisiana universities have a significant challenge to increase the quality of student populations as well as the number of highly talented professors and research staff.

## Best Practice Analysis: Scientific Talent Base

There are several generally agreed-upon approaches to enhance an academic science talent base:

1. Hire more Ph.D.-level scientists, particularly ones outside of traditional tenure track appointment, such as post-docs and research professor appointments.

2. Hire senior Ph.D.-level senior scientists who have established records of externally funded research and technology commercialization.

3. Bring younger research scientists up-to-speed faster in terms of acquiring resources, publishing, and IP development.

4. Build, maintain, and expand ORUs that become centers of excellence, and R&D clusters that cut across relevant disciplines and become magnets for talent.

5. Foster R&D partnerships between researchers at different state-based institutions who have complementary talents, whereby the aggregate amount and quality of research can exceed what each could pursue separately.

6. Foster a wider range of research funding alternatives, particularly support by technology-intensive industry, and in the context of industry consortia.

7. Support programs that will encourage the best-and-brightest young people to pursue undergraduate and graduate science and technology training within the state.

8. Support programs that will enhance the retention and attraction of B.S. and graduate-trained young scientists and engineers into the Louisiana R&D workforce.

9. Foster R&D convergence, particularly in areas of cutting edge science and technology, including developing the organizational implications of convergence, such as reconfigured departments, colleges, and centers.

Some examples thereof:

## *Supplements to Tenure-Line Hires*

There are four potential outcomes to making a tenure track hire of a fresh Ph.D.: (1) the hire will flounder, and not be tenured; (2) the hire will be tenured and promoted to Associate Professor, and over the next 20 years achieve a moderate level of scholarly prominence; (3) the hire will become a prominent researcher, be quickly promoted through the ranks, publish widely, get grants and never file an invention disclosure or be involved in technology transfer; and (4) the hire may do all of the third but also become one of the university's relatively few researchers who are also active and productive in technology transfer. The national experience indicates that the third and fourth outcomes are relatively rare. For example, at most major research universities, fewer than 25 percent of assistant professor hires make it to step two[30]—meaning that the "bet on a rising star" approach to faculty development not only takes too long but also in more than 75 percent of cases simply doesn't pay off.

One alternative solution to increasing the number of productive researchers on campus is by hiring more Ph.D.-level scientists outside of the normal tenure track professorial line. That is, hire scientists who are not professors per se, but who lead and staff significant research activities, and carry other position descriptions (e.g., Research Professors, Post Doctoral Scientists, Research Associates). Of note, Louisiana has a "best practice" in this area that could be more widely adopted. The Pennington Biomedical Research Center hires its scientists on a five-year renewable basis, whereby if their scientific performance is not up to expected standards they are released during their initial contract period. Researchers have no teaching obligations, and inter-unit collaborations and a high level of grants entrepreneurship are encouraged. The unit has among the highest level of research awards per capita anywhere in the state. Other examples can be found at various upper tier research universities such as MIT, Stanford, and Michigan, in which there are flexible procedures for individuals to have long careers as Research Associates or Research Professors.

The key to any of these approaches is to have clear expectations for individuals hired under these arrangements, attractive and comparable compensation and benefits packages and policies to enable "bridge" support between grants awards. For example, non-tenure line hires might be brought in early into an existing multi-year research grants, allowing them some time to develop their own proposals and lines of funding. Overly rigid human resource management practices will not permit such opportunities to flourish.

---

30 Siow, A. Tenure and Other Unusual Personnel Practices in Academia. Journal of Law, Economics and Organization. Vol. 14, No. 1, pp. 152-173

## *Hiring Star Researchers*

Another quick way to get around the time trap of hiring new Assistant Professors and waiting for them to develop into productive researchers is to instead hire battle-tested highly productive researchers in key fields of science, who also happen to be interested and talented in moving their science to market. In effect, this is the academic equivalent to the free agent market in professional football or baseball. The Georgia Research Alliance (GRA)—a partnership of state government, technology industry, and the key research universities in Georgia—is a national exemplar in doing this exact thing. Since the early 1990s, the GRA has participated in the hiring of over 50 endowed chairs of highly productive, senior faculty members. These individuals have become, in effect, instant research franchises at Georgia Tech, Emory, the University of Georgia, and other GRA-affiliated institutions. Most of them have brought portfolios of funded projects with them, along with graduate students and research staff. Typically, significant laboratory upgrades are often tied to the hires, as are large startup packages. Not surprisingly, standard approaches to academic hiring criteria, search and selection processes and funding of these positions are altered for these endowed chair positions. Nonetheless, the GRA has been successful in enabling the hiring of individuals who are involved in world-class science and who have experience in the commercialization of their science. Louisiana could do well in adapting some or all of this program's features, either as a new freestanding initiative or as a fine-tuning of an existing program (e.g., the Louisiana Board of Regents' Endowed Chairs for Eminent Scholars).

## *Enabling Faculty Involvement in Technology Transfer*

For most faculty members involvement in technology transfer and technology commercialization is rare. However, for those who are interested in seeing their science move into commercial applications, universities need to have policies in place that enable that activity and do not get in the way of succeeding in the march to tenure and promotion. For example, permissible activity while on sabbatical can help or hinder these objectives. It should be accepted and encouraged that a faculty can take a sabbatical leave and be involved in starting a company during that period. The current President of Stanford had that exact experience, which clearly has not hindered his traditional academic career path. Similarly, there could be less restrictive policies on the use of university laboratories and equipment in support of a startup venture that involves a faculty member (with costs covered at market rates by the venture company). By the same token, there should be ways in which university-controlled monies could be steered (on a matching basis) to a startup company that involves a faculty invention for further development of the technology (as does the University of Utah). There also need to be clear policies on conflicts of interest or commitment, such that faculty members can become involved in an off-campus venture but also understand the rocks and shoals of that involvement—as does his/her department chair. The point of all such policies and practices is to retain and encourage an entrepreneurial-inclined faculty member, not to drive that individual to another school that has a clearer and more practical approach to entrepreneurship and technology commercialization.

## *Attracting, Retaining and Nurturing the Best and Brightest Students*

One of the more striking findings that a sensitive observer will see in America's robust high-tech regions (e.g., the San Francisco Bay area, greater Boston, Austin, Raleigh-Durham-Chapel Hill) is their "stickiness" regarding talented people. One will encounter people who were Merit Scholars in a local high school, went to a local or regionally-located elite university, migrated to a career in a knowledge-intensive regional firm, planted personal roots—and their children are following the same path. One will also meet people who were attracted to a nationally prominent university—from a place with different dialects and sports teams—did extraordinarily well, got married and stayed.

States and regions trying to build "new economies" ignore these phenomena at their peril. In addition to recruiting people with Ph.D.s from afar, they need to pay attention to making sure they retain and nurture their own best and brightest, at various points along the R&D pipelines.

In two linked studies[31] conducted by the Southern Technology Council, Louisiana tends to have respectable numbers in terms of generally attracting science and engineering graduates from elsewhere, as well as retaining their own graduates in state. Nonetheless, the state is not in the top tier on these metrics and it should strive to maximize its performance therein. In the data cited above from the Center for Measuring University Performance, there is little evidence that Louisiana universities are distinguished in the recruitment of National Merit Scholars or a large cohort of entering students with exemplary test scores.

If one looks at institutions from the comparison states, however, there are a few that stand out in these rankings and that are a good source for useful practices. These include the University of North Carolina, the University of Arizona, Arizona State University, and the University of Florida. All rank in the top 10 for public institutions, with Florida in 2nd place behind the University of Texas. A few practices seem to characterize all of these schools and presumably contribute to their success. One is a much more self-conscious reaching out to Merit Scholars in their promotional materials

---

31 Tornatzky, L.G., Gray, D., Tarant, S.A., and Zimmer, C. Who Will Stay and Who Will Leave?: Individual, Institutional and State-Level Predictors of State Retention of Recent Science and Engineering Graduates . Research Triangle Park, NC: Southern Growth Policies Board, 2001. Tornatzky, L.G., Gray, D., Tarant, S. A., and Howe, J.E. Where Have All the Students Gone? Interstate Migration of Recent Science and Engineering Graduates. Research Triangle Park, NC: Southern Growth Policies Board, 1998.

and activities, including noting the latest data on their web sites on how many are on campus and the special services targeted to them. Second is the creation of streamlined access to special educational programs targeted for highly talented students such as honors curricula. Third is the earmarking of significant financial incentives in the form of numerous scholarships as well as in-state or otherwise reduced tuition. Fourth is the availability of a wide variety of specialized services and opportunities such as honors residence halls, mentoring and advising programs, workshops and speaker series, and social and cultural events. The Center for Measuring University Performance indicates a total of 665 National Merit scholars across the four schools noted above. During the same period, Tulane had 52, LSU-Baton Rouge had 43 and Louisiana Tech had 6. What is not clear from these data is the number of home grown National Merit Scholars from Louisiana who "got away."

However, even if the fraction that gets away in terms of enrolling at Louisiana institutions is reduced, there can still be a significant loss at graduation, as people leave the state for jobs elsewhere. Ideally, from an economic development perspective, one would want every one of the highly talented students recruited as freshmen to move through their bachelor's degree program with high honors and get hired by a knowledge-intensive firm in Louisiana. How does one increase the probability of that happening? Essentially, the best strategies involve getting students connected with high quality state-based employers while they are going through their degree programs. A little bit of "learn-by-doing" goes a long way here. This implies extensive internship, co-op, and community-based project learning opportunities. In many institutions there are insufficient resources and attention focused on this activity. Too many very talented students work at summer jobs that contribute little to their pocketbook or their intellectual and career objectives.

Some universities are exemplars in this area. Georgia Tech has developed a huge network of Georgia-based internship and co-op opportunities. North Carolina State has had a historic involvement in co-op programs. Some institutions are developing internship opportunities that tilt more toward entrepreneurial settings in addition to those based in established companies. Tulane has an Entrepreneurship Internship Program through the Levy-Rosenblum Institute; Iowa State has a Reiman Scholars in Entrepreneurship program; Notre Dame operates an Entrepreneur Intern Program through its Gigot Center for Entrepreneurial Studies. This is an area in which Louisiana universities could make significant gains in retention of the best and brightest with modest additional resources.

## Strategic Recommendations

Given all the above, Louisiana readers might be chastened as they face the challenges of moving toward excellence in the state's scientific talent base in ways that might positively impact economic opportunities. RTS thinks otherwise. Achieving R&D excellence is possible, as long as Louisiana approaches the task with a mindset that is strategically disciplined and tactically clever. It is also an area in which small numerical gains can yield huge percentage impacts. For example, if over a 5-year period the state could add 25-30 endowed professor positions with individuals who were nationally prominent in their field of science, were experienced and interested in technology commercialization, and preferably had some personal ties to the state, the impact would be large and nearly immediate. Similarly, if the Louisiana take in the national supply of National Merit scholars could be increased by a few dozen, many would stay and likely contribute to the building of a different economy. And if the state set a goal of enrolling 100 percent of its homegrown National Merit Scholars in Louisiana colleges and universities, and got close to that achievement, that would be a notable gain. It would be doubly so if there were ancillary programs to steer those young people to state-based graduate training or employment in state-based technology companies.

## *Toward a One Louisiana Strategy on Scientific Talent Base*

In order to achieve national excellence in academic scientific talent, several strategic guideposts should be observed:

Achieving research excellence is not consistent with epistemological democracy (e.g., "all our programs will be excellent") or entitlement approaches (e.g., "we must give all our programs a chance—and funding—to move toward excellence"). If excellence is looked at organizationally—in terms of departments, centers or organized research units (ORUs)—only a few can be top-ten. Thus, in the real world, strategic choices need to be made in terms of which units have the best shot to be among the research elite, particularly in areas of science that have robust applications in growing markets. It is important to note that the strategic university R&D investment areas identified in Task One of this effort provide sound guidance for these choices.

Achieving research excellence is not a big numbers game. The strategy needs to be focused on luring, nurturing, rewarding and supporting a small number of key scientists who can assume scientific leadership, and in turn, luring, nurturing, rewarding and supporting the cadres of junior faculty, post-docs and graduate students who will staff the new centers of research and development excellence. If one approaches the concept of research excellence from the level of the individual investigator, there is more than 80 years of research[32] to indicate that less than 10 percent of scientists do roughly 90 percent of the important work.

