Intellectual Property and Technology Commercialization in North Dakota

A Study for the North Dakota Department of Commerce and the State Board of Higher Education

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Contents

Sidebars

Tables

Figures

1. Executive Summary

In its last session, the North Dakota legislature directed the state's Department of Commerce and the State Board of Higher Education (SBHE) to conduct a study of incentives the state could adopt to "serve as catalysts for stimulating more efficient commercialization of new technologies." The legislature also requested a study of the state's intellectual property (IP) laws as they relate to the protection of IP rights. Since these studies are similar in nature, the parties decided to have them conducted by the same vendor. RTI International was chosen through a competitive process to conduct the studies.

RTI undertook these studies together in a process designed to identify opportunities to improve the IP and technology commercialization environment in North Dakota to stimulate economic growth. Although the legislature requested two separate reports, one on technology commercialization and one on intellectual property, we believe that these topics are inextricably linked. Therefore, the majority of the two reports are identical, with only the executive summaries and recommendations sections tailored for each.

Current economic theory holds that economic growth and development are functions of the growth of labor, capital, and knowledge. This is an extension of traditional theory that saw growth based on increasing stocks of labor and capital. Now it is recognized that knowledge is also an important driver.

To increase the stock of knowledge in a region, some source(s) of new knowledge and/or innovation are necessary. Common experience in the United States shows that increases in knowledge are fundamentally linked to the work being done at universities and other research institutions. However, the most important element of the economic development system is spillover: moving knowledge from the research asset into the local and regional economy.

While increased research capacity does indeed support economic growth, spillover is not automatic. Technology commercialization is the means by which knowledge becomes a product or a process that can generate economic development through new companies and/or new jobs. Entrepreneurship, that is, the taking of risk by individuals to create new ventures in pursuit of profits, also has been identified as one mechanism that facilitates an important catalyst for the spillover of knowledge. Entrepreneurship brings with it another critical quality benefit for a region or state: Start-up companies that are seeking to exploit innovation typically stay in the region where the innovation came from, and therefore cause localized spillovers.

States can get involved in stimulating technology commercialization and encouraging entrepreneurship a number of ways:

- increasing the **research capacity** (including infrastructure such as buildings and specialized equipment, faculty, and research funding) of their educational institutions and encouraging industry in their state to conduct research and development (R&D)
- working with the **technology transfer** offices at the universities to encourage licensing collaboration with local companies and by encouraging university research with corporate partners that offers beneficial opportunities to both parties, and providing a legal environment that protects the **intellectual property** of the state's firms
- encouraging and supporting **entrepreneurship**, including technical assistance to companies and entrepreneurs
- improving **access to capital** for local entrepreneurs and businesses

Overall, states **organize their science and technology-based economic development activities** in a number of different ways, and often use **cluster-based economic development** as a strategic mechanism to focus their efforts. Our report is organized around these possible roles.

1.1 Research Capacity

On the whole, North Dakota appears to have made investments and concerted efforts in recent years to expand the research enterprise, primarily within the university system in the state. The two major research campuses, North Dakota State University (NDSU) and University of North Dakota (UND), have seen considerable growth in their research awards and expenditures, essentially doubling in the period FY2000–FY2004. NDSU has experienced a near-tripling of research awards from federal sponsors. UND has also experienced a steady growth in federal awards, but not as extreme as NDSU.

The state of North Dakota has also played a prominent role in growing the research activity through direct sponsorship, including the Centers of Excellence (COE) program. At NDSU, state and local funding of research projects has grown from $1.7 million in FY2000 to $6.3 million in FY2004. UND state and local awards have tripled in the same time frame, reaching $3.8 million in FY2004.

However, the two universities have experienced movement in opposite directions in the area of industry-sponsored research. At NDSU in FY2000, industry-sponsored awards totaled $1.69 million, or 5.8% of the total awards. By FY2004, industry-sponsored awards had declined to only $0.93 million, or 1.23%. UND, on the other hand, has experienced steady growth in industry-sponsored research, expanding from $2.5 million (6% of total) in FY2000 to $6.0 million (8.7% of total) in FY2004.

North Dakota is making progress toward achieving the balance between university and industry R&D mentioned above through a variety of initiatives, including the Red River Valley Research Corridor effort, investment in faculty recruitment and infrastructure with the National Science Foundation (NSF) Experimental Program to Stimulate Competitive Research[1] (EPSCoR) funds, and the North Dakota Centers of Excellence initiative.

North Dakota has also used its EPSCoR funding to make strategic investments in recruiting key faculty and the necessary laboratory and computational equipment to help propel their research efforts.

1.1.1 Recommendations for Increased Research Capacity

Efforts to recruit more senior faculty, like those conducted by the Georgia Research Alliance (GRA) (see sidebar in Section 4.3.3), should be considered for strategic investments in key technical areas.

Expanding industry-sponsored research in North Dakota universities should become part of a multi-pronged effort to continue increasing the state's research capacity and capitalizing upon outcomes from the research enterprise. The goal should be to increase the competitiveness of the research universities so they can move away from earmarks and EPSCoR dependencies and win more competitive grants and contracts. These objectives, coupled with continuing to grow the research enterprise, will enhance the odds of spillover into North Dakota companies and the North Dakota economy.

North Dakota could benefit from amending their R&D tax credit for private companies. To ensure that this credit encourages increased R&D in the state to boost the economy, the credit should only be allowable on new or increased R&D expenditures. Additionally, to allow small companies and start-ups to receive equal benefit, the credit rate should be higher on the first increment of increased expenditure. Finally, if the state wishes to encourage specific types of R&D expenditures, the credit could be higher for specific fields, such as biotechnology. The state could also structure the credit to be higher for companies operating in distressed areas.

[1] The Experimental Program to Stimulate Competitive Research (EPSCoR) promotes the development of the states' science and technology (S&T) resources through partnerships involving a state's universities, industry, and government, and the federal research and development (R&D) enterprise. EPSCoR operates on the principle that aiding researchers and institutions in securing federal R&D funding will develop a state's research infrastructure and advance economic growth. EPSCoR's goal is to maximize the potential inherent in a state's S&T resources and use those resources as a foundation for economic growth. North Dakota is one of 25 states, Puerto Rico, and the U.S. Virgin Islands eligible for EPSCoR funds. The other states are Alabama, Delaware, Maine, Kansas, Nebraska, New Mexico, South Dakota, Vermont, Alaska, Hawaii, Kentucky, Mississippi, Nevada, Rhode Island, Tennessee, West Virginia, Arkansas, Idaho, Louisiana, Montana, New Hampshire, South Carolina, Oklahoma, and Wyoming.

1.2 Intellectual Property and Technology Transfer

Intellectual property laws are difficult to alter in any fundamental way except through changes in federal law. Any attempt by a state to modify or abrogate federal law covering patents and copyrights will be unsuccessful. There are state laws, however, that have a tangential relationship to the role that intellectual property plays in technology commercialization. These have to do with securing the process by which federally-protected intellectual property is commercialized to maximize value to the university and state economy. Many states recognize the importance of helping new technology companies located within state borders to protect their intellectual assets. States providing a secure and encouraging environment in which competitive companies can grow are more likely to be attractive to small and medium-sized companies because risk of losing valuable assets to larger competitors has been eliminated.

While states are limited as to how they can affect intellectual property law, other than tangentially, a state can make a difference in how intellectual property is used to promote effective transfer from its universities to the private sector. In North Dakota, the state has accomplished this to a large degree through the delegation of authority to the SBHE. The wisdom in taking this approach is evident. The sophistication of the intellectual property policies and practices adopted by the SBHE, and the delegation of implementation to the universities, place the North Dakota universities in the mainstream of major research universities in the United States.

Ample data show that adopting policies that encourage and motivate faculty to become engaged in the technology transfer process is indispensable to switching on the transfer pipeline. The second important building block for successful knowledge transfer from the research asset to the private sector is an effective management process. The SBHE has chosen the route preferred by all major U.S. universities in placing responsibility for management within an administrative unit located in the universities themselves. Co-locating where innovation is occurring, that is, in the laboratory, and establishing personal relationships with faculty and students have been shown repeatedly to be the most efficient construct for successful spillover.

While the SBHE has done a creditable job in adopting intellectual property and technology transfer policies and in delegating significant authority to the universities, RTI did find areas with room for improvement, if North Dakota is to catch up to some of its peers. Particularly needed is a review of policies that lead to a lack of flexibility in responding to the needs of commercialization partners. There are also areas where it would be helpful for the SBHE to provide a greater degree of leadership in laying out principles to give direction and minimize confusion on the part of commercialization partners seeking to do business with the universities. Finally, some of the SBHE polices, especially those related to copyrights, should be reviewed for consistency with applicable federal law.

1.2.1 Recommendations for Intellectual Property and Technology Transfer

RTI noted several weak spots in North Dakota law that place the state at a disadvantage in terms of providing a protective environment for new technology companies. These are listed below.

- Open-records law
  - that exposes certain private, nonpublic, competition-sensitive information to public disclosure
  - that exposes trade secrets, otherwise protected under state law, to release under open-records
- Law that makes certain activities of nonprofit organizations subject to open-records requests. This impacts the ability of organizations representing North Dakota universities to enter into business transactions with companies in competitive industries.
- Law that makes void a contract seeking to limit competition by an employee upon termination of employment.

Efforts should be undertaken to modify these existing laws to bring North Dakota into alignment with peer states by achieving the following:

- providing greater protection for competition-sensitive transactional information for which there is no public need to know
- amending its trade secret and open-records laws to eliminate the preemption of open records under reasonable circumstances
- instituting state programs wherein IP of new companies will be guaranteed protection from release under other laws
- reconsidering greater protection for employers against departing or terminating employees seeking to use company-confidential information for competitive purposes

The SBHE should review its policies, with the following objectives:

- Provide greater flexibility in its policies relating to patent ownership. This is especially true where inventions are made by students.
- Ensure that its policies covering ownership and disposition of student copyrights are consistent with its treatment of faculty copyrights.
- Provide its universities with enough control of the technology commercialization process to permit good business decisions to be made.

- Adopt a number of best practices as identified by RTI.
- Conform certain definitions such as "work for hire" with federal law.
- Introduce new policies or principles to provide clearer guidelines in areas such as conflict of interest.

1.3 Entrepreneurship

Between 2003 and 2004, North Dakota had a modest gain in new businesses (1.89%), with a large percentage of this gain in small businesses. The healthiest small business growth was seen in these industries: educational services (7.14%), mining (4.90%), and real estate (4.53%).

Small businesses are vital to North Dakota's economy, but small high-technology businesses play a very small role. Of an estimated 59,158 small businesses in North Dakota in 2004, the number of high-technology establishments is estimated to be only 1,000, representing 4.12% of North Dakota's total establishments. These 1,000 high-tech establishments employ 14,072 people, an average of 14 people per establishment. The high-technology community therefore, as it now stands, is basically an entrepreneurial community, which will have to grow to reach a point where its numbers are substantial enough to more than marginally affect the North Dakota economy.

North Dakota has quite a few entrepreneurial support organizations, covering a broad geography. The Small Business Development Center network, for instance, has 12 locations. Other important elements of the network include the Institute for Business and Industry Development (IBID) run by NDSU, the Manufacturing Extension Partnership, the Women's Business Center, and the Entrepreneurial Center of North Dakota. The Center for Innovation at the University of North Dakota is both an incubator and a source of technical assistance for entrepreneurs, and the incubator at the NDSU Technology Park is currently under construction.

RTI's assessment of these organizations, however, reveals limited expertise for the support of high-growth or technology-based entrepreneurial companies, with the exception of the university-based programs. We believe that the existing small business support networks, while providing an important service for North Dakota's small businesses, lack the experience necessary to support the emerging high-tech entrepreneurs. The university programs, while competent to support high-technology entrepreneurs, are constrained by resources and can only serve a very small number of clients.

Current thinking is that an entrepreneurial community, defined as an integrated system of entrepreneurs, support organizations, money, customers, and service organizations, surrounded by supporting public policy, is essential to growing and maintaining a significant number of high-growth entrepreneurial companies in a region. Entrepreneurial regions grow in a well-documented pattern, jump-started by the presence of a university or a successful entrepreneurial company and nurtured through a supportive climate and culture.

Our observations are that North Dakota has some challenges in this regard because of the culture of risk aversion and discomfort with displays of wealth. Both could discourage potential entrepreneurs from thinking about starting companies. On the other hand, the strong business support for investment in the New Economy evidenced from our discussions with business leaders and with the North Dakota Chamber of Commerce suggests that perhaps some elements of the "old" culture may be eroding.

1.3.1 Recommendation for Entrepreneurship

North Dakota should invest in a high-quality program to support an entrepreneurial climate, train high-growth entrepreneurs, and enable mentorship connections within the community. This program should be part of a network that includes the existing and planned entrepreneurial support organizations and should support those organizations in achieving their goals.

1.4 Access to Capital

Financing high-growth technology companies is a substantially different challenge than funding other small businesses or, for that matter, existing companies. There is a well-documented gap in funding that is available for high-growth technology companies for proof-of-concept and early-stage technology development. Our focus was on state programs that seek to address this gap: Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) programs, seed-stage, or gap financing and investment tax credits.

1.4.1 Small Business Innovation Research/Small Business Technology Transfer

The federal government has two set-aside programs for small business to engage in federal R&D with the potential for commercialization. Both the Small Business Innovation Research and Small Business Technology Transfer programs tap into a congressionally mandated amount (0.30% in FY2004) of the federal extramural R&D budgets. Ten agencies[2] have SBIR and STTR programs.

North Dakota has done an adequate job in supporting the SBIR/STTR program. North Dakotans have won about the same number of SBIR/STTR awards, per gross state product, as the other EPSCoR states. The Center for Innovation is widely known in North

[2] DOD, HHS, NASA, DOE, NSF, USDA, DOC, EPA, DOT, and ED.

Dakota for the assistance that it provides for SBIR/STTR applicants and has received support from the Small Business Administration Federal and State Technology Partnership (SBA FAST) program.

However, states continue to invest to support SBIR/STTR applicants in their states. Several of the states whose growth rates are remarkable have the most comprehensive SBIR/STTR support programs. North Dakota could do more to enable their companies to access these important funds.

1.4.2 Seed-stage Grants, Angel Networks, and Venture Capital

North Dakota receives very little venture capital funding, like many other rural states. Venture capital investment in the United States is highly concentrated in California, Massachusetts, and a handful of other states. For instance, in the first quarter of 2006, Silicon Valley (CA) received 36.56% of all venture capital investments, followed by New England with 15.5% and Los Angeles with 6.41%. Note also that total U.S. investments in seed-stage companies represented only 3.32% of the total deals.

North Dakota has averaged less than one venture-backed seed-stage deal per year over the last 10 years, about the same as the average of the EPSCoR states. This suggests that North Dakota should use state funds to invest in pre-seed or seed-stage deals to improve the likelihood that these companies will grow and, perhaps, eventually attract venture capital investments.

1.4.3 Seed Capital Investment Tax Credits

One incentive that many states, including North Dakota, use to encourage angels and angel investors to invest in local companies is a seed capital investment tax credit. At least nine states currently have these credits, which generally range from 15–50% of the amount invested and can be taken against the investor’s state income tax.

1.4.4 Debt

North Dakota has a wide array of debt and debt-like programs available for mature companies and strategic industries. These are managed through the Department of Commerce and the Bank of North Dakota.

These types of debt programs are common among the states and represent the mainstream of business financing, especially as organized to facilitate the attraction of businesses to the state. However, these programs are not aimed at the seed-stage or pre-revenue technology-based ventures, which have the opportunity to drive North Dakota’s future economy. The existence of these excellent programs does not, in our view, support technology commercialization, although they have an important role in North Dakota's existing economy.

1.4.5 Recommendations for Access to Capital

North Dakota should institute at least one or potentially a series of grant or investment programs targeting young, potentially high-growth technology companies in the state to bridge the gap between university research funding and private capital. This should include modifying the criteria for New Venture Capital Fund at the Bank of North Dakota to enable investments in early-stage companies.

North Dakota should increase the resources dedicated to supporting SBIR/STTR applicants and winners to provide more technical assistance, outreach, and grants for proposal preparation.

1.5 Cluster-based Economic Development

We conclude that North Dakota's current strengths in high-technology industry include agricultural machinery (which could be classified as advanced manufacturing), computer systems design, semiconductor and related manufacturing, and software (which could all be combined into information technology). We note, in addition, that several areas of technology strength in the R&D sector, such as agricultural biotechnology, chemicals, energy and environment, and materials, such as nanotechnology, could be the basis for supporting emerging clusters.

The North Dakota Department of Commerce has set as its "Targeted Industries" advanced manufacturing, energy, technology (including life sciences, polymers and coatings, and bio-terrorism), value-added agriculture, and tourism. These targets are based upon the recommendations of a strategic planning study done in 2002. This study employed standard location quotient and shift-share analyses of highly integrated groups of industries defined by strong vertical and horizontal linkages through supply chains.

In contrast, many states are focusing on a cluster-based strategy for economic development that looks at a state's industries in a broader context. An industry cluster is defined as a group of firms and related economic actors and institutions that are located near one another and draw competitive advantage from that proximity and its attendant connections.[3]

The difference between clusters and targeted industries is subtle but important. Cluster strategies focus on the interactions among members of a cluster, including the sources of

[3] Cortright, Joseph. 2006. "Making Sense of Clusters: Regional Competitiveness and Economic Development. Washington, DC: The Brookings Institution. www.brookings.edu

innovation that drive technology-based clusters. Therefore, a cluster strategy depends upon the identification of not only the firms in a cluster, but the key innovation assets and other institutions that support it. Cluster strategies go beyond economic development subsidies and recruitment, and instead focus on improving the competitiveness of the group of firms and institutions.

1.5.1 Recommendations for Cluster-based Economic Development

North Dakota should inventory its innovation assets, that is, its research capacity, both within its universities and its industry; compare these assets with the current industry clusters in the state; and consider the market and technology trends in these areas.

This analysis should be the basis for the refinement of technology clusters, both existing and emerging, that can be the subject of the alignment of all other programs—COE, incubation, grants, etc. RTI recommends that the Department of Commerce accomplish the following:

- Organize and deliver government-supported services to clusters.
- Target investments to clusters.
- Strengthen networking and associative behavior within each cluster and across the clusters.

1.6 Organizing to Support Science and Technology-based Economic Development

To provide an appropriate focus on science and technology, most states have now established an organization that provides policy guidance and/or direct technical assistance to technology companies. All of the states except Montana, South Dakota, and North Dakota have some entity designated by their legislature to focus on building a science and technology-based economy.

The large majority of the states chose to define this science and technology organization as a state entity, almost all within the department of commerce or economic development or some equivalent. In eight cases, the states created private, nonprofit organizations, and in two cases, private/public partnerships were chosen.

The organizations have a wide range of responsibilities and budgets. A few are primarily policy organizations with missions related to advising the governor and the commerce department on issues relating to science and technology. These organizations provide research and evaluation of existing programs as part of the advising role. The largest organizations, on the other hand, have both policy and programmatic roles. These programmatic roles include support for COE programs, EPSCoR oversight, entrepreneurship, access to capital, and industry cluster activities.