Achieving research excellence involves making hard choices. There are finite resources available to the State of Louisiana as well as to academic institutions therein. This is likely to mean a partial abandonment of standard hiring criteria, processes and

32 Lotka, A. J. The frequency distribution of scientific productivity. Journal of the Washington Academy, 16 (12), pp. 317-322, 1926.

participants. For example, national research exemplars tend to be doing work outside of "normal science" in Kuhn's classic analysis; they are more often involved in establishing new paradigms, which are in large part beyond or different from those of standard disciplines and units. Much cutting edge work is done at the seams between disciplines, and to the extent that commercialization potential is a priority—which it is—with business and industry as a stakeholder. All of this implies a strategic rethink of how one needs to go about the practice of enhancing scientific personnel assets.

Another aspect of hard choices is the reality that there are only a small number of research domains in which Louisiana can sustain national excellence—and at the same time foster technology commercialization—across the several campuses in the State (see Task One R&D Assessment findings). That doesn't mean that the less competitive areas are ignored. It will likely mean, however, that *in terms of this initiative* not everything can be targeted for significant state investment.

Not enough attention has been devoted to dealing with the issue of attracting and retaining the best and brightest young people at the undergraduate level. Modest investments, tied to a very visible statewide strategy, could make a big difference.

# White Paper #4: Enabling University Technology Commercialization in One Louisiana: External Infrastructure and Networks

The world-class excellence of university R&D and the astuteness of university technology transfer offices notwithstanding, early stage technology from academia does not commercialize itself. The processes of technological innovation and commercialization involve an interacting set of organizations and individuals, almost all of whom are external to the research university. They may include: law firms with IP expertise, equity investment firms and solo angels, outsourcing specialists, management and human resource experts, product development specialists, manufacturing engineers, plant designers, and many other experts. Two important points: first, in order to facilitate the processes of commercializing academic science and technology, these specialty assets need to be relatively dense within a region—and hopefully adjacent to a university—as well as extensively "networked" with each other. Second, some networking evolves as a natural result of business transactions. In addition, in many areas there are non-profit or government organizations whose primary purpose is to facilitate interactions amongst these specialists, perhaps a local software association or a regional technology council or a technology-oriented chamber of commerce. These network-facilitating organizations are important for a state like Louisiana.

Moreover, in order to be of significant help to the commercialization of early stage, new-to-the-world technology, this cohort of experts needs to have a mindset and an experience base that is oriented to the craft of entrepreneurial start-up companies. That is often the most logical path for commercialization, instead of licensing to existing enterprises. Over the past two decades, an increasing fraction of the most compelling and successful tales of university technology commercialization have involved startup companies, as opposed to straight license deals with existing larger companies.

Unfortunately, these networks of private sector specialists in business assistance to startups are not equally distributed across the U.S. They tend to be concentrated in metro areas and regions that have established national pre-eminence in building technology-based, entrepreneurial economies. These include places like Santa Clara County, greater San Diego, metro Boston, Denver, Atlanta, and metro-Washington, DC. The Raleigh-Durham-Chapel Hill area is emerging as an area that may soon rank with these larger metropolitan economies.

## Strategies for Infrastructure Development

In those places that are less naturally endowed with "soft infrastructure" assets as embodied in a well-developed business services industry, creative solutions are pursued. University leaders trying to promote technology commercialization, regional economic development organizations and local technology industry may all join forces to jump-start a more comprehensive technology business development infrastructure. Several strategies might be undertaken:

### *Facilities-Based:*

***Technology Business Incubators.*** Since its establishment 1985, the National Business Incubation Association (NBIA) has played an active role working with local organizations to develop business incubators. Of the more than 700 currently operating in the U.S., roughly a third are technology-focused, and many of these are linked to research universities. As currently structured, incubators provide reasonably priced office and laboratory space, and brokered technical assistance, to fledgling companies. A body of best practice knowledge has evolved, and the evidence is persuasive that incubators increase the survival chances of startups.[33] It should be noted that non-profit incubators are more likely to be found in places where the existing private sector network of business service providers is limited.

***Research Parks.*** For those universities that are not space-constrained, a relatively common initiative is the establishment of research parks adjacent to their campuses. High quality office and lab space is made available to established technology companies, often in technological domains that reflect the core competencies of the hosting university. From a technology commercialization perspective, the presence of these operations tends to increase industry-university research partnerships as well as providing a landing place for university startups that are beyond cash flow break-even and are now growing at a respectable rate. (It is important to note, however, that research parks can be a risky proposition, due partly to their high start-up costs. Many technology commercialization activities involve risk, but those seeking to develop research parks should proceed with caution.

***Core Labs.*** In life science and particularly biomedical R&D areas many institutions and states are making investments in state-of-the-art laboratory facilities that go beyond the needs of individual investigators, but which can aggregate and serve the needs of emerging clusters of academic scientists. Sometimes core lab facilities are managed such that several universities in a state that are doing significant work in complementary areas can access them.

---

33 Tornatzky, L.G., Sherman, H., and Adkins, D. Incubating Technology Business. A National Benchmarking Study. Athens, OH: The National Business Incubation Association, 2003.

## *Services:*

*Product Development Centers.* Either as independent companies that do product ideation, prototyping, and development (e.g., IDEO is an exemplar) or as reduced-fee operations attached to colleges of engineering or extension programs, this is an important service for start-ups. This is particularly so when the commercialization plan involves the development of a device or tangible product. Again, some regions have rich networks of private firms in this domain, while other regions are trying to kick-start the capacity through public-private innovations.

***Manufacturing Extension Programs***. While generally funded through NIST's Manufacturing Extension Partnership program, and typically focused on problem-solving work with established small manufacturing companies, these programs have also become an asset for newer companies, some of which may be university-linked startups.

***Legal.*** Either as part of an extension or incubator operation, or as a freestanding phenomenon, networks of preferred legal practitioners that can address issues of "entrepreneurial law" have emerged. Key needs that are served include intellectual property issues, venture legal structures and financing. In some cases, legal services may be a component of an incubator program, and provide reduced-rate services to tenant companies, betting on the prospect of future business when the startup matures.

***Contract R&D.*** Few start-ups can afford all the R&D personnel and facilities needed to get products to market. Accordingly, they may turn to private consulting firms or to contract research operations brokered by universities. Some institutions (e.g., Penn State, Georgia Tech) have large contract research operations that cater to a range of customers, including Federal agencies, but which also include small technology-based companies as part of their client base. Key to deploying this asset to the start-up community is the capacity and policy structure to process and execute contracts quickly.

## *Financial-Focused:*

***Seed Funds and Angel Networks.*** By definition few technology-based entrepreneurial companies have collateral that will enable debt financing. While self-financing (plus friends and family) is still the major source of startup capital, regions and states that do well at commercializing university technology via startups have developed significant equity investment assets, including angel investors and networks thereof, as well as venture capital firms. Nonetheless, the vast majority of these activities are concentrated in a few regions and metro areas. One important wrinkle has involved states and/or quasi-public entities (e.g., public employee pension funds) being a significant investor in funds, with a corresponding soft promise that some investments will be in state.

***SBIR Assistance***. Despite somewhat cumbersome policies and procedures, the federal SBIR (and much smaller STTR) programs represent significant sources of "free" money in the form of grants. While these programs are national competitions in nature, the trick to winning lies in having in place the skills, craft and infrastructure in how to structure a compelling proposal. Again, a relatively few states and regions have dominated this program, with some recent rapid growth among those that had been lagging.

### *Networking Infrastructure:*

***Chambers.*** Local Chambers of Commerce in many regions have been transformed from general business promotion to programmatic emphases on key local technology industries. As elsewhere, they conduct a variety of business networking, educational and advocacy activities.

***Technology Associations.*** Technology associations or councils have come to play significant roles as meeting conveners, hosting venture forums, and providing venues for interaction among entrepreneurs, academic scientists, investors, and other entities.

***Industry Associations.*** Where a region has clusters, industry associations are likely to offer services, including networking type functions. These will tend to be focused on a narrower range of technologies and participants, but will perform many of the networking functions mentioned above.

***Networks of Entrepreneurs*** (*e*.g., the Council for Entrepreneurial Development (CED) in the Triangle). Helps entrepreneurs and potential entrepreneurs connect, provides role models, assists connections with VC, among other services.

## Benchmarking External Infrastructure and Networks: Analytic Issues

Benchmarking the extent and impacts of technology commercialization infrastructure and networks—whether focusing on "hard assets" or relatively un-tethered services and activities—is not an easy proposition. First of all, it is not clear what an outcome or result might constitute, nor how to obtain relevant quantitative data. For example, is the relative density of IP attorneys a meaningful statistic? Should it be patents/million residents, despite evidence that many patents involve attorneys from other states or regions? The reality is that inputs and outcomes are hopelessly confounded when it comes to community-based organizations that have quite variable relationships with the university, in size and nature.

Second, the "spread of impact" is highly variable across different types of infrastructure elements. Illustratively, a technology business incubator that is adjacent to and linked with a research university is likely to have clients and experience outcomes that are all within a few miles. In contrast, a venture capital firm located one block away from the incubator will have investments scattered across the state, region, and country. Again, therefore, it becomes difficult to determine where the effective locus of activity is and how one should sort out inputs and outcomes.

Third, there is the reality—observed by many students or practitioners of regional economic development—that infrastructure elements tend to have synergistic rather than additive impacts on commercialization, particularly if there are also well-developed network building entities. Thus, if a research university has ready access to a technology business incubator located in a contiguous research park, that in turn works with a local angel network and a product development center in the College of Engineering—and the primary managers of each of these entities can work well together—then the net positive impact on commercialization outcomes can be significant indeed.

Finally, many of the elements of a networked soft infrastructure are not typically implemented by universities (or their technology transfer offices) or state government. They may emerge spontaneously out of the natural networking behavior of technology entrepreneurs in a community; they may evolve out of non-profit regional economic development organizations or foundations; they may emerge from the market driven behavior of individual companies. It is hard to deliberately create a network via public policies and programs, although it can be done.

For all of these regions this paper will not attempt to present comparative "performance" measures at a state level. First of all, it is not clear what metric might capture the performance of a networked infrastructure. Second, it is not clear that networks of services that fundamentally operate at a regional or local level can be construed as a "state" phenomenon.

## *Some University-Linked Examples of External Infrastructure and Networks*

A more informative approach is to describe some "best practice" examples where they have emerged in some propinquity to research universities that seem to be doing well in commercializing their technologies, particularly through the creation of startups. Following the approach used in the associated white paper on *Enhancing University Technology Transfer*, the focus is on a small number of research universities that are highly ranked in terms of the Milken Institute study[34] of university technology transfer. The analysis identifies elements of a soft infrastructure or service network that clearly is enabling the technology commercialization performance of those institutions, but which

34 DeVol, R. and Bedroussian, A. Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization. Santa Monica, CA: Milken Institute, 2006.

may have only a loose connection to state policies or programs, or explicit university action.

**University of Wisconsin/University of Michigan.** Michigan is a top-ten performer on the Milken overall index of Technology Transfer and Commercialization—as well as top-five in startups—and Wisconsin is a top-20 in the overall index. They also rank 3rd and 4th nationally in research expenditure. Venture Investors Inc., an early stage and seed investor, now has $200 million under management and has just raised $115 million for its Early Stage IV Limited Partnership. It will heavily focus its investment on these two Big-Ten R&D giants, as they are seen as an untapped potential. Venture Investors Inc. is now an important part of the soft infrastructure of technology transfer at these schools.

**North Carolina State University.** NC State is a top-20 school on the Milken overall index and a top-5 school in terms of the fraction of its research that is funded through industry partnerships. The school's Centennial Campus is a major ingredient in that success story. Springing from a modest beginning in 1991 through its College of Textiles, North Carolina State University's Centennial Campus has blossomed into a 1,300-acre research park and campus where university faculty and students work with industry and government to develop new technologies, products and services and to solve problems—success on a large scale. Today, the campus features more than 100 tenants representing over 1,500 jobs, a mix of larger companies and startups, a business incubator, cutting edge facilities and equipment, an advanced telecommunications network, and an affiliated venture capital fund (Centennial Venture Fund.) Its technical focus is on advanced materials, information communications technologies and biosciences and biotechnology. Its future plans are driven by an ambitious vision. In addition to adding more office and lab space, condominiums, townhouses, an advanced transportation system, a hotel and conference center, a golf course—even a town center -- are all on the drawing board. University-industry interaction at the level of investigators is wired into the geography. This vision makes Centennial one of the "new breed" of research parks—quite a different type of animal than the more traditional Research Triangle Park a few miles down the road.

**University of Illinois at Urbana-Champaign.** Illinois is a top-10 Startup Score school on the Milken index. As part of its contiguous infrastructure, the UI technology transfer office is networked to both EnterpriseWorks (EW) and Illinois Ventures LLC. Enterprise Works is a 53,000 square foot business incubator. Operating since 2003 it has been instrumental in launching 50 startups. It has wet labs, extensive shared equipment, presentation facilities, and high-speed wireless. Illinois Ventures is a private seed and early-stage fund, with offices in both Chicago and Champaign-Urbana. A major portion of its portfolio is focused on UI technologies. It was identified in 2005 by Entrepreneur magazine as a top-100 fund.

**University of Michigan.** In addition to all the technology transfer and entrepreneurial culture-building programs within the University, UM is an active partner and promoter of Ann Arbor SPARK (www.annarborspark.org), which bills itself as "a public-private partnership whose mission is to advance innovation-based economic development in the greater Ann Arbor region. Members and board members are drawn from UM, city and county government and technology companies in Washtenaw County. SPARK is basically a networking and event-making entity, as well as an operator of programs. It operates a Business Accelerator (e.g., incubator), brokers relations to several VC and angel investor groups, runs an entrepreneurial boot camp program (2 days of intensive training), links SBA programs, promotes various workforce and executive training programs, and identifies employee recruitment organizations (heavily at UM, but also at Eastern Michigan University). It works with various forums (Ann Arbor IT Zone—a networking activity, the Great Lakes Entrepreneurs Quest—a competition, and a New Enterprise Forum) and follows and reports on various changes in tax law and state incentives of relevance to tech entrepreneurs.

**BiotechConnect in New Orleans.** An excellent best practice example that speaks to the heart of the matter can be found in Louisiana. The New Orleans Regional Biotech Networking Group was initiated by faculty at Tulane and includes a small group of the research universities, medical schools, and biotech companies that want to make connections among the firms and organizations within the area's emerging biotech cluster. The network's core was defined by the group as biotech, pharmaceutical and medical device firms. About three times a year the group sponsors an event called BiotechConnect. The gatherings are held at a local bar and are regarded by the biotech and economic development communities as extremely successful in a competitive environment where the prudent regard networking, collaborative ventures, and strategic alliances as a requirement for success. The meetings are exclusively for networking and are "program free." Here is an excerpt from their email meeting announcements:

> No lectures, no agenda, just relaxed networking. There will be many people you'll recognize and plenty of new faces: Entrepreneurs, investors, attorneys, scientists, executives, deans/presidents, biotech incubator directors, journalists, consultants, and other professionals. Please feel free to invite your colleagues and friends from biotech, pharma, and medical device-related firms.

**CIT.ms (Mississippi).** Certain kinds of private industry associations can also function as major technology development networking and infrastructure assets. One of the early products of the Mississippi's Information Technology cluster initiative was the formation of the Communication Information Technology Organization of Mississippi (CIT.ms). Spearheaded by several of the state's leading IT companies, the organization was promoted, sponsored and incubated by the state's three of state's major economic development intermediaries—the Mississippi Technology Alliance, the Mississippi Development Authority and the Mississippi Economic Council. CIT.ms is now a well-established industry association with 150 active participants. The mission of CIT.ms is to preserve and promote the value of communications information technology as the centerpiece of economic development in Mississippi and to connect CIT.ms members to information, resources, and tools.

In addition to networking opportunities, CIT.ms provides hard information and benefits to its members including:

- A single point of access to Mississippi's communalizations and information technology industry through an interactive web portal. This includes a database and a robust "request for proposal engine" that allows members to identify and contact companies that offer products, services, skills, and certifications that meet specific project requirements as well as track proposal requests against companies that can fulfill each project's required services.
- Retirement Benefits
- e-Newsletter for members
- Professional development opportunities
- A public policy agenda for the entire CIT industry

## Strategic Recommendations

Clearly, many universities that do well at technology transfer and commercialization also benefit from a contiguous network or soft infrastructure of public and private service providers oriented toward technology ventures. The origin of network member organizations seems to vary widely from state to state, and across communities. In none of the examples given here does there appear to be an overpowering state government role. Some of the more comprehensive, in fact, seem to arise with a flexible collaboration on the part of a university, committed local tech companies, and visionary local politicians.

### *Toward a One Louisiana Strategy on Commercialization Infrastructure*

It is not clear what the most efficacious path might be to foster networks—emphasis on plural—of entrepreneurial service providers. Since the relevant communities in Louisiana are very different in size and character, it is not obvious how to craft a single program that would fit all communities. Some relevant strategic implications of this analysis include:

- Develop program components that emphasize facilitation and enabling of networks, not full funding.
- Build on networks that already exist, but which might be given incentives and guidance to focus on technology commercialization.

- Understand that the substantive focus of networks elements will be colored by the particular disciplinary emphases of the adjacent university (e.g., network elements in Rushton interested in materials science and engineering; those in New Orleans more focused on life sciences).
- Focus on commercialization infrastructure and networks that are most appropriate for university technologies and associated business models—not micro-enterprise or retail.

# White Paper #5:
# Maintaining Policy and Program Continuity in One Louisiana

Boosting the research capacity to foster university technology development, commercialize technology, and create and grow high impact knowledge-based companies is a long-run proposition. As described in the prior white papers, implementing versions of strategies and actions focused on improving the scientific talent base and expanding and filling the bachelors to doctorate pipeline, improving technology transfer, advancing the on-campus entrepreneurial culture, building out the soft infrastructure that supports technology commercialization, and linking and leveraging all of these elements in networks that enable this to happen at scale requires a ten-, twenty-, even thirty-year planning horizon.

What are the key elements in workable strategies for establishing a statewide system to fuel, focus, and artfully manage this activity across decades and administrations? If there is an entity or hub at the center of this system, what elements should be considered as Louisiana works toward creating a sustainable organization with strong program continuity? What can be learned from the experience of others?

This white paper is intended to examine the experience of other states and distill those elements that may have applicability to Louisiana and to the goals of the Board of Regents. None of the examples that described are a panacea nor do they represent the range of possible options. Nevertheless they represent programs that have survived economic turmoil, changes of administration and political leadership, and the shifting tides of academic opinion on what constitutes good technology-led economic development policy. Their success over time provides a starting point for developing a unique and comprehensive strategy for Louisiana that, while responding to the specific needs of the state, is designed from the ground up to deal with long-term and deeply embedded structural issues.

## Louisiana-Specific Issues of Program Implementation and Continuity

Over the past twenty-five years, almost every state in the nation has started and invested in some form of technology-based initiative to contribute to the growth of their economies. Most of these programs have included some form of relationship with local and regional institutions of higher learning—from research universities to community colleges.

While many of these were not long-lived, a handful of statewide science- and technology-based economic development organizations have survived and prospered and have become institutionalized within their state's economic development and, to a lesser degree, academic culture. These organizations developed substantive and committed private and public sector constituencies by producing results, by thinking strategically, and by establishing governance and management structures that propelled their missions.

Louisiana's history here is long on vision and short on execution. In the early 1980's Louisiana was among a handful of states (and first among the southern states) to conceive of a statewide program to encourage technological innovation in an integrated fashion (from inception to commercialization) as a crucial public economic development initiative. By 1984, the Louisiana Legislature passed legislation creating the Louisiana Science and Technology Foundation. The Legislature originally intended to provide the Foundation with a $500 million dollar endowment over a l0-year period. Subsequent to the passage of this legislation, as a result of Louisiana's economic difficulties, state revenues began contracting. It was determined that no funds could then be made available for the Foundation's endowment. In following years, attempts were made to fund the Foundation at lesser levels, but by then the state's economy and the state's revenue stream had deteriorated even further and no funding was available.

A second visionary statewide action initiated during the mid-1980s was the Louisiana Quest for Technology program. In 1984 Gulf South Research Institute (GSRI) received one year's funding from the State to develop and implement a program to train university personnel in the technology transfer process, as well as establish on-site technology transfer offices at each of the sixteen participating higher education institutions. At the heart of the Quest program was a process for identifying, evaluating, and inventorying previously unrecognized or under-valued technologies in colleges and universities. The first year's results far exceeded all goals in terms of participating universities, technology submissions, and viable commercial assessments. However, when the Quest program was originally funded, it was the intent of the State to transfer this activity from the State Board of Regents (the program's initial sponsor) to the newly created Louisiana Science and Technology Foundation, once the Foundation was operational. As previously mentioned, the Foundation was never funded. In view of the program's success and widespread support, the Legislature chose to fund the Quest program through the Board of Regents for another year. However, as a consequence of the State's fiscal crisis, the second year funding was never made available. The good news here is that a number of the technology transfer offices installed on the various campuses are still in productive operation.

It is important to consider the present initiative within this historical context. There is a substantive cohort of Louisiana university scientists, engineers, administrators and technology transfer professionals and of private sector risk capital providers, scientific entrepreneurs, and business leaders that either participated or actively supported this kind of effort the first time around. They understand and value what the Board of Regents and the Louisiana Recovery Authority are trying to accomplish. However, they are also somewhat skeptical of the State's capacity to implement any plan that is developed because of their past experience. To put it simply, they will move from being intrigued but leery to active support when they see a credible plan that has attracted strong champions and identified long-run funding levels and sources.

Any plan should be grounded in Louisiana assets and aspirations and any plan should resonate within the state's unique culture. However, to be credible it should also be informed by the lessons and experiences of relevant successful state programs that have gone before. In the early 1980s, when Louisiana first attempted to create a statewide presence to boost research capacity and commercialize university technology it was trailblazing. There was no existing body of knowledge or practice to guide its efforts. In 2007 this is not the case.

## A Brief Description of Three Successful State-Level Technology-Driven Organizations

This section of the white paper will examine the organizational development experience and operations of three successful organizations that 1) have characteristics that are particularly relevant to this planning effort and 2) have been able to achieve organizational and program continuity. The three programs are:

- The Pennsylvania Ben Franklin Partnership (BFP)
- The Arkansas Science and Technology Authority (ASTA) and
- The Georgia Research Alliance (GRA)

The oldest of these organizations (BFP and ASTA) have existed since the early 1980's and the GRA was created in 1990. The birth of these entities was the result of a convergence of factors primarily driven by global economic competition, from Japan and Germany, which was severely impacting traditional U.S. industries. As a result states looked for new ways to revive their economies. They hit upon a strategy of merging the intellectual capital available through academic institutions with the new technologies that were emerging at that time—computers, biotechnology, robotics, CAD, etc. The goal was to use university resources—faculty and students—to create new companies, help existing entrepreneurs build new enterprises and bring new technology to existing industries.

While all three organizations began as statewide programs focusing on broad based technology-driven economic development goals, with universities as a primary driver, they have all evolved to different degrees. When viewed together they now represent more of a gradient in university versus private sector orientation with the BFP focused on private sector endeavors, ASTA pursing a balanced mission with programs servicing both universities and private sector clients and GRA focusing on activities at universities, though with a much more statewide reach.

Following is a brief description of each initiative (more extensive details on each program may be found in the Appendix) as well as an outline of nine key elements necessary for the successful implementation and continuity of these types of initiatives.

### *Pennsylvania's Ben Franklin Partnership*

The BFP (originally known as the Ben Franklin Partnership, the name now refers to an expanded Ben Franklin Technology Development Authority, but for the purposes of this report will be referred to as BFP) was initially created in 1982 as an economic development and jobs creation program as a result of severe dislocations in Pennsylvania's traditional manufacturing industries.

The intent was to use the resources and capabilities of the state's six research universities—Carnegie Mellon, U. of Pittsburgh, Penn State U., U. of Pennsylvania, Drexel, and Temple—to work with industry and build a stronger state economy.