1.6.1 Recommendation for State Support Organization

The North Dakota legislature should establish a dedicated Office of Science and Technology in the Department of Commerce to advise the Governor on science and technology-related policy and to manage programs such as the Centers of Excellence and other initiatives that may be promulgated. The Office should be responsible for tracking the success of science and technology initiatives through an annual benchmarking process and through ongoing evaluations of any public investments in R&D.

2. Introduction

In its last session, the North Dakota legislature directed the state's Department of Commerce and the SBHE to conduct a study of incentives the state could adopt to "serve as catalysts for stimulating more efficient commercialization of new technologies." The legislature also requested a study of North Dakota's IP laws as they relate to the protection of IP rights. Since these studies are similar in nature, the parties decided to have them conducted by the same vendor. RTI International was chosen through a competitive process to conduct the studies.

RTI undertook these studies together in a process designed to identify opportunities to improve the IP and technology commercialization environment in North Dakota—to stimulate economic growth.

1. RTI first conducted a situational analysis, which encompassed the following:
   - focus groups and informational meetings with a broad variety of key stakeholders from academia, industry, state and local government, and the financial community (a complete list is included in **Appendix A**)
   - a review of current relevant legislation
   - a comparison of North Dakota with comparable states and peer educational institutions on key indicators
   - a technical and industry snapshot
2. We then compared North Dakota practice with both theory and best practice gleaned from a review of policies and programs in place in other states and at other institutions.
3. Finally, we made recommendations for North Dakota that include, where relevant, legislative language. We have considered the word "incentives" in the enabling legislation in its broadest definition to mean something that induces or motivates action.

RTI's report is organized as follows:

- **Section 3** contains the theory of technology-based economic development and describes the roles that states can play in stimulating the commercialization of technology.

- **Sections 4 through 8** identify each of the general roles that states can play, describing existing North Dakota laws, policies, and programs and analyzing them in a context of both best practice and outcomes.
  - Section 4 – Research Capacity
  - Section 5 – Intellectual Property and Technology Transfer
  - Section 6 – Entrepreneurship
  - Section 7 – Access to Capital
  - Section 8 – Cluster-based Economic Development
  - Section 9 – Organizing for Science and Technology
- **Section 10** contains RTI's recommendations.

Although the legislature requested two reports, one on technology commercialization and one on intellectual property, RTI believes that these topics are inextricably linked. Therefore, the majority of these two reports are identical, with only the executive summaries and recommendations sections tailored for each.

3. The Role of Technology in an Economy

Current economic theory (endogenous growth theory)[4] holds that economic growth and development are functions of the growth of labor, capital, and knowledge. This is an extension of traditional theory that saw growth based on increasing stocks of labor and capital. Now it is recognized that knowledge is also an important driver.

Further research has found that increases in knowledge are fundamentally linked to the work being done at universities and other research institutions.[5] This means that to increase the stock of knowledge in a region, some source(s) of new knowledge and/or innovation are necessary. This is often in the form of a research university, but can also be a federal laboratory, a nonprofit research institution, or a company's R&D facility. The strongest economies have more than one of these, and have a robust R&D community with federal, state, and private funds supporting these institutions.

Communities without the strongest of these assets are currently investing in the assets, with the objective of increasing the research capacity of their region. In the United States, this is often funded by the NSF's EPSCoR.[6] EPSCoR is a set-aside program where funding for basic research and other capacity-building programs are funneled to states with lower federal research funds.

3.1 Spillover

The key element of the system is spillover: moving knowledge from the research asset into the local and regional economy. There are multiple avenues for spillover, some formal and some informal.[7] Formal spillover occurs when knowledge generated at a research asset (intellectual property) is formalized and protected through patents, copyrights, etc., and then licensed to an outside entity. This can be a company that is already in business, or a start-up. This mechanism is usually referred to as technology transfer and codified in offices of technology transfer at most research institutions.

Formal spillover also occurs when companies sponsor (pay for) research at research institutions, and often representatives from the company and the institution work together in the laboratory. This is most effective in assisting with the spillover of tacit knowledge, knowledge that is difficult to write down, such as "know-how." Informal spillover occurs

[4] Romer, P. 1986. "Increasing Returns and Economic Growth." *American Economic Review*. 94: 102-1037. Romer, P. 1990. "Endogenous Technical Change." *Journal of Political Economy*. 98: 71-102. Aghion, P. and Howitt, P. 1998. Endogenous Growth Theory. Cambridge, MA: MIT Press.

[5] Jaffe, A.B. 1989. "Real Effects of Academic Research." *The American Economic Review*. 79 (5): 957-970.

[6] http://www.nsf.gov/div/index.jsp?div=EPSCoR

[7] Goldstein, H.A. and M.I. Luger. 1997. "Assisting Economic and Business Development." In M.W. Peterson, D. Dill and L. Mets (eds.). *Planning and Management for a Changing Environment*. San Francisco: Jossey-Bass Publishers.

when students move from the laboratory and take jobs at local companies, when seminars and presentations are made in the local community, and during networking and other interpersonal encounters.

Recent research[8] has found that while increased research capacity does indeed support economic growth, spillover is not automatic. Entrepreneurship, that is, the taking of risk by individuals or new ventures in pursuit of profits, has been identified as one mechanism that facilitates the spillover of knowledge. In fact, the researchers found that while research capacity was important for economic growth, entrepreneurship was required.

Entrepreneurship has another important quality, which is that start-up companies based on intellectual property typically stay in the region where the research asset is, and therefore cause localized spillovers.[9]

3.2 The Role of the State in Promoting Technology-based[10] Economic Development

Technology commercialization is the process by which knowledge becomes a product or a process that can generate economic development through new companies and/or new jobs. The process is illustrated in **Figure 3.1**.

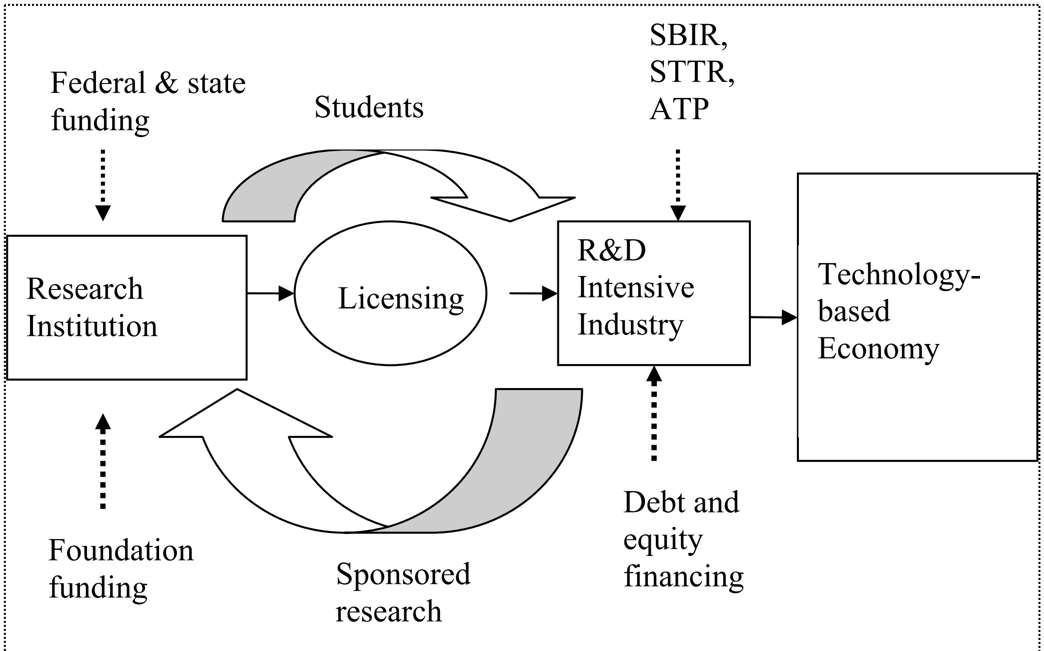
States can get involved at the very beginning of this process by increasing the ***research capacity*** of their educational institutions and by encouraging industry in their state to conduct R&D. States can help with the spillover process by working with the ***technology transfer*** offices at the universities to encourage licensing to local companies and by encouraging joint industry-university research. Promoting and supporting ***entrepreneurship*** is also critical because so much innovation occurs in new companies. This can include technical assistance to companies and entrepreneurs as well as programs to improve ***access to capital***. Overall, states organize their science and technology-based economic development activities in a number of different ways and often use ***cluster-based economic development*** as a strategic mechanism to focus their efforts. Each of these elements is discussed in more detail in the following subsections.

[8] Acs, Z., Audretsch, D., Braunerhjelm, P. and B. Carlsson. 2005. “Growth and Entrepreneurship: An Empirical Assessment.” Center for Economic Policy Research Working Paper No 5409. www.cepr.org.

[9] Jaffe, A. B. and M. Trajtenberg. 1996. "Flows of Knowledge from Universities and Federal Laboratories: Modeling the Flow of Patent Citations over Time and across Institutional and Geographic Boundaries." Proceedings of the National Academy of Science, USA. 93 12671-12677. Jaffe, A. B., M. Trajtenberg and R. Henderson. 1993. "Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations." *Quarterly Journal of Economics.* 108 (3): 577-598.

[10] Here “technology-based” is used as a general term to mean economic growth and development derived from the application of science and technology.

Figure 3.1. Model for technology-based economic development



Source: RTI International

3.2.1 Increasing research capacity

States often get involved in increasing research capacity.[11] While the federal government is usually thought to be the appropriate place for funding of basic research, because basic research is a public good, state research funding is usually focused on applied research. The rationale is that applied research is closer to the market and helps local research assets move knowledge to the local and regional economy. States increase research capacity in a number of ways. The most common is a mechanism called centers of excellence. These are programs that support highly targeted investments in applied research, often with industry partners, that focus on technology strengths of importance to the state's economy.