Four regional university based centers were created to invest the state appropriations (which have averaged about $25 million annually since 1984). Initially these funds went to pay for technology partnerships that required a university and company to work together on a specific technology project with an anticipated benefit to the state—new product, new company, job creation, etc. Because community colleges and other institutions of higher education had difficulty generating what were essentially R&D projects, the legislature allowed the BFP centers to support other activities with these institutions.

Over time, it became a challenge to achieve the anticipated outcomes by partnering solely with the academic community and the focus of the four centers increasingly became to invest directly in the growth of companies.

### *Arkansas's Science & Technology Authority*

The Arkansas Science & Technology Authority (ASTA) was created by statute in 1983 with the mission to bring the benefits of science and advanced technology to the people and state of Arkansas. This mission is addressed by strategies to promote scientific research, technology development, business innovation, and math, science and engineering education. As with Louisiana, Arkansas is also an EPScoR state.

The Authority currently receives about $6 million annually from the state legislature and offers a variety of programs including:

- Applied Research Grant Program
- Research & Development Tax Credit Program

- Seed Capital Investment Program
- Technology Development Program
- Technology Transfer Assistance Grant Program
- Centers for Applied Technology Program
- Arkansas Research Matching Fund
- Basic Research Grant Program
- Arkansas Manufacturing Solutions
- STEM Education programs

### *Georgia's Research Alliance*

Unlike the BFP and ASTA, the GRA was created by leaders of Georgia's business community in 1990 as a 501(c)3 non-profit corporation and is not included in the state statutes. State appropriations, which in the current year totaled $30 million, are passed through and made available by the Board of Regents.

The GRA was designed to be a collaborative research initiative and charged with building the state's research infrastructure in targeted areas. The investments were intended to generate economic development results including new company startups and high-tech industry relocations.

The GRA has three major parts to its investment portfolio. The cornerstone of activities is the Eminent Scholars program, 57 of which have been endowed to date. Other initiatives include investing in Research Infrastructure, such as partnering with federal sponsors to build Centers of Research Excellence and Commercialization, which includes investments to launch companies out of university research.

It is a partnership of six public and private universities—Clark Atlanta University, Emory University, Georgia Institute of Technology, Georgia State University, Medical College of Georgia, and the University of Georgia. While there has been some concern that GRA was concentrating its resources in the 'greater Atlanta' area, the organization also works with local economic development organizations by making research investments to retain, attract, or develop business.

The three programs differ substantively in many ways: organizational structure, level of academic orientation, governance, funding, statewide versus regional focus, etc. On the other hand, they share two common elements, namely a commitment to technology-led economic development and demonstrated long-term commitment, viability, and policy continuity. What are the common lessons from these three diverse examples for building a long-term solution within Louisiana?

# Organizational Lessons from Successful State Programs on Issues of Implementation and Continuity

Following is a comparison of the three state programs in nine areas which need to be given careful consideration in establishing a new entity, and which are critical to the success of these types of initiatives:

### 1. The presence of clear and compelling public policy objectives of the program.

**BFP**—Created as an economic development and jobs creation program with the university community as the primary driver. University role has diminished over time.

**ASTA**—Established to bring benefits of science and technology to state economic development efforts through a broad range of activities.

**GRA**—Designed to enhance the assets and research capabilities of the state's major universities, which would lead to economic development benefits.

***Organizing lesson: While each organization pursues a different public policy objective and has modified tactics and strategies over the years, all three have remained focused on their initial objectives.***

### 2. The importance of legitimating and enabling legislation.

**BFP**—Enabling legislation adopted in 1982. This has since been amended several times.

**ASTA**—Enabling legislation adopted in 1983.

**GRA**—No enabling legislation but receives an annual state appropriation. Established as a 501(c)3 non-profit organization by Georgia business leaders in 1990.

***Organizing lesson: Enabling legislation is not a requirement for a successful initiative; establishment of organization is dependent on preferred governance structure. A state commitment of funds is critical no matter the structure.***

### 3. Having a robust and workable governance structure, including organizational by-laws.

**BFP**—Oversight for the program is provided through an appointed (primarily by Governor) statewide Board, which is responsible for policy and program guidelines. Each of the four BFP centers that provide services, are independent 501(c)3 corporations, with independently chosen boards.

**ASTA**—A Board of Directors, appointed by the Governor with the approval of the Senate, is responsible for the governance of the organization.

**GRA**—As an independent **501(C)3** organization, the GRA appoints it's own Board of Trustees, which includes business and academic leaders.

***Organizing lesson: In these types of initiatives, independent boards have been shown to be more flexible, responsive and accountable and also consistent with state commitment of funds.***

## 4. Establishing a workable organizational structure of the entity, including staffing requirements, job descriptions, reporting relationships, etc.

**BFP**—The BFP is a decentralized service delivery model. The legislation created four regional centers as independent organizations, with their own Boards of Directors to address regional needs. Each Center has a staff ranging from 14 to 28 individuals. The state Board, on the other hand, has a very small staff to address policy and guideline development issues.

**ASTA**—The organization has a staff of about 17 individuals delivering services statewide through three departments—Commercialization, Research and Industry.

**GRA**—The GRA has a small staff of seven whose primary activities include planning, managing the investment portfolio, brokering working partnerships between companies and universities, and marketing the GRA's initiatives. Additional resources are provided, as needed, by the participating universities.

***Organizing lesson: While BFP provides services through regional centers, GRA and ASTA offer a more centralized approach. Service delivery mechanisms are to a great degree dependent on availability of funds.***

## 5. Establishing a long-term funding plan (and following through) including a mix of federal, state, private industry, and foundation support.

**BFP**—The four BFP Centers have received about $25 annually over the past 25 years from the state. While matching dollars have always been required for state funds, the program's track record has made it possible to leverage the state investment with federal government, foundation, and venture capital funds.

**ASTA**—Similarly, ASTA has been able to leverage state funds to attract federal and foundation grants for specific objectives.

**GRA**—The GRA has always required matching funds for its Eminent Scholars program and has also used state funds to attract significant federal dollars for it's Research Infrastructure investments as well as venture capital for it's Commercialization portfolio.

***Organizing lesson: While establishing a funding plan that includes a mix of federal, state, and industry commitments is a worthwhile goal, it is difficult to achieve. GRA is the only organization that has been able to generate an appropriate mix, and that success has been the result of its tight mission focus.***

## 6. Sustainability goals of the organization.

**BFP/ASTA/GRA—**One of the first issues generally raised by potential investors in these types of entities is that of sustainability—how the organization might survive without public funding. Sadly, the answer is that it wouldn't. Many efforts in the U.S. and abroad have attempted this feat without success. The simple reason is that these types of initiatives are create to serve a "public purpose"—activities that private industry might partner in, but certainly not generate any type of profit that would interest them.

Of the three state programs reviewed, the GRA has made the most progress in that their staff and operating costs of about $1 million annually are paid for by contributions from the business and academic communities and not from state appropriations.

***Organizing lesson: A continuing state commitment of funds is a programmatic necessity due to the "public purpose" function of many organizational activities.***

## 7. Successfully communicating with and involving stakeholder groups.

**BFP—**One of the hallmarks of the success of the BFP was the early recognition that they had to generate support from a variety of constituencies—companies, the University community, community colleges, economic development organizations, state legislature, etc. Today the BFP brand is recognized nationally by individuals throughout the technology-based economic development community.

**ASTA—**Communicates with its stakeholder groups through its advisory committees, its annual reports and through its science and technology related public policy endeavors.

**GRA—**The GRA has also placed great emphasis in communicating with stakeholders. Because it was created with much fanfare by the business community, university presidents and with support of a new governor the GRA generated a great deal of early publicity. Now, 17 years later, it continues to place a great deal of emphasis on stakeholder communications, which has contributed to its national 'brand' recognition.

***Organizing lesson: A formal stakeholder communications function is needed to build buy-in, bipartisan support, and brand recognition.***

## 8. Accountability—Having in place policies and systems to address how the organization defines and evaluates results and outcomes.

**BFP—**Has very specific policies and systems in place to measure the outcomes of the Center investments. These are outlined annually in guidelines published by the Board (see Appendix. ) Measures include jobs created and retained, product commercialization and sales, funding dollars attracted, and capital attracted and leveraged.

**ASTA—**Has established policies and procedures and is audited annually. IT has no formal assessment process but publishes outcomes in its annual report.

**GRA—**The GRA's performance Index includes measuring outcomes for eminent scholars recruited, new nationally recognized Centers of Research excellence, federal and private investment leveraged, existing companies served by university partnerships; and companies and jobs created.

***Organizing lesson: It is critical that the initiative have clearly defined accountability and performance outcome objectives, the more specific the better.***

## 9. Overall organizational development strategy: alignment of mission, objectives, general program areas, and funding sources.

**BFP—**Has a clearly aligned development strategy that has responded to changing environment. Focus has remained on people, innovation, and regional economies. The university focus has declined over time.

**ASTA—**As a quasi-state agency the ASTA must respond more directly to legislative will. Changes in statutes and funding have added responsibilities to their mission, e.g., Manufacturing Extension, but the organization has always retained its focus on using technology to improve the state's economic performance.

**GRA—**The programs of GRA have maintained their focus on technology-led innovation and economic development with a tight alignment with Georgia's public and private research universities. Of all the state programs reviewed, the GRA has perhaps been the most consistent in maintaining a focused organizational development strategy. With an independent Board focused on substance and results, they have tweaked tactics over the years, but have maintained a clear focus as to what they were trying to achieve.

***Organizing lesson: Historically, there has been very strong alignment between mission and program objectives and activities in all three of these successful programs, otherwise they would not continue to exist today. Relating day-to-day activities to the mission needs to be part of the organizational culture. A strong alignment between budget allocations and mission objectives has also existed, but in some years this has suffered as states have faced budget crunches.***

## Lessons Learned and Guiding Principles for establishing a successful technology-based public/private system to transfer university technology to private sector.

Within the technology-based economic development community, the statewide programs described above—BFP, ASTA, GRA—have been considered a success. They have each been in existence for a minimum of 15 years and have provided significant contributions to their state economies—the proof being that their primary investors, state legislatures, continue to support them extensively irrespective of which political party is in power.

Perhaps the first lesson to be learned is that an initiative of this magnitude will be challenging to establish unless there are one or more "champions" who are available to see it through its genesis phase. These champions can come from private industry such as in the case of the GRA or government as with the BFP and ASTA. The BFP was created by Republican Governor Thornburgh and ASTA by Democratic Governor Clinton. Clearly the BoR will need to be one of those champions.

While state legislatures are an integral part of the process, they have generally not been the drivers of these initiatives at the state level. These champions will also be needed to deflect criticism of the initiative as it makes its way through the legislative process and will also be needed in the early years until the initiative begins generating results.

In looking at the three state initiatives, it is important to note that each of the three programs have a different focus or mission—BFP was created to grow technology-based companies, ASTA, to contribute the elements of science and technology to a broad range of economic development activities, and GRA, to enhance university research.

As a result, a second lesson is that mission or focus ***does not*** determine long-term success. This is important to Louisiana, because launching a successful initiative will require more than just copying what some other states have done. The plan for Louisiana should be based on the needs and priorities of the primary stakeholders in the state as well as Louisiana culture and values.

Other key elements for success can be broken down into the following three categories.

1. Mission
2. Organizational issues
3. Intangibles

## 1. Mission

In order to succeed, it is critical that the Louisiana initiative have a clearly defined mission and focus. "Clarity of purpose" is perhaps the most important element in getting a new initiative off the ground. It is why stakeholders buy into the concept, why legislatures decide to invest and why the general public approves of this as an appropriate investment of public funds.

The tendency in creating a new program is that any number of parties will want to add new elements to the core mission. This should be avoided. Careful prioritization and targeting do not guarantee success, but being all things to all people will surely lead to failure.

This does not mean that, over time, the original mission may not be modified or that the path you have originally taken to get there may not change. The BFP is a good example of this. The original goal was to grow technology-based businesses in the state and the initial plan called for using the intellectual capabilities at research universities to be the driving force in this effort. This did not work as planned, and the BFP developed new approaches to growing technology companies while redefining their role with the academic community.

A second important element for success is that the initiative not be perceived as elitist. The BFP and ASTA are good examples of organizations that have served statewide constituencies and been programmatically inclusive of all types of institutions of higher learning. Any type of academic institution—from a community college to a major research university—can make a significant contribution to its community and target market. The GRA has in the past received some criticism when it has been perceived as serving only the six major research universities in the Atlanta area.