Other avenues that states use to bolster research capacity include providing matching funds for major research initiatives, such as EPSCoR or other federal projects. A third mechanism is to provide funding to recruit and retain "star" scientists. Programs such as the Georgia Research Alliance[12] (see Section 4.3.3) help state universities recruit world-class scientists and provide them with the appropriate support in terms of laboratory space, research funding, and assistants to jump-start an institution's capabilities in a particular field.

[11] http://www.nga.org/Files/pdf/AM02SCIENCETECH.pdf
[12] http://www.gra.org/eminentscholars.asp

Finally, states encourage their industry to undertake R&D to support new products and new processes through the use of state R&D tax credits that parallel the federal R&D tax credits.

3.2.2 Intellectual property and technology transfer

One important element of the technology commercialization mix—technology transfer—has largely been devolved to the university or research institution, and has not been managed at the state level. Transitioning technology out of universities most often deals with IP. "Intellectual property law seeks to balance two potentially conflicting public goals: 1) to provide an incentive to create by giving creators property rights in the products of their creativity, and 2) to provide the greatest possible public access to products of creativity, in order to create a competitive marketplace."[13]

The U.S. Constitution[14] and various acts of Congress[15] define the U.S. intellectual property regime as administered by the US Patent and Trademark Office (USPTO). The USPTO is charged with administering the laws relating to patents and trademarks. "The federal courts have had exclusive subject matter jurisdiction over all cases arising under the patent laws since 1836."[16]

Another important piece of legislation that governs at both federal and state levels is the Bayh-Dole Act.[17] The law requires any organization, including universities and nonprofit research institutions, receiving financial assistance for research from the federal government (basically, federal research grants, contracts, or cooperative agreements) to disclose, protect, and commercialize for the public benefit any patentable intellectual property that is discovered during the funded research program. This legislation has led to the creation of technology transfer organizations at almost all major research universities and is credited with changing the national environment with regard to the patenting and licensing of university inventions.

Further, universities feel confined by Internal Revenue Service Procedure 97-14 that places limits on the use of facilities and equipment financed by tax-exempt bonds.

Many states, however, feel that university technology transfer policies and procedures, although compliant with Bayh-Dole, fail to recognize the importance of local and regional economic development. In fact, many university technology transfer offices have missions that include generating revenue for the university and supporting their faculty,

[13] Barrett, Margreth. 2000. *Intellectual Property—Patents, Trademarks & Copyrights*. New York, NY: Aspen Publishers, Inc. page C-1.
[14] Article 1, Section 8, Clause 8 of the United States Constitution
[15] 15 U.S.C. 1051-1127, 15 U.S.C. 1511, 35 U.S.C. and 44 U.S.C. 1337-1338.
[16] Schwartz, Herbert F. 2001. Patent Law and Practice. Washington, DC: Bureau of National Affairs. page 44.
[17] 35 U.S.C 200-212, 45 CFR 650.

and do not explicitly recognize economic development at all. This remains a point of contention in both the economic development and university communities.

3.2.3 Technical assistance for entrepreneurs

Another area of assistance that states provide is technical assistance for entrepreneurs and small and medium enterprises (SMEs). Because information about how to grow and maintain the competitiveness of SMEs is not universally available, states (and localities) often provide this information to their companies. Offered through federal programs such as the SBA's Small Business Development Centers and Service Corps of Retired Executives (SCORE), through local, regional, or state incubators, or through research parks, this technical assistance has been found to increase the likelihood that the target companies will remain in business.[18] Since small businesses are known to be generators of the majority of new jobs in our economy,[19] this is believed to be a sound investment.

According to the Center for Rural Entrepreneurship, part of the Rural Policy Research Institute (RUPRI), a national research and policy center, "A key to economic success in the first half of the 21st Century may be entrepreneurs, [and] lean, agile, small, growth-oriented businesses."[20] To support these entrepreneurs, communities should consider five key steps:

1. Create focus and awareness.
2. Support innovation projects.
3. Facilitate service provider networks.
4. Implement categorical program flexibility.
5. Undertake documentation and evaluation.

3.2.4 Access to capital

The fourth general area of assistance that states provide is access to capital. Capital, especially equity capital, is not uniformly available across the country. In fact, it is highly concentrated in a few geographic areas. Debt capital will, without government guarantees, tend to be available to only the most established businesses. Therefore, to support the entrepreneurial and SME community, many states have a variety of capital programs. These range from loan guarantees and micro loan programs to organized angel

[18] Lalkaka, R. 1996. "Technology Business Incubators: Critical Determinants of Success." *Annals of the New York Academy of Sciences* 798: 270–90. Mian, S.A. 1996. "Assessing Value-added Contributions of University Technology Business Incubators to Tenant Firms." *Research Policy* 25: 325–335.

[19] http://www.sba.gov/advo/

[20] State Policy Brief, Energizing an Entrepreneurial Economy, No. 1, December 2003, www.rurale-ship.org.

networks to tax credits for investors. Some states have even formed their own venture capital funds.

States have played four basic roles in access to capital:

- Expand the knowledge of seed and venture capital investing.
- Promote local entrepreneurs to sources of capital and vice versa.
- Create investment capital to fill a market niche.
- Create investment capital for seed-stage investments, including the use of investment tax credits.[21]

3.2.5 Clusters

According to Michael Porter, a leading Harvard economist, "Today's economic map of the world is dominated by … clusters."[22] Clusters are groups of companies and related organizations, such as local universities and nonprofits that are dependent upon each other for their competitiveness. A healthcare cluster, for instance, might include the local hospital, doctors, laboratories and testing facilities, local medical school, medical device and pharmaceutical companies, and the public health infrastructure.

Many localities, regions, states, and even countries are involved with identifying their clusters, using a variety of analytic techniques. Many believe that since innovation is so important in building competitive technology clusters, the analysis of technology clusters should include the following:

- an inventory of local/regional/state innovation assets (researchers, universities, nonprofits, federal laboratories)
- an understanding of existing industry and their strengths and weaknesses
- an assessment of the market trajectory of key subcluster areas and technologies that can form the basis for long-term growth (most important)

Once localities/regions/states have identified their clusters, they work to improve their competitiveness, strengthen them, and develop the linkages within and among them.

3.2.6 Organizing for Science and Technology Support

For the first half of the post World War II era, science and technology policy was a federal issue. Concern for the appropriate public investment in science and engineering

[21] Heard, Robert and Siebert, John, 2000. "Growing New Businesses with Seed and Venture Capital: State Experiences and Options." National Governors Association. Available at http://www.nga.org/Files/pdf/VENCAPITAL.PDF.
[22] Porter, Michael E. 1998. "Clusters and the New Economics of Competition." *Harvard Business Review*. November-December 1998. Reprint Number 98609.

research and in the educational enterprise was vested in the NSF, an arm of the federal government. NSF invested in academic research capacity among U.S. colleges and universities, mainly in basic research. The policy justification was simply that research was a public good. Without government investment, industry and academia would under-invest in research because the results could not be appropriated and the organizations would not be able to capture returns on their investments.

States first began to believe that they too had a role in science and technology policy in the early 1980s. Three events led to this change. First, the passage of the Bayh-Dole Act of 1980 enabled universities to own the IP rights from research supported by federal monies. Bayh-Dole enabled universities to have a mechanism—patenting and licensing—to move technologies from the laboratories into the marketplace. This increased discussion about the spillover effects from universities and their potential impact on local and state economies. Second, under the Reagan administration, federal investment in R&D started to decrease, creating concerns in the states about the future funding of their state university research establishment. Third, a major competition for the location of the Microelectronics and Computer Consortium (MCC), which was won by Austin, Texas, focused many economic developers on the importance of a state's science and engineering infrastructure as a competitive advantage.

These related but distinct historical events created a window of opportunity that Ohio, Pennsylvania, New York, and Virginia, among others, reacted to quite quickly. All of these states established science and technology institutions in 1983–84. The Rust Belt states were reacting to the severe recession caused by the decline of their traditional industry; the other states were reacting to the MCC loss.

The increasing competition from Japan in the latter half of the 1980s created a movement to increase the competitiveness of American industry, particularly small and medium-sized enterprise. The competitiveness movement led to the creation of manufacturing extension programs[23] in Minnesota, Kansas, and Indiana, among others, which became aligned with existing and emerging state science and technology enterprise. These states were concerned with the slow erosion of their small business base, especially manufacturers.

The third wave of state institution building in science and technology came from the Internet revolution of the mid and late 1990s. The notion that science and technology-based companies were the backbone of a thriving economy took hold across the country. The states that had not heretofore participated in the science and technology investments began to see the importance of these incentives.

[23] Manufacturing extension programs provide technical assistance to small and medium-sized manufacturers so that they can incorporate current technologies into their firms. Most centers are funded through the National Institutes of Standards and Technology (NIST) Manufacturing Extension Partnership program. http://www.mep.nist.gov/.

The Dot-Com crash of 2001 and the resulting recession, however, also heralded an era when some states decided that science and technology programs were a luxury, not a necessity, when state budgets tightened. Several states eliminated their programs entirely in the 2002–2004 period; other established programs were severely curtailed by as much as 50% budget cuts.

Throughout the 20–plus-year history of state science and technology programs, however, the portfolio of laws, policies, and programs that support science and technology-based economic development has coalesced into a well-defined set of initiatives focused on the process of technology commercialization. These are the initiatives that are discussed in this report.

4. Research Capacity

The responsibility for creating and supporting research capacity in a state falls on many shoulders. Public research organizations, including universities and research laboratories, must create the infrastructure, including buildings containing research facilities and specialized equipment as well as qualified faculty and staff, to compete for, win, and conduct research. Private research organizations such as corporations large and small must also conduct research (or fund others to do so) to stay competitive. State and federal governments must set policy, provide appropriate support, and create funding opportunities for these organizations to compete and advance the state of the art.

4.1 Research Capacity in North Dakota Universities

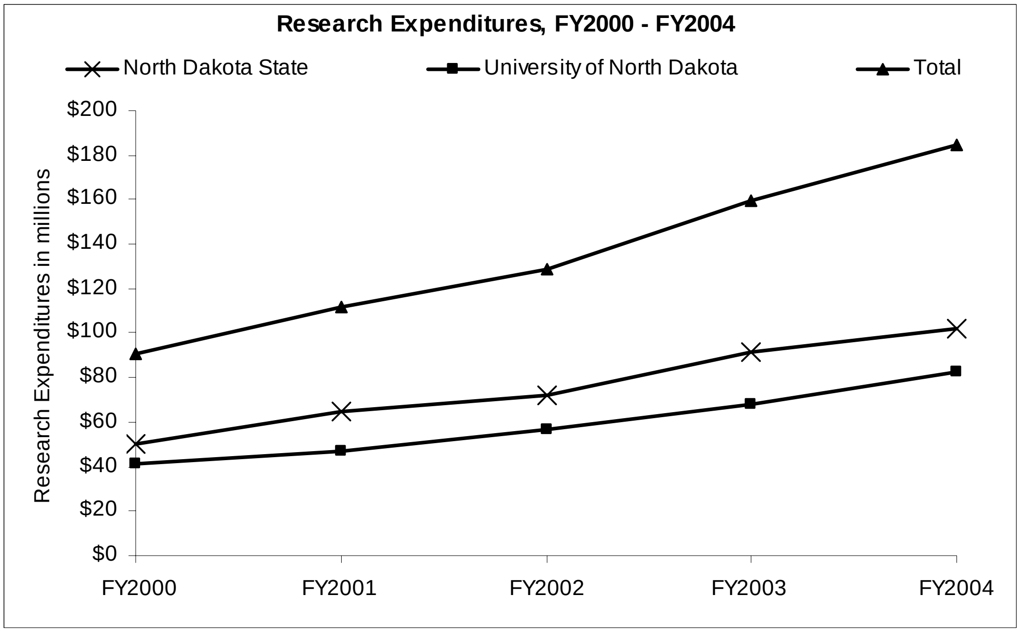
On the whole, North Dakota appears to have made investments and concerted efforts in recent years to expand the research enterprise, primarily within the university system in the state. The two major research campuses, NDSU and UND, have seen considerable growth in their research awards and expenditures, essentially doubling in the period FY2000–FY2004. **Table 4-1** and **Figure 4-1** outline the year-by-year growth at the two flagship universities.

Table 4.1. Total sponsored research expenditures (in millions)

	FY2000	FY2001	FY2002	FY2003	FY2004	% growth FY00–04
North Dakota State University	$50.1	$64.9	$72.1	$91.8	$102.1	104%
University of North Dakota	$41.0	$46.7	$56.5	$67.7	$82.6	102%
Total	$91.0	$111.6	$128.6	$159.5	$184.7	103%

Source: NDSU Data from the Association of University Technology Managers (AUTM) Annual Surveys from Fiscal Years 2000–2004, UND Data from FY2005 Annual Report

Figure 4.1. Total sponsored research expenditures (in millions)



Source: NDSU Data from the Association of University Technology Managers (AUTM) Annual Surveys from Fiscal Years 2000–2004, UND Data from FY2005 Annual Report

The majority of the research funding in North Dakota, as in other states, comes from federal government funding agencies. As **Table 4-2** indicates, NDSU has experienced a near-tripling of research awards from federal sponsors. UND has likewise experienced a steady growth in federal awards.

The state of North Dakota has also played a prominent role in growing the research activity through direct sponsorship. At NDSU, state and local funding of research projects has grown from $1.7 million in FY2000 to $6.3 million in FY2004. UND state and local awards have tripled in the same timeframe, to reach $3.8 million in FY2004.

However, industry-sponsored research has been moving in opposite directions at the two universities. At NDSU, industry sponsored awards totaled $1.69 million, or 5.8% of the total awards. By FY2004, industry sponsored awards had declined to only $0.93 million, or 1.23%. UND however has experienced steady growth in industry-sponsored research, expanding from $2.5 million (6% of total) in FY2000 to $6.0 million (8.7% of total) in FY2004.

Table 4.2. Summary of external awards by source (in millions)

	FY2000	FY2001	FY2002	FY2003	FY2004	Percent growth FY00–04
North Dakota State University						
Federal	$21.97	$28.81	$31.97	$44.72	$63.53	189%
Nonfederal	$6.91	$9.88	$9.98	$6.75	$11.80	71%
State & Local	$1.73	$2.66	$4.57	$1.80	$6.27	262%
Foundation / Nonprofit	$0.63	$0.68	$0.63	$1.05	$1.87	197%
Business / Industry	$1.69	$2.71	$1.31	$0.86	$0.93	-45%
Commodity	$1.77	$1.69	$1.93	$1.78	$1.68	-5%
Other	$1.08	$2.13	$1.56	$1.27	$1.05	-3%
Total	$28.88	$38.69	$41.95	$51.47	$75.33	161%
University of North Dakota						
Federal	$35.80	$38.14	$44.10	$52.22	$56.90	59%
Nonfederal						
State & Local	$1.25	$0.43	$3.16	$1.31	$3.76	201%
Foundation / Nonprofit	$1.24	$1.31	$0.30	$0.91	$1.98	60%
Business / Industry	$2.52	$4.45	$6.10	$5.63	$6.08	141%
Commodity						
Other	$0.90	$0.89	$0.72	$1.10	$0.99	10%
Total	$41.71	$45.22	$54.38	$61.17	$69.71	67%

Source: NDSU FY2004 Annual Report and UND Office of Sponsored Research

While NDSU's decline in industry-sponsored research is not unlike national trends over the same period of time, increasing industry-sponsored research in North Dakota universities should become part of a multi-pronged effort to continue increasing the capacity and outcomes from the research enterprise, accompanied by increasing competitiveness by moving away from earmarks and EPSCoR dependencies and into more of the competitive grants and contracts arena. These objectives, coupled with continuing to grow the research enterprise, will increase the odds of spillover into North Dakota companies and the North Dakota economy.

When compared to peer schools in neighboring states (peer states and schools include Iowa [University of Iowa, Iowa State University], Kansas [University of Kansas, Kansas State University], Minnesota [University of Minnesota], and Oklahoma [University of Oklahoma, Oklahoma State University]), North Dakota's competitive position is obvious.

Efforts to increase the research expenditures in North Dakota are becoming increasingly needed. **Table 4.3** and **Figure 4.2** indicate that NDSU and UND were significantly lower than the peer universities in research funding in FY2000, with the exception of Kansas

State University. The peer universities had a median of $193 million in research expenditures in FY2000, compared to UND's $41 million and NDSU's $50 million.

By FY2004 the picture looks more promising. Thanks in part to drops in expenditures at a few peer schools, the median among the peers fell to $119 million in FY2004, compared to $82 million at UND and $102 million at NDSU. While UND and NDSU are making great strides, many of their peer schools in neighboring states, such as the Iowa schools and the University of Minnesota, have already ramped up their research efforts and are continuing to grow them into the few hundreds of millions of dollars each year. North Dakota must continue to find ways to increase the research capabilities in order to grow its competitiveness in the world of university research.

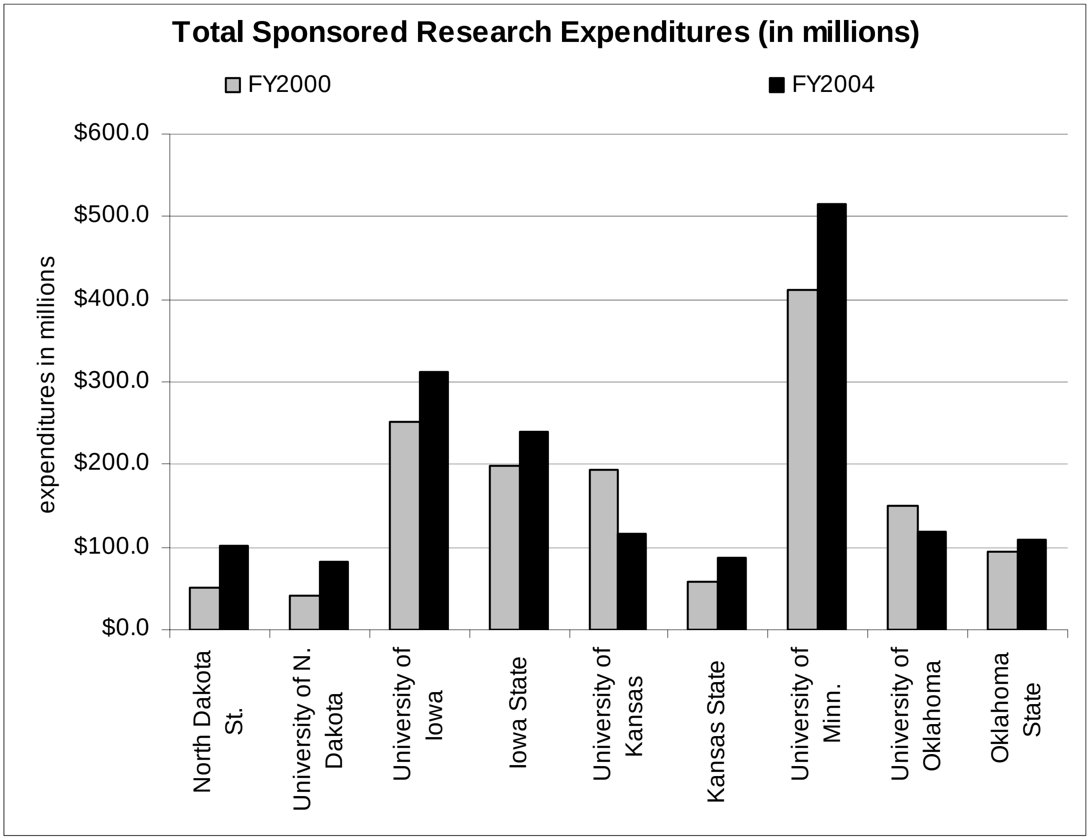
For more insight into how NDSU and UND compare to peer universities in other states on measures of intellectual property, see Section 5.3.