## 2. Organizational Issues

A critical question to be resolved when creating these type of technology-based organizations, is the form it should take. Experience shows that organizations which are free standing (i.e. not a state agency or part of a university) and established as non-profit entities, are the ones most likely to succeed. These organizations have flexibility as to hiring and firing practices of staff, are able to recruit non-political, independent boards, are able to create more flexible by-laws and will have access to additional sources of funding and revenue opportunities. Both the BFP Centers and the GRA are non-profit organizations.

One exception to this model is ASTA, which has thrived despite being a state affiliated organization for two reasons. One is that with a broader mission than other entities—science and advanced technology benefits to the state—it has been able to grow by adding new programs its mandate. The other reason is continuity in leadership. ASTA has had the same CEO since its inception in 1983 and has established itself as a mission-driven, professionally run organization. The executive leadership has crossed a number of Republican and Democratic administrations.

There are also other ways organizations can be structured to meet the needs of stakeholders. For example, Minnesota created an independent 501(c)3 non-profit, the Greater Minnesota Corporation, with at-will employees—but kept the state funds in the state coffers to provide financial oversight. The goal, at the end of the day, is to create an entity that will be able to fulfill its mission with minimal red tape and political interference.

Closely related to the organizational structure, is the ability of the entity to recruit and hire the most talented individuals available. Without strong managers who are able to deal effectively with various constituencies, including private industry, the university community, and governmental organizations, success will be difficult to achieve. In fact, there is a saying in these circles applicable to university-industry partnerships which notes that good science + bad management = bad science.

A third set of important issues on the organizational side include accountability and defining roles for stakeholders. Effective organizations have excelled in reporting the results of their investment of public funds, issuing press releases, regular annual reports, and conducting independent audits of their work.

They have also reached out to all their stakeholders—public, private, academic—and have involved them on advisory boards, committees and other activities to ensure that they considered themselves part of the broad umbrella of technology-based economic development in their state.

## 3. Intangibles—Culture

While a clear mission and the correct organizational structure are critical components to success, in many ways it is the cultural identity of the organization and how it perceives itself that is the difference between those organizations that excel over the long term and those that merely survive from one legislative session to the next.

In many ways establishing an entity to bridge the gap between university research and commercialization is about creating a culture of change. Successful organizations reflect this philosophy and imbed it into how *they themselves operate*. Entities that have seen themselves as simply being a funding vehicle for the state have failed.

Success has come to organizations that have defined themselves and their mission as being more than simply the sum of its parts. They have recognized that their value added was in being a catalyst, a facilitator, a business development agent for their partners (seizing opportunities they could not see), and often, a think tank or strategist for state policy makers.

The real success for the BFP and GRA, and, to a lesser degree, ASTA, has been to translate their successes in being able to generate economic impact for their communities into a role as a valuable asset and advisor to politicians in helping to develop and implement policy for their states. This has led to more sophisticated and beneficial partnerships and relationships among government, industry, and academia—all of which currently contributes to economic growth in their states today.

These organizations have become players in their states and created a national brand image, which indicates that they are at the leading edge of technology development—an attractive proposition for emerging technology companies, entrepreneurs and the image of the state in the national scene.

# Addenda to White Paper #5:

## (A) State Program Details
## (B) Technology Commercialization Infrastructure in Louisiana

# Addendum A: State Program Details

## Pennsylvania's Ben Franklin Partnership

### Organization Genesis and Program Mission and Objectives

The BFP (originally known as the Ben Franklin Partnership, the name now refers to an expanded Ben Franklin Technology Development Authority, but for the purposes of this report will be referred to as BFP) was initially created as an economic development and jobs creation program as a result of severe dislocations in Pennsylvania's traditional manufacturing industries (1982—HB 2344). In fact Gov. Thornburgh set a four-year goal of creating or retaining at least 10,000 jobs between 1983 and 1987.

The intent was to use the resources and capabilities of the state's six public and private research universities—Carnegie Mellon, U. of Pittsburgh, Penn State U., U. of Pennsylvania, Drexel, and Temple—to work with industry and build a stronger state economy.

Four regional university based centers were created to invest the state appropriations (which have averaged about $25 million annually since 1984). Primarily these funds go to pay for technology partnerships that require a university and company to work together on a specific technology project with an anticipated benefit to the state—new product, new company, job creation, etc. Because community colleges and other institutions of higher education had difficulty generating what were essentially R&D projects, the legislature allows the BFP centers to support other activities such as:

- Training & curriculum development
- Technical assistance & tech transfer
- Business incubators
- Market development, feasibility studies
- Staff support for advanced tech councils or other consortia

As a result the BFP generates strong support throughout the state and has become inclusive of Pennsylvania's entire academic community.

Legislative support continues strong today, 25 years after the BFP was created. However, the role of the Centers has significantly evolved in the way the state perceives them and through the way they conduct business. This evolution stems from the original mission of the BFP—to be an economic development and jobs creation program. Over time, it became challenging to achieve the anticipated outcomes by partnering solely with the academic community and the focus became to increasingly invest in the growth of companies directly.

Today, the Centers are in many ways seen as the primary technology and economic development catalysts helping their regions transition to a knowledge-based economy. For example, the BFP NE Partner Center is the fiscal agent and a key participant for the WIRED project in their region. In addition, today's initiatives and investments are driven primarily by the needs of companies, communities, and the marketplace as opposed to the university community.

The current mission of the BFP, as noted in the 2006 Program guidelines, is:

To assist Pennsylvania in developing a robust, globally competitive economy through:

- High value added products, processes, and services;
- Innovative integration of technology and Pennsylvania human resources;
- World-class Pennsylvania-based technology and business, financial, and information services; and
- Investing in economic, community, and university-based innovation.

Projects are no longer required to have an academic partner. Increasingly the centers have become much more involved in investing directly in companies, venture capital, entrepreneurial activities, etc. While the strategy has changed, the BFP's transaction approach as the primary service delivery mechanism– helping individual firms grow their businesses—has remained the same. The academic community is still an important partner in the BFP, but has a much more diminished role than originally conceived. The Guidelines note that:

> A close association with colleges and universities has been a significant element of the Ben Franklin Partnership since its founding. University personnel are particularly valuable in technology innovation because they generally understand not just existing applications of technology, but what is behind those applications. This understanding allows them to help develop innovative ways to apply and integrate known technologies as well as develop new technologies. A secondary but very important benefit is that faculty gain a greater practical understanding of the marketplace, and students are prepared by real life experiences to be ideal future employees and employers and to find such opportunities in Pennsylvania thereby, helping to stem the "brain drain." This type of win-win leveraging of opportunities and services is an example of the broad benefits that have been derived by the ***Partners' approach of using industry-driven, community-based organizations to build relationships and execute strategies over a long period of time.*** (emphasis added)

## Enabling Legislation

As noted above, the original legislation creating the Ben Franklin Partnership Fund focused on universities as being the drivers of the program.

The act creating the Ben Franklin Partnership Fund in 1982 indicated that

> the BFP Fund may establish advanced technology centers which shall serve as university-based consortiums between business, universities and government to provide advanced technology research and development, training, education and related activities which show significant potential in diversification of Pennsylvania's economy and the State's economic growth.

Still, reconciling the economic development mission of the BFP with the needs of the university community in the early years proved challenging and the requirement for university participation in all company engagements posed limitations. Nonetheless, the BFP survived two sunset reviews in 1988 and 2000.

As with any legislatively mandated initiative, this legislation was been amended over the years to address a variety of issues. Within this context, the role of the university community as the driver of BFP slowly diminished, with other state programs emerging to support university research and technology projects.

The most significant legislative change occurred in 2001 when the BFP was merged with the Pennsylvania Technology Investment Authority (the PTIA) to create the Ben Franklin Technology Development Authority.

The PTIA had been created to promote university technology-based research and facilitate commercialization of new technologies i.e. to invest in companies requiring non-asset-backed, equity-type investments and also provide, where applicable, phantom stock and low-interest loans. An example of how PTIA supported University research was by providing a $10.5 million three-year grant to support a Center for Nanotechnology co-directed by Penn and Drexel faculty.

- The mission of this new entity, with a $50 million+ budget, though, was broad based and included:
- "Serving as the Commonwealth's key regional partners in identifying, developing, adapting and implementing advanced technologies."
- "Acting as regional facilitators and managers for interactions, programs and initiatives."
- "Establishing partnerships."

## Governance structure, including organizational by-laws

The BFP was created as a decentralized system—four regional Centers addressing specific regional needs. However, an oversight Board was also created at the state level that was to be responsible for policy, creation of program and investment guidelines and allocation of funds to the four BFP Centers.

Currently the state Board of the Ben Franklin Technology Development Authority includes 21 members. Members include the Governor, Secretary of Community and Economic Development, Secretary of Education, Secretary of Administration, seven representatives from technology community appointed by the governor (four from Boards of BFP centers and at least one from private capital community), one from the Pennsylvania Economic Development Association (appointed by the governor), one from local government (appointed by the governor), one from community development sector (appointed by the governor), three representatives from education sector (appointed by the governor) and four members of the General Assembly.

The Board issues detailed guidelines to the Centers annually concerning eligible activities, IP considerations, royalty and payback policies, etc. The Centers then submit a portfolio of projects, proposed investments, etc. for the Board's approval. In the early years of the program state funds were allocated based on a formula, creating a competitive situation for the Centers. More recently, state appropriations have been divided equally among the four entities.

## Organizational structure of entity, staffing requirements

The staffing for the state Board is minimal—about 6 individuals, all of whom are state employees. Their primary roles are to issue guidelines, review Center projects, and undertake some marketing of the BFP.

Each of the four Centers however are independent non-profit corporations with their own Board of Directors comprised of private industry executives and other representatives from education and the community. The boards must have at least 50% representation from industry.

These organizations are now referred to as Ben Franklin Partners and all have significant budgets and larger staffs than at the state level. They include:

- Innovations Works, Inc, The Ben Franklin Technology Partner serving southwestern Pennsylvania—(staff of 15)
- The Ben Franklin Technology Partner of Central and Northern Pennsylvania—(staff of 14)
- The Ben Franklin Technology Partner of Northeastern Pennsylvania—(staff of 27)
- The Ben Franklin Technology Partner of Southeastern Pennsylvania—(staff of 28)

## Funding plan—mix of federal, state, private industry, foundation support

The BFP was started with a $1 million planning appropriation in 1983. By FY '85 the appropriation had risen to $18 million, and since then has averaged about $25 million annually—FY '97 $29.3 million, FY '04 $27.6 million. Currently the Ben Franklin Technology Development Authority has an appropriation of $50.2 million.

While the vast majority of the Center's income is derived from the state appropriations, there is also an income stream from royalties and paybacks as well some support from foundations and federal agencies.

## Sustainability goals of the organization

The BFP has received, on average, an annual appropriation from the Pennsylvania Legislature of around $25 million since 1985. This has made it possible for the four centers to establish themselves and also generate other income through foundation and federal grants and paybacks from company investments.

This program would not be sustainable without significant state support.

## Successfully communicating with stakeholder groups

For the most part, communicating with stakeholder groups has been the role of the four centers. The Board and BFP staff in Harrisburg has played a relatively minor role in promoting the BFP.

The centers have reached out and built broad and deep relationships with partners throughout their regions, including academia, private industry, and public sector organizations at all levels. In addition to a regional Board, advisory committees have been established and the media is regularly informed of successful BFP investments.

## How the organization defines and evaluates results and outcomes

The state BFP Board has some very detailed guidelines on how the Centers are to report outcomes and results. In addition, the state has periodically hired outside firms to evaluate the economic impact of the BFP and confirm the Centers' reports.

## The performance measures for impacts at companies served include:

- Number of jobs created with BFTP assistance
- Number of jobs retained with BFTP assistance

- Number and description of new products commercialized with BFTP assistance
- Number and description of new internal processes implemented with BFTP assistance
- Dollars of federal funding attracted to BFTP projects and clients
- Dollars of industry funding attracted to BFTP projects and clients
- Dollars of venture capital attracted to BFTP projects and clients
- Dollars of private capital leveraged to BFTP projects and clients
- Annual Sales of new Products and Processes introduced with BFTP assistance

## Overall organizational development strategy: alignment of mission, objectives, general program areas, and funding sources

With over two decades worth of experience, the BFP has a clearly aligned development strategy. From its early beginnings as a transaction oriented, tech based economic development organization the Centers have now become a catalyst for change in their regions.