Table 4.3. Total sponsored research expenditures for North Dakota and peer universities (in millions)

	FY2000	FY2004
North Dakota State University	$50.1	$102.1
University of North Dakota	$41.0	$82.6
University of Iowa	$250.8	$312.9
Iowa State University	$198.9	$239.2
University of Kansas	$193.2	$115.2
Kansas State University	$59.0	$86.9
University of Minnesota	$411.3	$515.1
University of Oklahoma	$150.9	$119.0
Oklahoma State University	$95.1	$108.8
Total	$1,450.2	$1,681.9

Source: NDSU Data from the Association of University Technology Managers (AUTM) Annual Surveys from Fiscal Years 2000–2004, UND Data from FY2005 Annual Report

Figure 4.2. Total sponsored research expenditures for North Dakota and peer universities

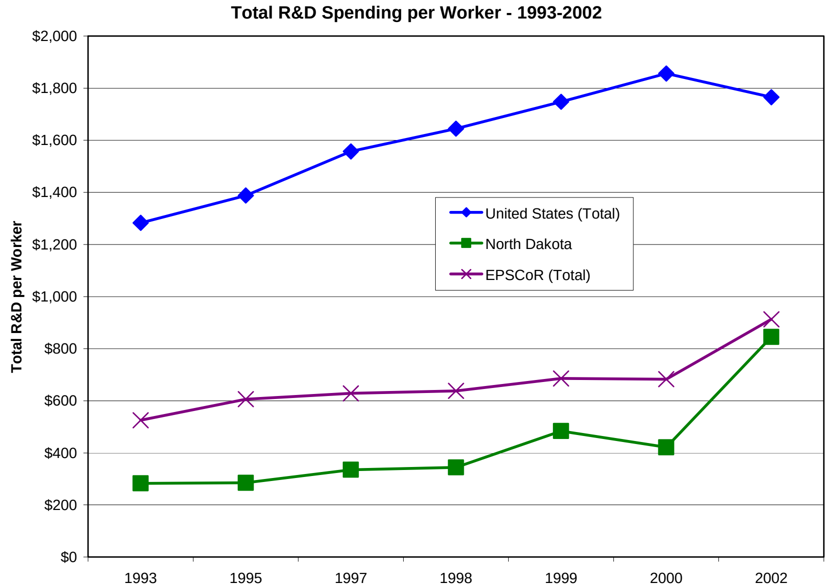


Source: NDSU Data from the Association of University Technology Managers (AUTM) Annual Surveys from Fiscal Years 2000–2004, UND Data from FY2005 Annual Report

4.2 North Dakota Research & Development Competitiveness

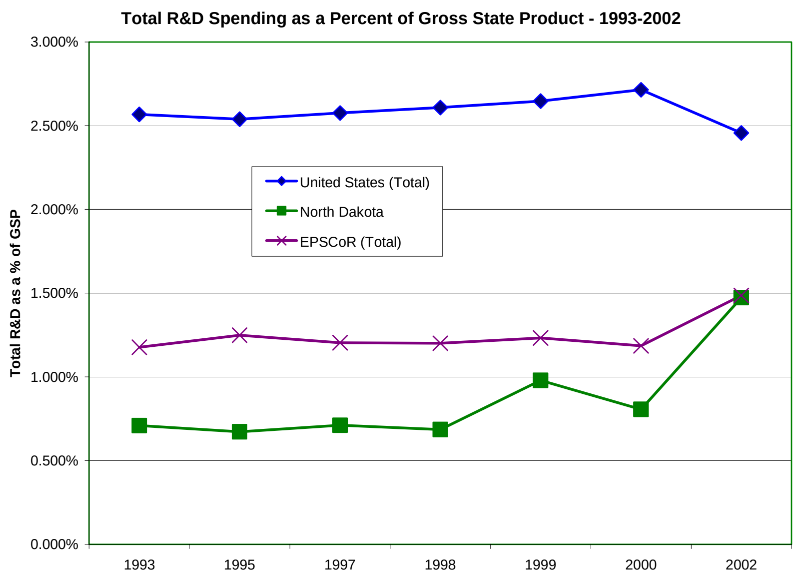
How does North Dakota compare to other states in terms of R&D competitiveness? The following charts paint a clear picture. **Figure 4.3** shows total R&D spending per worker from 1993–2002. **Figure 4.4** shows total R&D spending as a percentage of gross state product over the same period. North Dakota has historically been at the bottom of the scale in both measures—well below U.S. averages and even noticeably lower that other EPSCoR states. The recent upturn in R&D activity in the state, however, is moving North Dakota into comparable position with other EPSCoR states.

Figure 4.3. Total R&D spending per worker from 1993–2002



Source: Based on EPSCoR data tracking by Policy One Research, Inc., using data published by the National Science Foundation/Division of Science Resources Statistics and the U.S. Department of Labor, Bureau of Labor Statistics

Figure 4.4. Total R&D spending as a percentage of gross state product 1993–2002

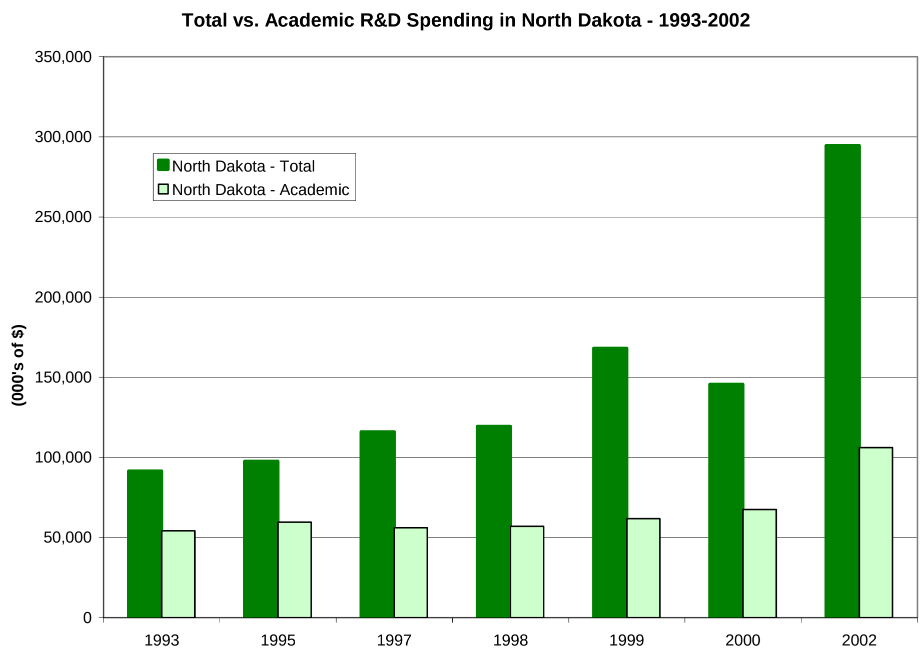


Source: Based on EPSCoR data tracking by Policy One Research, Inc., using data published by the National Science Foundation/Division of Science Resources Statistics and the U.S. Department of Commerce, Bureau of Economic Analysis

Recent investments by EPSCoR states into science and technology initiatives may provide one explanation for the contrast between EPSCoR and U.S. averages for the period 2000–2002, where EPSCoR states were trending higher at a time when overall R&D in the United States was trending downward. As R&D activities begin accelerating again, North Dakota will not be able to rest on its laurels if it wants to stay competitive, even within the EPSCoR population.

The driver of change in the normalized charts (Figures 4.3 and 4.4) is evident in the pure data shown in **Figure 4.5**. Total R&D spending over the period 1993 to 2002 jumped from $91 million to $295 million, an increase of 222%. The majority of growth took place from 1998–2002, and is attributed in part to the growth of university R&D. However, non-university R&D in North Dakota, led mostly by industry R&D, has experienced similar substantial growth. Non-university R&D represented only $37 million in 1993. By 1999 that amount grew to $107 million. In 2002, non-university R&D accounted for approximately two-thirds of the total ($188 million of $295 million).