Their mission today includes:

- Helping companies with high growth potential to form and grow through the development and commercialization of innovative products and services, and to reach a stage in their development that will facilitate the attraction of follow-on funding;
- Helping established companies to develop and innovatively apply new technologies and practices that make them more competitive in the global market economy; and
- Facilitating and supporting the availability of services, technical assistance, and collaborative activities throughout Pennsylvania to enhance the community's capacity to support modern business.

The common theme among this broad range of activities and goals is innovation related to people, systems, markets, and technology. Centers are expected to be proactive and creative in helping clients achieve leadership in their industries and in transforming their communities to be an excellent place for technology businesses to thrive. As noted above, the role of the university community has diminished over the years from being the primary driver of this program.

# Arkansas Science and Technology Authority

## Organization Genesis and Program Mission and Objectives:

The Arkansas Science and Technology Authority (ASTA) was born from the examples of Silicon Valley, Boston's Route 128, and the Research Triangle Park. These three regions, and others, presented a compelling case for technology-led economic development. ASTA's mission, modeled on these successes, was to bring the benefits of science and advanced technology to the people and state of Arkansas. This mission is addressed by strategies to promote scientific research, technology development, business innovation, and math, science and engineering (STEM) education.

The legislation for ASTA offers this description:

> The authority is authorized and designated to engage in undertakings, programs, enterprises, and activities involving agriculture, manufacturing, medical and health care, transportation, public utility services, research and development, and other programs involving the establishment and encouragement of science and technological research. (Arkansas Code 15-3-108)

ASTA classifies programs within three broad areas: research and commercialization, technology and manufacturing extension and management services. Over time ASTA has developed a range of programs, small and large, that deal with issues from k-12 education, STEM, industrial extension, innovation tax credits, equity and debt finance, competitive innovation grants, and both basic and tech transfer research. While many ASTA programs require or encourage university roles, the university is seen as only one of its many priorities. Clearly ASTA has taken a broader and more comprehensive approach instead of the relatively narrow and targeted programs of the BFP and GRA.

Below is a list of some of the programs that ASTA is involved in.

**Applied Research Grant Program**: Is a (50:50) cash-matching effort to support applied research in science and engineering. The goal of the Applied Research Grant Program is to stimulate the transfer of science and technology in Arkansas by enhancing opportunities for research partnerships between Arkansas colleges and universities and private industries.

**Research & Development Tax Credit Program**: allows credits against a taxpayer's Arkansas state income tax for making certain qualified research expenditures as well as certain donations or sales below cost of new machinery and equipment to a qualified research program.

**Seed Capital Investment Program (SCIP):** provides working capital to help support the initial capitalization or expansion of technology-based companies located in Arkansas. The program is funded by a $4,000,000 revolving fund.

**Technology Development Program**: provides royalty financing for qualified projects possessing a well developed, comprehensive project plan, and which utilizes the benefits of science and technology to provide economic and employment growth potential in Arkansas. This program had $150,000 in state funding authorized for the 2003-04 fiscal year.

**Centers for Applied Technology Program**: is a competitive effort to support applied technology in areas of advanced materials and manufacturing systems; agriculture, food and environmental sciences; biotechnology, bioengineering and life sciences; and, information technology. The benefits of establishing a center is that an income tax credit equal to 33% of qualified research expenditures may be allowed to an Arkansas taxpayer who invests in an active project under research and development programs offered by the Arkansas Science and Technology Authority.

**Basic Research Grant Program**: is a competitive, (60 percent state: 40 percent institution) matching grant effort to support basic research in science and engineering. The goals of the Basic Research Grant Program are to promote and support the growth and development of Arkansas scientists and to enhance the status of science and engineering in Arkansas colleges and universities.

**EPSCoR**: attempts to increase federally supported research in Arkansas institutions of higher education. Guided by an advisory committee to the Authority's Board of Directors, the project is also charged with planning and implementing an effort that would increase federally supported research at colleges and universities.

**Arkansas Manufacturing Solutions**: provides on-site consultation by project managers. AMS is charged with providing technical and management assistance to manufacturers in Arkansas. By helping individual manufacturers, AMS assists the surrounding communities and the entire state.

**Mini-grant Program**: works in conjunction with the Arkansas Community Foundation Affiliates Minigrant Program. It provides $500 awards to Arkansas teachers in grades 5, 6, 7, and 8 to purchase consumable science materials. Kits are permitted if they are grade standard based and meet the State Frameworks requirements. This program has $200,000 in annual funding.

## Enabling legislation:

The legislation that established ASTA is Act No. 859 of 1983. ASTA's structure and role are spelled out in Arkansas Code 15-3-101 through 124, 15-3-130 through 35, and 15-3-201 through 208. Much of the structure and governance described below is prescribed by the legislation. Over time changes to the legislation have broadened the goals and mission of the organization.

## Governance structure, including organizational by-laws:

The Board of Directors has complete authority within ASTA. The legislation establishing ASTA confers the power to make all decisions within the authority granted to ASTA to the Board of Directors. The limits faced by the Board arise from the aims of the programs the legislature funds and charges ASTA with responsibility for. Members of the Board can serve two 4-year terns, but no more. They are appointed by the Governor with approval from the Senate, and can be removed from their position by the Governor. They elect the chair, vice-chair, and secretary for the executive committee independently from the Governor or Legislature. ASTA's activities are audited annually to ensure compliance with state and federal guidelines.

## Organizational structure of entity, staffing requirements:

ASTA consists of a Board of Directors, Advisory Committees, and staff.

The Board of Directors has 14 members that are appointed by the governor for staggered 4-year terms. The seats on the Board are divided as follows; three seats are set aside for scientists or engineers, two seats for representatives of academic institutions, five seats for representatives of the private sector, three seats for representatives of the private sector that have experience in the field of manufacturing, one seat for the director of the Department of Higher Education (or the Director's appointee)

There are 3 advisory committees within ASTA:

- The Arkansas Manufacturing Solutions (AMS) Committee
- The Experimental Program to Stimulate Competitive Research (EPSCor) Committee
- The Science, Technology, Engineering, and Math (STEM) Committee.

The AMS Committee consists of four members three of which are representatives of local firms. The EPSCor Committee has 12 official members and 4 ex-officio members. The members of the EPSCor Committee are a mix of representatives of universities, private business, and government officials. The committees include both members of the Board of Directors and individuals from outside of the Board. The purpose of the committees is to offer input to the Board of Directors.

ASTA's staff is led by the President, and is divided into three programmatic departments, each headed by a vice-president with a fourth administrative department headed by an executive vice-president. The departments are Commercialization, Research, and Industry. The Industry department has by far the largest staff with eight positions described in ASTA's organizational chart. The Research and Commercialization departments are smaller with just two positions described for Research and only one for Commercialization.

## Funding plan-mix of federal, state, private industry, and foundation support:

Arkansas Legislature authorized $6,603,093 for the ASTA in the 2007-2008, and $6,630,625 for 2008-2009. Historically, the legislature has been the primary source of funding for ASTA. Other organizations, such as the Federal Government and the Winthrop Rockefeller Foundation, have provided matching and sole funding for specific grant programs.

## Sustainability goals of the organization:

As noted above ASTA is largely funded by the state. The myriad of programs within ASTA likely insures that the organization will exist over the long term, if only because many of its programs like manufacturing extension are considered "bread and butter" services in most states. The authority undergoes an annual audit as prescribed by legislation but also documents performance, though less explicitly than BFP and GRA.

## Successfully communicating with stakeholder groups:

Communication with stakeholders is facilitated through the Board of Directors, the Advisory Committees, and the staff. The Governor selects the Board of Directors with the requirements listed above. These requirements serve to insure representation of private business, universities, and state government on the Board. The advisory committees include roughly thirty different members of the community from private businesses, universities, and the state government. Additionally, the staff of ASTA works extensively with different stakeholder groups as is expected given the broad range of organizational programs.

## How the organization defines and evaluates results and outcomes:

For ASTA's 2005-2009 Strategic Plan it relied on a series of metrics to measure its success in achieving different goals. For the goal of increasing research activity in Arkansas it measured the number of projects and initiatives in the area, the level of federal R&D funding to colleges and universities, the number of companies and new enterprises enabled, and the amount of venture capital invested within Arkansas. For the goal of transforming existing enterprises into knowledge based companies and increasing global competitiveness ASTA measured, the number of jobs created or retained, the number of enterprises assisted in a year, and the number of jobs in high-technology NAICS codes.

Overall organizational development strategy: alignment of mission, objectives, general program areas, and funding sources:

ASTA is clearly the least focused and most comprehensive of the three state programs reflecting the broad language of the enabling legislation and the organization's mission. The range of programs and level of legislative oversight gives the authority the feel of a state agency instead of a focused technology organization. Still, ASTA programmatically reflects the goals and mission given to them. Their success providing a broad range of services has served to provide continuity over time and an established clientele.

## Georgia's Research Alliance

### Public Policy Objectives of Program

Since its inception in 1990, the Georgia Research Alliance has had very clear public policy objectives—goals that remain the lynchpin of the organization today.

The GRA was created to be a collaborative research initiative and charged with building the state's research infrastructure in targeted technology areas—biotechnology, telecommunications, and environmental technologies. The investments were intended to generate economic development results including new company startups and high-tech industry relocations.

The GRA has three major parts to its investment portfolio. The cornerstone of activities is the Eminent Scholars program, 57 of which have been endowed to date. Other initiatives include investing in Research Infrastructure, such as investing in labs and equipment and partnering with federal sponsors to build Centers of Research Excellence and Commercialization, which includes investments to launch companies out of university research.

It is an alliance of the state's six research universities—Clark Atlanta University, Emory University, Georgia Institute of Technology, Georgia State University, Medical College of Georgia, and the University of Georgia. In recent years, the GRA has supported the participation of other academic institutions in GRA consortia projects when the opportunity has risen.

### Enabling Legislation

Unlike almost every other organization of this type in the nation, the GRA has no enabling legislation and was in fact created by leaders of Georgia's business community in 1990 as an independent 501 (c) 3 non-profit corporation—it is not included in the state statutes. State appropriations are identified by the legislature to be made available to GRA and are included in the Board of Regents appropriations. When the GRA Board approves initiatives, staff works with the Regents fiscal office to have the funds transferred to the appropriate institution.

The impetus for the creation of the organization is attributed to the loss of a major national competition for a technology project—the Microelectronics and Computer Consortium—in the mid-1980's to Texas. The business community was galvanized to look for ways to increase the capabilities of its research universities, created the organization, and then lobbied prospective gubernatorial candidates to support their efforts.

## Governance structure, including organizational by-laws

As an independent non-profit corporation, a 25 member Board of Trustees, including senior executives from industry as well as the six university presidents that form the Alliance, governs the GRA. The Board is responsible for all policy decisions and approves the investment of all GRA funds appropriated through the legislature. Alliance members and/or GRA staff recommend investments in projects, which are then reviewed by the Board.

## Organizational structure of entity, staffing requirements

In addition to being an independent private non-profit corporation, what makes the GRA unique is that its $1 million operating budget is paid for through contributions from its members, corporations and the foundation community. No state funds are used to support the operating costs of the GRA. Because of its independent status, the state of Georgia is seen as an investor in the GRA not as its creator.

While the organization has an individual responsible for finance and administration, the primary roles of the seven staff members are to be catalysts for change not administrators of state funds. The GRA was not designed to run programs—its role was to help plan and get enacted activities that members of the alliance would run.

Staff works with members of the alliance as well as federal and other funding sources to identify opportunities and turn them into viable investments for the GRA. Staff is also augmented by individuals that are identified by each member of the alliance to act as a liaison with the GRA—at the University of Georgia, for example, this role is part of the job description of the vice president for research and associate provost. In addition, corporate Board members often also provide 'executives on loan' to the GRA.

## Funding plan—mix of federal, state, private industry, foundation support

The initial state appropriation in 1991 totaled $15 million and the prime strategy was the establishment of the Eminent Scholars program by endowing five chairs.