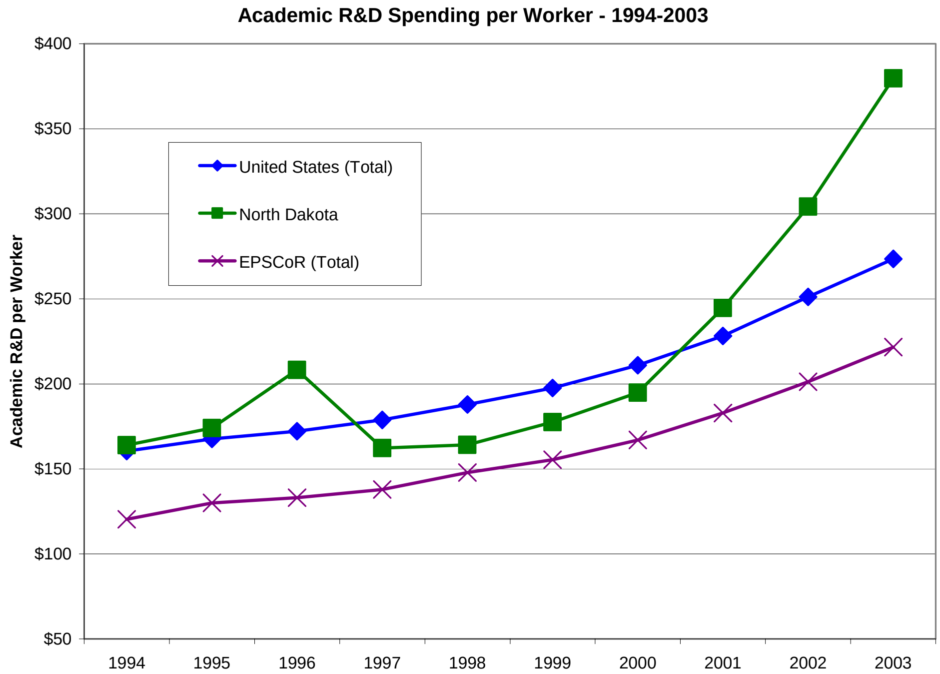
Figure 4.5. Total vs. university R&D spending in North Dakota 1993–2002



Source: National Science Foundation/Division of Science Resources Statistics

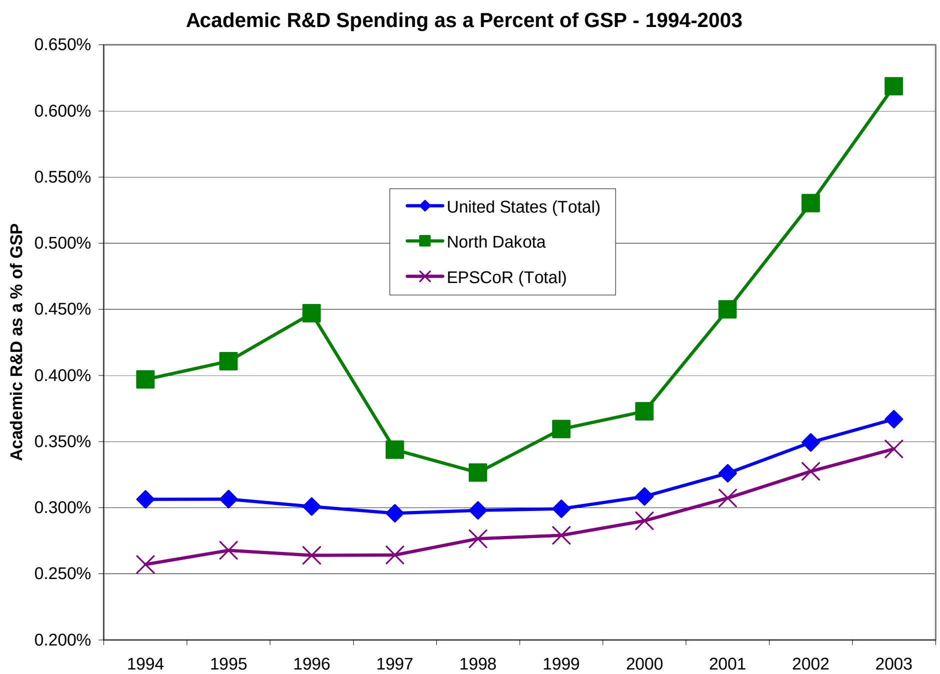
Figures 4.6 and 4.7 focus on university R&D in the state and show that North Dakota is experiencing more university R&D spending per worker in the state as well as rapidly increasing university R&D spending as a percent of gross state product. These figures indicate a high proportion of university R&D in North Dakota as compared to other EPSCoR and non-EPSCoR states, and point out the challenges that North Dakota faces in the coming years. University R&D in North Dakota is taking off, and North Dakota needs to continue to find ways to continue that momentum and capitalize on the strengths and capabilities that a growing university research program can provide. However, the state also needs to bring the level of university R&D activity into better balance by creating more industry R&D opportunities and activity in the state.

Figure 4.6. Academic R&D spending per worker, 1994–2003



Source: Based on EPSCoR data tracking by Policy One Research, Inc., using data published by the National Science Foundation/Division of Science Resources Statistics and the U.S. Department of Labor, Bureau of Labor Statistics

Figure 4.7. Academic R&D spending as percentage of gross state product, 1994–2003



Source: Based on EPSCoR data tracking by Policy One Research, Inc., using data published by the National Science Foundation/Division of Science Resources Statistics and the U.S. Department of Commerce, Bureau of Economic Analysis

4.3 North Dakota Strategies to Increase Capacity

North Dakota is making progress toward achieving the balance between university and industry R&D mentioned above through a variety of initiatives, including the North Dakota Centers of Excellence, the Red River Valley Research Corridor effort, and investment in faculty recruitment and infrastructure with EPSCoR funds.

4.3.1 Centers of Excellence

Many states have relied on centers of excellence as a mechanism not only to boost research capacity but to affect the research institution's ability to commercialize any resulting innovations. The National Governors Association wrote that, "Investing in specialized research and research facilities is a critical first step in the innovation process."[24] Centers of excellence, one way that states have invested in research capacity, are characterized by the following features:[25]

1. Conducting **both basic and applied research**, both research and development, in order to move innovations as close to the market as possible
2. Focused on a **cutting edge technological** area, especially one consistent with the current industry clusters and international market trends
3. Encompassing teaching and research, **to train students** to work in the relevant industries as well as learn to conduct good research
4. **Partnering with local and regional industry** to maximize the flow of innovation out of the laboratory and into the market
5. **Supporting entrepreneurial efforts** to start enterprises around new innovations
6. **Operating in an appropriate intellectual property regime** that balances the institutional need for return with the desire to maximize the flow of innovation into the economy
7. Collaborating closely with sources of **risk capital**

[24] National Governors Association. 2002. "A Governor's Guide to Building State Science and Technology Capacity." www.nga.org/files/pdf/AM02sciencetech.pdf.

[25] For more information, see Cohen, Wesley, Florida, Richard, Randanzzese, Lucien, and Walsh, John. 1998. "Industry and the Academy: Uneasy Partners in the Cause of Technological Advance." In Noll, Roger G., ed. *Challenges to Research Universities*. Washington, DC: The Brookings Press. http://brookings.nap.edu/books/0815715099/html/171.html. Also, SRI International, 2001."Outcomes and Impacts of the State/Industry-University Cooperative Research Centers (S/UIRCC) Program. www.nsf.gov/pubs/2001/nsf01110/nsf01110.html. And Council on Governmental Relations. 1996. "A Review of University Industry Research Relationships." www.cogr.org.

The New York Centers of Excellence Program has been in existence since the early 1980s, and follows many of these practices.

NYSTAR Centers of Excellence, New York

Since 1995, New York has fostered the growth of New York's high-tech and biotech industries by supporting the investment of more than $1 billion in its technology business sector and its world-class research laboratories and academic centers.

The New York State Office of Science, Technology and Academic Research, better known as NYSTAR, was formed to harness New York's outstanding university research and development resources for high-technology economic growth in the 21st century.

(NYSTAR's predecessor organization, the New York State Science and Technology Foundation, was founded in 1963 and modified in 1981. The Centers for Advanced Technology Program was a central element of the Foundation's work, designed to encourage greater collaboration between private industry and universities in developing and applying new technologies.)

The current NYSTAR Research Centers Program provides the physical and intellectual infrastructure necessary to achieve unprecedented breakthroughs in science and technology in New York State. Ultimately, these research facilities are expected to attract a critical mass of nationally recognized researchers, generate significant new research funding, spur the establishment of spin-off enterprises, and increase the development and transfer of technology from the research lab to the marketplace.

The current Research Centers are focused on computer science, energy and environment, life sciences, electronic devices, materials, nanotechnology, microelectronics, optics, imaging and sensors.

The most recent Center to open is the Center of Excellence in Bioinformatics and Life Sciences in Buffalo. This Center is being opened with commitments of $320 million, including $141 million in state funding for facilities, $120 million in corporate partner investment, $27.75 million in federal grants, and $30 million in foundation grants.

The Buffalo Center of Excellence is a collaboration led by the University at Buffalo and includes the Roswell Park Cancer Institute, the Hauptman- Woodward Research Institute and the Hunter James Kelly Institute. Private sector partners include Hewlett-Packard, General Dynamics, Dell, Stryker, Informax, Pfizer, Invitrogen Corporation, Cognigen, TATA Corporation, HealthCare Tech Inc., General Electric, Bristol Myer Squibb, Corning, and IBM. Total employment at the Center of Excellence is expected to be 500 and will produce many new private sector jobs in the region.

Source: http://www.nystar.state.ny.us/research_programs.htm and http://www.nystar.state.ny.us/pr/06/press18-06.htm

North Dakota Governor John Hoeven is credited with initiating the Centers of Excellence concept in 2002, and worked with legislators to fund the earliest projects in the 2003 session. In 2005, Governor Hoeven and the North Dakota legislature established and authorized $50 million for the Centers of Excellence in Economic Development program.

To date, $20 million in state support has been distributed to 11 COEs, with matches of up to $81 million expected. The Centers are based on creating university and industry interaction, and require at least a 2:1 match by external (preferably industry partner) funding. The Centers funded to date encompass a wide range of strengths and capabilities that form the basis of university-industry interaction. Some of the Centers funded so far will focus on emerging high-technology areas such as the following:

- Advanced Electronic Design and Manufacturing (Radio Frequency Identification [RFID] tags and advanced sensors)
- Ag-biotechnology (biofuels, specialty lubricants, and healthcare products)
- Customized Business Solutions (IT enterprise applications)
- Energy Technology (energy & environment and use of coal)
- Life Sciences and Advanced Technologies
- Petroleum Safety and Technology (new oilfield technologies)
- Surface Protection (protective coatings that will enhance the durability of manufactured products)
- Technology-optimized Agriculture
- Unmanned Aerial Vehicle (UAV)

A summary of all North Dakota Centers of Excellence is provided in **Appendix B.**

North Dakota has done an excellent job in taking the first steps to fund and establish several COEs and to strive for industry-university partners forged around targeted research. While the response to the Centers of Excellence has been overwhelmingly positive, RTI heard a few concerns about the process expressed during our interviews. Specific topics of concerns included those listed below:

- unclear stance on IP coming out of the Centers
- cumbersome peer review processes
- a desire for stricter adherence to the selection criteria, concern that the process will become political (funding Centers primarily because of their location in the state versus technical merit)
- interest in seeing a greater match with federal funds
- desire for more emphasis on partnering

These concerns need to be taken into account as future investments in Centers are made. To realize success from this investment, the state must be patient, diligent in how Centers are selected, and willing to invest in regular evaluation, and must follow through on remaining funding and be willing to let the investments have time to become successful.