In recent years the state has been investing in the range of $30 million annually in GRA initiatives. In the current year, this has been augmented by an additional $10 million investment in the Life Sciences.

Currently the GRA recruits two Eminent Scholars annually and spends about $3 million (this is matched 50-50 by the participating university) on this activity. About $20 million of the state funds are invested in research infrastructure activities—labs, equipment, facilities—many of which are associated with the work of the Eminent Scholars. Lastly, some $8 million is invested in commercialization activities, financing IP scale up, venture capital, and the launching of companies started through university research.

The availability of state funds has also made it possible for GRA to leverage a significant level of additional federal, foundation and private dollars to support new initiatives. This has become increasingly important, as a priority of the GRA has been to enhance collaborative efforts among its members and build new consortia.

## Sustainability goals of the organization

The founders of the GRA were concerned about sustainability issues from its inception. Creating an independent organization that was not beholden to a particular governor or political party was one way that the business community addressed this issue.

Since 1990 the driving philosophy of the organization has been to invest in initiatives that provided broad economic benefits to the state. They have expanded their activities by including institutions of higher learning into consortia projects, where appropriate and have reached out to help small firms throughout the state access the technology resources available at Georgia's research universities.

In a broad sense, GRA's long-term success can also be attributed its continuing efforts to connect together disparate technology resources around the state. The organization is perceived as being more than just a source of funding and is seen as a significant 'player' in both academic and economic development circles. They have enhanced their reputation by taking a relatively low-key approach to promoting their own organization—when touting successes they have always highlighted and given the credit to the appropriate Eminent Scholar, company or academic institution.

## Successfully communicating with stakeholder groups

From its start, the GRA has recognized the importance of communicating with stakeholders in the public sector, private industry, higher education—and the general public as a whole. One of its seven full-time staff members has the title of Director of Communications.

Success is evident from the fact that GRA is now a well-recognized brand nationally among members of the academic and technology-based economic development community.

## How the organization defines and evaluates results and outcomes

The organization has a variety of ways of evaluating outcomes for their investments. The Board is very sensitive to the fact that they are investing public funds and want to ensure that there are positive economic impacts and results commensurate with the level of investment. The latest GRA annual report reports the following outcomes for activities.

***Eminent Scholars:***

- 57 Eminent Scholars to date
- $1 billion in new grants
- 25 companies launched from scholar research
- 1,500 jobs created at universities

## Research Infrastructure

- 18 national Centers of Research Excellence as of 2006
- $600 million in private investment in Georgia; more than $1 billion in new grants

## Commercialization

- 125+ start-up companies launched as of 2006
- 3,000+ high-value jobs created
- $600 million in private investment in start-ups
- 100+ partnerships with Georgia companies
- 6 major industry recruitments (supported with GRA investments)

## Overall organizational development strategy: alignment of mission, objectives, general program areas, and funding sources

Of all the state programs reviewed, the GRA has perhaps been the most consistent in maintaining a focused organizational development strategy. With an independent Board focused on substance and results, they have tweaked tactics over the years, but have maintained a clear focus as to what they were trying to achieve.

# Addendum B: Technology Commercialization Infrastructure in Louisiana

Presented below is a roster of entities that represent the kinds of organizations that would comprise a Louisiana technology commercialization infrastructure. It is not intended as a comprehensive inventory but rather a point of departure list to help inform LIA's Communications and External Relations efforts. (University-based technology transfer functions and entrepreneurial culture are addressed in other sections of this report.)

## Risk capital providers

### *Public – Federal, state, regional, local*

**Federal**

- Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awards
- Federal contract awards that are used to develop technology and product, processes, services in which they are embodied (private market applications, dual use, sell backs to federal entities) -- DOD/DARPA, DOE, etc.
- SBA {Programs: 7a, 504, Small Business Investment Companies (SBIC) and New Market Venture Capital companies (NMVC)}

**State**

- Louisiana Economic Development Corporation (LEDC)/Dept. of Economic Development

**Equity and Early Stage**

- Venture Capital Match Program
- Minority Venture Capital Match Program
- Venture Capital Co-Investment Program
- Louisiana Seed Capital Investment Program
- BIDCO Investment Program
- Specialty BIDCO Investment Program

**Other**

- Small Business Loan Program
- Micro Loan Program
- Contract Loan Program,
- Workforce Development Program
- Louisiana Recovery Authority Small Business Aid Program (approx. $200 million)

## *Private*

### Formal

- Louisiana Ventures LP

  Invests in companies based in Louisiana or with operations in the state. Capital Under Management: $10 million from private investors in Shreveport and Baton Rouge and $5 million from the Louisiana Economic Development Corp. Louisiana Ventures will be housed in BioSpace 1, the $12 million wet-lab incubator under construction in Shreveport

- LSU Systems Research and Technology Foundation, based in Baton Rouge, has established a similar fund, Louisiana Fund 1. Its initial partners include LEDC ($5 million) and The Teachers' Retirement System of Louisiana ($10 million), as well as other foundations, companies and individuals.
- Louisiana Technology Fund, created specifically to invest in emerging technology companies. Established by Enhanced Capital Partners LLC of New Orleans, it is capitalized at $2.39 million by three Louisiana CAPCOS, or certified capital companies. Louisiana's four research parks, including Shreveport's InterTech, will participate in investment decisions.
- Sisung Capital (New Orleans)
- Advantage Capital (New Orleans)
- Source Capital (Baton Rouge)
- Gulf States BIDCO (Baton Rouge)
- Enterprise Corporation of the Delta (ECD) and ECD Investments BIDCO/ and HOPE – New Orleans, Alexandria (Baton Rouge, Monroe/)
- Enhanced Capital Partners, New Orleans

***Small Business Investment Companies***

- Stonehenge Capital (Baton Rouge) – expansion, later stage, mezzanine
- Audubon Capital (SBIC) – (Covington) – mainly later stage and mezzanine
- Hibernia Capital Corp. – New Orleans -- inter-stage, acquisitions etc
- Jefferson Partners, Metairie

### Informal – i.e. angel networks, etc.

- The Louisiana Angel Network – Baton Rouge, Dean Capital (management)

## Hard soft infrastructure

### Incubators

- Arts Incubator/Arts Council of New Orleans
- Biomedical Research Foundation (Shreveport)

- Central Louisiana Business Incubator
- Dixie Business Center (Denham Springs)
- Enterprise Center of Louisiana (Carenrco)
- JEDCO Enterprise Center
- Louisiana Business & Technology Center
- Louisiana Technology Incubator (Baton Rouge, Louisiana Technology Park)
- Metro/Regional Business Incubator (Shreveport/CDC)
- Newcorp Business Assistance Center (New Orleans, Minority business assistance)
- University of New Orleans Research & Technology Park
- New Orleans Bioinnovation Center (wet lab, GMP) – under construction
- Biospace1 Wet Lab Incubator InterTech Science Park (Shreveport)

**Research parks**

- Louisiana Technology Park (Baton Rouge, Bon Carre' Business Center)
- Intertech Science Park (Shreveport)
- LSU/GSRI Ave. Research Park ?
- The University of New Orleans Research and Technology Park
- New Orleans Biomedical District (?)
- University of Louisiana at Lafayette Research Park

**"Gateway" centers**

(Centers that develop and improve technological opportunities and relay into the market place – examples, advanced manufacturing centers, joint use facilities for equipment, GMP facilities connected to incubators, joint use labs, prototyping, etc.) – Generally will be non-profit or University/community College based

### University of New Orleans

- Gulf Coast Region Marine Technology Center: The GRMTC mission is to help US shipbuilding industry become more competitive and to reduce the Navy's acquisition costs. The center conducts research in ship design and manufacturing to improve performance, productivity and quality.
- National Center for Advanced Manufacturing: NCAM is a partnership of the University of New Orleans (UNO), National Aeronautics and Space Administration (NASA), and the State of Louisiana . The center provides research and advanced manufacturing technology for use in aerospace and commercial markets.
- Robert E. Nims Center for Entertainment Arts, Amusements, and Multi-Media Industries: Research Areas: The formation of the Center will enhance the full potential of the Department's film and video program and UNO's Studio Center through

professional and economic partnerships with national and international producers of film, video and multimedia. Special Capabilities and Facilities: Studio Center, acquired in 1998 by UNO, is a 70,000 square foot production facility with three sound stages, a scenic shop, production offices and learning labs. The Center offers the same cutting-edge production as used by such media innovators as DreamWorks, Warner Brothers, Imagica and Sony Pictures

### New Orleans Bioinnovation Center

A key component of the facility will be a 22,000 sq. ft. FDA compliant clinical manufacturing facility owned and managed by the Louisiana Gene Therapy Research Consortium. The facility will produce cell and gene therapy technologies for clinical trials and will operate under stringent FDA guidelines to meet the scrupulous requirements for producing therapies used in humans.

### Louisiana Tech

- Institute for Micromanufacturing (ifM): A state-of-the-art high technology research and development facility at Louisiana Tech University. As an applied research institute, the IfM contributes to the economic development of Louisiana and the nation through the invention and realization of specific types of micro and nanosystems, which may be commercialized through technology transfer and start-up businesses.
- Biomedical Foundation GMP Biomanufacturing Facility (Shreveport)

## Key Public and Non-profit Intermediaries with explicit technology-based economic development and/or commercialization missions

**National (with local, state or regional presence) and regional including:**

- Southern Technology Council
- Association of University Technology Managers (AUTM)
- Licensing Executives Society
- USDA Southern Regional Research Center (New Orleans)
- US Geological Survey (Baton Rouge, Lafayette)

**State**

- Board of Regents
    - Research Commercialization and Educational Enhancement Program (RC/EEP)
    - Post-Katrina Support Fund Initiative (P-KSFI)
    - Support Fund R&D Program
    - Research Competitiveness Subprogram (RCS)

    - Industrial Ties Research Subprogram (ITRS)
    - Pilot Funding for New Research (Pfund)
    - Endowed Chairs
    - EPSCOR
- Louisiana Partnership for Technology and Innovation
- Manufacturing Extension Partnership of Louisiana (MEPOL)
- Louisiana Technology Council

**Regional**

Includes regional partnerships that have explicit efforts to support technology-based economic development

- Greater New Orleans, Inc. (GNO. Inc.)
- Lafayette Economic Development Authority (LEDA)
- Cenla Advantage Partnership (CAP)

**Local**

Local technology councils and community based organizations, even some chambers or ED foundation if they have explicit technology-based economic development initiatives or services

Venture forums (e.g. MIT which is now regionally franchised) or equivalent, run by whomever

- N.O. Regional Planning Commission
- Baton Rouge Area Chamber of Commerce
- Capital Village
- Louisiana Purchase Venture Capital Forum
- Greater Baton Rouge Venture Capital Forum
- Lafayette Venture Capital Forum
- Greater New Orleans Venture Capital Club

## Credible, experienced private sector assistance sources and resources

*To be added during system implementation*

- IP attorneys, licensing consultants, market assessment pros, dealer/brokers(?), investment banker types, export/import pros with tailored skill sets, business consultants with tailored skill sets
- Full service product design/development outsource firms

- Corporate out-licensing functions (e.g., of on the shelf technology)
- Corporate “outpost” functions co-located or contiguous with universities
- Outsourcing brokers (of non-essential functions)

# Appendix C: The Louisiana Innovation Alliance and Workforce Development

## Introduction

The purpose of the Louisiana Innovation Alliance (LIA) is to support the creation and application of knowledge that helps grow companies, jobs, and wealth in Louisiana. LIA's business plan states that the Alliance is designed to:

> *accelerate the growth of Louisiana's economy by enhancing technology based research, developing and attracting talent, encouraging technology commercialization and nurturing entrepreneurial skill and spirit.*[35]

The fundamental rationale for creating and investing in LIA is to develop a knowledge economy in Louisiana that produces high value jobs in technology-based companies. At its core, the Alliance is about more than science and technology rankings, peer-reviewed research publications, and even discoveries. It is about providing more opportunities for the state's citizens to move into higher paying jobs than many currently have access to, thereby supporting economic growth and prosperity. This paper describes the workforce dimension of LIA's mission and how it will go about accomplishing workforce-related objectives.

The thrust behind LIA will be investing in and transferring research and development from the state's educational institutions into Louisiana companies, existing and new, that can commercialize them. To succeed, first Louisiana needs more companies capable of bringing to market technology-based products. With this in mind, a primary LIA activity will be working to increase the number of such firms in the state. Next, those companies will need qualified workers—from technicians to business managers to PhD scientists—in order to succeed. If they cannot find the qualified workers they need, they are at risk of failing or leaving the state. All of these jobs are important; however, we anticipate that as Louisiana's technology economy grows, the most numerous new jobs will be mid-skilled technicians who, for example, produce advanced products, work in labs, maintain equipment, and monitor quality. Technician positions are important because companies typically recruit locally to fill them, and those regions—and states—that do a good job producing and quickly training quality technicians create a competitive advantage.

35 Louisiana Innovation Alliance: Business Plan for a Statewide Innovation Economy Organization, Regional Technology Strategies, Inc., 2007.

We do not yet know the specific scope and types of jobs and accompanying skills that will result from the commercialization and licensing deals that LIA spurs, and so it is not wise to set up focused or specialized education and training programs at this juncture. In fact, doing so would be putting the proverbial cart before the horse. It is not, however, premature to know that LIA must engage on two foundational workforce issues: supporting the pipeline and retention of science technology, engineering and math (STEM) graduates and creating a cadre of business entrepreneurs and managers who understand how to start and run technology companies. Both of these are described in more detail later.

To accomplish these goals—as well as to engage on other technology workforce issues as they emerge—LIA's business plan recommends two strategies: First, LIA will directly carry out some key workforce-related activities by designing and funding specific programs. Second, LIA will take a leadership position in engaging with other Louisiana policy leaders on critical workforce issues facing the state. The balance of this paper describes both of these strategies.

## Strategy 1: Direct LIA Activities to Support Louisiana's Technology Workforce

As presented in the business plan for the Louisiana Innovation Alliance, there are several workforce support activities that will be carried out by this new statewide innovation economy organization. Most will be housed under the Louisiana Technology Entrepreneurship Training Program (LTET), one of four proposed LIA program areas. The purpose of LTET is to support activities that help develop the state's stock of science and technology entrepreneurs and managers to create and run Louisiana's new science and technology companies—which in turn will create more demand for a technology workforce in Louisiana. Examples of LTET activities include:

- Supporting projects that will introduce concepts and basic understandings of technology and technology entrepreneurship to K-12 students in Louisiana communities
- Developing joint degrees between Louisiana business and engineering education programs (or other technical programs)
- Creating funding sources to provide seed funding to Louisiana entrepreneurs who are working toward a degree at a Louisiana institution while starting their businesses.
- Placing university interns into Louisiana companies that have licensed Louisiana university technology
- Providing seed funding ($5 to $10K) for graduate students pursuing a technology start-up while in school

These activities stimulate demand for a technology workforce by developing the ability of Louisiana citizens to create and run innovation-based companies. This is the appropriate starting point because, given Louisiana's low number of existing technology firms, without creating entrepreneurs able to commercialize new products there is little likelihood of capturing universities' R&D and therefore little likelihood of creating demand for technology workers in the state.

## Strategy 2: Engaging on Critical Workforce Issues

Three critical functions that reach beyond LIA's sole purview and locus of control yet are clearly linked to its goals and mission are 1) encouraging Louisiana's young people to go into science and technology programs and careers in order to create and retain a pipeline of qualified workers, 2) understanding the workforce needs of technology-based companies as more firms emerge and evolve, and 3) engaging with state leaders to encourage statewide capacity to quickly upskill technicians as needed for technology-based companies.

LIA's business plan calls for engaging and collaborating on these issues with other state policy makers, industry representatives, and education providers through its Office of the President and its External Affairs/Communications staff.

### *Producing and retaining more STEM graduates*

Even before the setbacks brought about by the damage suffered from Hurricanes Katrina and Rita, Louisiana was at best in the middle of the pack with regard to indicators of its ability to produce and retain STEM graduates. The most recent data on these indicators are from 2003—2005. While these indicators might look different if up-to-the-minute data were available, we can assume that the state has not been in a position to make major improvements between 2005 and now.

For those indicators for which national rankings are available, Louisiana shows consistently mid-level rankings:

- Number of doctoral scientists: 27th
- Number of doctoral engineers: 32nd
- Science and engineering doctorates awarded: 25th
- Science and engineering graduate students: 32nd
- Science and engineering post-docs: 31st

These mid-level rankings are in the context, however, of a state that consistently has the second or third highest poverty rates in the country, that ranks 51st in median family income, and that shows up at or near the bottom in the *New Economy Index* rankings of states' knowledge jobs and workforce education levels. Louisiana's ability to stay in the middle of the pack on these indicators, despite working against some of the most significant economic challenges in the nation, suggests that it also has considerable strengths.

A comparison with a handful of Southeastern states (Mississippi, Alabama, Georgia, Arkansas, and North Carolina) continues to show Louisiana in the middle on most STEM indicators. The state performs most poorly in indicators of eighth grade science and math performance, in which only Mississippi scores lower. With regard to higher education, however, such as science and engineering degrees as a percentage of degrees granted, only North Carolina and Georgia score higher.

When we examine STEM-related occupational and workforce indicators, Louisiana's performance seems somewhat weaker compared to education performance. On a few indicators, such as life and physical scientists as a share of the workforce, only North Carolina scores higher (as would be expected given North Carolina's strong bioscience presence). On others, such as science and engineering occupations as part of the workforce, Louisiana's rankings are close to the bottom. One occupational indicator on which Louisiana scores particularly low is that of computer specialists as a share of the workforce—only Mississippi is lower.

Overall, Louisiana presents a picture of average performance in the education of STEM graduates, but a lower than average performance in getting these graduates into Louisiana's workforce and keeping them there. The implication is that Louisiana is losing STEM graduates somewhere along the line.

Census data on the migration patterns of Louisiana residents bear out this interpretation. Between 1995 and 2000, Louisiana saw a net loss of its college-educated residents between the ages of 22 and 29 of more than 9,000. And for all age groups, Louisiana saw a net migration loss in every educational category except that of "less than high school"—in this category, the state gained nearly 5,000 residents.

The jobs held by those who left—as well as by those who came—also indicate a problem in holding onto a talented workforce, and in providing job opportunities for skill-intensive workers. Those most likely to leave were in occupations such as financial specialists, medical practitioners, and computer specialists. For people aged 22-29, those most likely to come to Louisiana were working in food service or construction trades.

As a starting point to engage on the STEM pipeline and retention issue, RTS recommends two initiatives for LIA—a biannual workforce report that benchmarks progress and, in conjunction with partners, the development of programs to retain the state's brightest youth in Louisiana.

## *Biannual Report on State of Louisiana's Science and Technology Workforce*

LIA should publish a biannual report on state of Louisiana's science and technology workforce that monitors and benchmarks STEM graduation and post graduation retention rates. The report should also analyze trends related to the import and export of the state's technology workforce by education and occupation. This benchmarking data will provide important information about where Louisiana stands and how it is performing, serving as a platform to advocate for policy efforts at the secondary and postsecondary levels to improve STEM production and retention.

The workforce report could become the flagship workforce product for which LIA becomes known and respected. It can serve as a visible resource and clarion call that receives statewide media attention. Another recommended element t in the report is an assessment of the workforce needs of science and technology firms. That component is further described later.

## *Keeping the Best and Brightest in Louisiana*

A second recommended STEM initiative on which LIA should engage is promoting efforts to keep the best and brightest students in the state. The state could accomplish this, for example, through educational stipends for National Merit semifinalists, finalists and Scholars, and National Achievement Scholars (a program that recognizes achievement among African American high school students) who attend Louisiana postsecondary institutions and enroll in science and technology programs. The stipends could go toward non-tuition expenses while in college. (These students already qualify for tuition assistance through other state scholarship programs.)

Of course, as the data presented earlier indicate, retaining bright students and supporting the STEM pipeline is only part of the challenge. Having enough successful technology companies available to hire and keep these graduates—from technicians through Ph.D.s—is just as necessary. One idea to improve retention of STEM grads while also supporting technology companies is to provide paid industry internships for Louisiana students. Again, this could be targeted toward high achievers at all levels of STEM education. Bolstering relationships between technology companies and potential employees can improve Louisiana's STEM workforce retention performance.

## *Monitoring the workforce needs of technology-based companies*

A second critical issue on which LIA should engage is monitoring the workforce needs and challenges facing high performing and high potential growth technology companies. As more of these firms develop it will be important to keep tabs on their workforce needs and to report findings so that policy makers can respond appropriately.

We recommend this information be included as part of the biannual state of Louisiana's science and technology workforce report described above.

The definition of technology companies should be broader and extend beyond the targeted research areas funded by LIA (Food Science, Materials Science, Bioscience, and Chemistry & Chemical Engineering) and encompass high performing and high growth technology companies in many areas. Through surveys, interviews and secondary data (as available), the monitoring should cover the types of positions technology companies are creating, which positions are difficult to fill, critical workforce skills, and other workforce issues they face.

It will be important to obtain adequate responses from small firms (fewer than 25 employees). Too often their needs fall by the wayside because young, small firms tend to fly low and have little time for outsiders who come asking questions. Their inclusion is crucial because if small technology firms are under-represented, many of the companies with the greatest potential need—and impact—will be overlooked.

It may be necessary for LIA to contract out development of the report because of its scope and the organization's lean staffing structure.

### *Building links between LIA and Louisiana's education providers and state training resources*

Finally, the ultimate responsibility and resources for educating and training qualified workers for technology companies in Louisiana lies with, of course, the state's education providers and state agencies that support workforce training. LIA should develop relationships and partnerships with secondary and postsecondary system leaders as well as those at the Louisiana Department of Labor. RTS recommends that the LIA president become an appointed member of the Louisiana Workforce Commission, which serves as an interagency entity to support workforce development. This will formally connect LIA to the workforce system.

A critical issue for LIA is ensuring that Louisiana has the capacity to quickly train technicians for new technology areas as they emerge. In a growing number of states, education systems are developing specialized curricula that can be rapidly deployed for high growth industries. In North Carolina, for example, the community college system created BioWorks, a ten-week program that trains entry-level biomanufacturing employees through community colleges. Alabama, South Carolina, and Georgia have the ability to create *and* deliver statewide programs through their economic development-driven customized training programs. In another example, Montana's Department of Commerce recently gave funding to the University of Montana to create a 14-week lab technician program to quickly produce a workforce for Glaxo Smith Kline's new plant. Developing this capacity at the state level in Louisiana would be a positive development and could increase the state's economic competitiveness.

The Louisiana Department of Labor runs two training programs that technology companies could tap to help with workforce training. LIA may want to examine these programs' structures to ensure they adequately serve the needs of technology firms, and advocate for any necessary changes. Brief descriptions of them follow.

The *Incumbent Worker Training Program (IWTP)* supports skills development of existing Louisiana employees through employer-driven training. Training is expected to create new jobs; retain jobs that otherwise may have been eliminated; prevent job loss caused by obsolete skills, technological change, or national or global competition; and increase wages for trained workers. The program is funded by a portion of Unemployment Insurance (UI) tax contributions dedicated solely for customized training. Trainees must be incumbent workers for whom the employer incurs a Louisiana UI tax liability. The employer decides what training is needed and selects a suitable training provider(s). In 2007-08 the program is funded at $47.3 million and about a third of that amount is available for new projects. New projects are funded on a first come, first served basis.

The *Small Business Employee Training (SBET*) program assists Louisiana-based business with 50 or fewer employees that have been in business in the state for at least three years. The program pays for individual, standardized (off-the shelf) training in high demand occupations. Trainees must be incumbent workers for whom the employer incurs a state UI tax liability. Training costs cannot exceed $3,000 per trainee per state fiscal year. Funding is provided through the Workforce Development Training Account, at 2.3 percent of all IWTP funds available.

Finally, as part of its package of incentives to attract new companies to the state, the Louisiana Department of Commerce operates a customized training program for companies that have been in the state for less than three years. This is another resource LIA should examine to determine how it can support the state's technology companies and workers.

## Conclusion

Undoubtedly LIA's workforce-related activities will evolve as the organization matures and as education and workforce issues in Louisiana change. Workforce-related success factors for LIA will be: 1) staying connected to education and policy leaders, 2) maintaining clarity about workforce activities that are mission-critical, and 3) augmenting impact through collaborative partnerships and projects.