4.3.2 Red River Valley Research Corridor

The Red River Valley Research Corridor (RRVRC) effort represents another initiative to grow a technology-based economy. The RRVRC seeks to build capacity by pursuing federal research funding in several targeted fields, primarily in life sciences. The initial (virtual) corridor connects UND with NDSU, and work is under way to extend the corridor northward to Winnipeg to create international collaborations, then south toward South Dakota, and east into Minneapolis, St Paul, and Rochester, MN.

The COE initiative also plays a role in advancing the RRVRC. For example, the Center of Excellence in Life Sciences and Advanced Technologies at UND will create a 60,000-square-foot, secure, biosafety level 3 (BSL-3) laboratory at the UND Technology Park. The facility will house the UND Center for Infectious Disease, Proteomics, Genomics, and Bioinformatics and will help create linkages to related capabilities and facilities located in North Dakota, Winnipeg, and Saskatoon.

4.3.3 Investing in Faculty

North Dakota has also used its EPSCoR funding to make strategic investments in recruiting key faculty and the necessary laboratory and computational equipment to help propel their research efforts. For example, in FY2004, EPSCoR funds were used to start up research laboratories for nine new faculty members at NDSU. At UND in FY2005, six faculty received start-up funding, and nearly $700,000 was invested in permanent research equipment.

These programs have been effective in recruiting young research faculty to North Dakota. Efforts to recruit more senior faculty, like those conducted by the Georgia Research Alliance (see sidebar), should be considered for strategic investments in key technical areas.

Georgia Research Alliance

The Georgia Research Alliance (GRA) was created in 1990 as a public-private collaboration to stimulate economic growth in Georgia. The goal for the GRA was clear: Invest in recruiting top research talent to the state so that Georgia would be better positioned to do the following:

- Compete for larger federal and foundation research funds.
- Attract other talented faculty and graduate students to Georgia.
- Foster new companies and create new relationships with industry to commercialize technologies resulting from the research.

The result would be more high-technology jobs and economic opportunities for Georgia's citizens.

The centerpiece of the GRA is the Eminent Scholar program, which recruits world-renowned faculty to Georgia universities. GRA funding has been used to attract top-tier faculty and establish research facilities for over 50 eminent scholars. The success of this program has led to expanded GRA initiatives, such as investing in other specialized research facilities, establishing Centers of Excellence, and even supporting technology commercialization activities like VentureLabs.

To date, the $400 million invested by GRA has been leveraged to bring $2 billion in private and federal investment into the state of Georgia, a 5:1 leverage ratio. GRA is credited with adding 5,000 new technology jobs in the state through expansion of existing Georgia companies and creation of 120 new ventures. The GRA is now internationally recognized as a successful model not only for growing a technology-driven economy, but also for bringing business, research universities, and state government together to lead the growth.

4.3.4 State Research and Development Tax Credits

It is widely accepted that using public funds to stimulate R&D activities by private companies can be a promising avenue for boosting a state's economy and producing new jobs and private investment. Tax incentives are one way to stimulate investment in R&D.[26] Minnesota enacted the first state tax credit in 1982, one year after the federal tax credit was introduced.[27]

State credits are similar to the federal R&D tax credit system. State credits allow companies to take a tax credit equal to a percentage of their qualifying R&D expenditures, typically over some base amount. The real value of the tax credit to companies depends on three main factors:

- The tax credit rate determines the percentage of expenditures the company may take a credit against

[26] Berglund, Dan and Clarke, Marianne. 2000. "Using Research and Development to Grow State Economies." National Governors Association. http://www.nga.org.

[27] Wilson, Daniel J. 2006. "Beggar thy Neighbor? The In-State, Out-of-State, and Aggregate Effects of R&D Tax Credits." Federal Reserve Bank of San Francisco Working Paper 2005-08. http://www.frbsf.org/publications/economics/papers/2005/wp05-08bk.pdf

- The definition of the base amount is important in determining the true value of the credit.
- The credit may or may not be taxed at the corporate rate and hence partially recaptured.

North Dakota has a corporate income tax credit for research and experimental expenditures (§57-38-30.5 of the North Dakota Century Code) that allows a credit equal to a percentage of the increase in qualified research expenses over the base period. Currently, the percentage applied is 8% of the first $1.5 million in increased research expenditures and 4% on any amount over $1.5 million. An unused credit may be carried back 3 years or forward 15 years.

Since 1982, state tax credits have become more and more generous, with the average effective credit rate growing substantially. Currently, 31 states provide a general tax credit on company R&D. Other states offer more narrowly targeted credits, for example:

- for R&D in specific fields
- by small companies only
- exclusively in certain geographic zones[28]

The definition of the "base" for state R&D tax credits is critical in determining the real value of the credit to companies and the amount of tax revenue forgone by the state. A credit with no base, or a "non-incremental credit," is the most valuable for companies because all qualified R&D is eligible for the credit rather than the amount over some base.[29] However, this system may not produce increased R&D by companies as there is less incentive to expand R&D expenditure. Only Hawaii and West Virginia have exclusively non-incremental credits. Other types of base definitions, such as using a moving average of a company's R&D expenditures over the past few years, provide less value to firms but also help ensure that companies only receive benefits on increased R&D expenditures. Most state programs are structured to reward only new and increased R&D expenditures.[30]

[28] Ibid.
[29] Federal Reserve Board San Francisco Economic Letter 2005-26. "The Rise and Spread of State R&D Tax Credits.",. October 14, 2005. http://www.frbsf.org/publications/economics/letter/2005/el2005-26.pdf
[30] National Governors Association, Center for Best Practices. "Enhancing Competitiveness: A Review of State Economic Development Initiates – 2005." May 8, 2006. http://www.nga.org.

Some highlights from other states include the following:

- In 2005, the tax credit rates ranged from a low of 1% to a high of 20%. Some states offer different rates for different levels of spending to provide greater incentive for small businesses and start-ups to increase their R&D expenditures.[31]
- In 2002, Rhode Island had the highest credit rate in the nation at 22.5%.[32]
- In 2005, the governors of Idaho and Indiana signed legislation exempting R&D activity from sales and use taxes.[33]
- In 2005, Indiana signed legislation offering a 15% credit on the first $1 million in qualifying R&D expenses.[34]
- In 2005, Nebraska enacted the Nebraska Research and Development Advantage, which allows qualifying R&D companies to claim a tax credit of 3% of increased R&D expenses.[35]

A bill (H.B.1480) was introduced in the Fifty-ninth Legislative Assembly of North Dakota to amend the research tax credit in several ways. First, the maximum credit was proposed to increase to $2 million, and the percentage changed from 8% to 10% with no caps and 12% for research conducted within the boundaries of an Indian reservation. Furthermore, this bill proposed that the tax credit be applied to the entire amount of a company's research expenditures, not the increase over a prior period.

As noted in this discussion, this bill would place North Dakota's R&D tax credit as an outlier among the states. It could be argued that this would be a valuable tool in enticing companies to move to the state to perform their R&D. Several issues need to be taken into consideration. The most important is that companies that engage heavily in R&D are often in their early stages and are not yet profitable; therefore, they do not have a tax liability. Thus, a credit is not an inducement for them to increase their R&D spending. Second, the size of the credits currently in place in most states is not large enough to induce a company to change their behavior, especially with regard to moving to a location such as North Dakota that may have few other inducements for such a move.

[31] Federal Reserve Board San Francisco 2005 op. cit.
[32] Progressive Policy Institute. 2002. "State New Economy Index, Economic Development Strategies for the New Economy." http://www.ppionline.org/.
[33] National Governors Association 2006 op .cit.
[34] Ibid.
[35] National Governors Association 2006, op. cit.

5. Intellectual Property and Technology Transfer[36]

Many universities subscribe to the notion that the academic institution has as its central mission the open and free dissemination of knowledge for the greater benefit of society. The university fulfills this mission through teaching, research, and public service. Historically, many academic institutions have viewed innovation for profit and entrepreneurial activities as not only outside of, but potentially contrary to, an educational mission. However, with an increasingly knowledge-based economy in the 21st century, universities can and must play an expanded role in society—and they are. Universities today are collaborating with industry and generating ventures on a scale and in ways that were previously unthinkable. Industry-sponsored research, licensing, corporate internships, business incubators, and spin-out companies are already providing great educational and revenue-generating opportunities. These activities are providing new products and services that benefit the public. They also create new industries and new jobs for local economies.

The relationship between academia and industry can be fruitful but is not without challenges. Universities believe in public sharing of research, whereas businesses prefer confidentiality; universities exist to educate, whereas businesses exist to create profits. Because of its unique position where the interests of industry and academia intersect, the technology transfer function can be the institutional vehicle for managing these diverging interests. The institution's own guiding principles are the key to keeping IP policy aligned with the institutional mission. Therefore, those endeavoring to shape IP management should start with the institution's core values and principles and consider how best to manifest them in IP management policies and practices.

5.1 Background—Technology Transfer and Commercialization

Technology transfer can manifest itself in many ways, but at academic institutions there are two formal vehicles for commercializing intellectual property: licensing to existing companies and licensing to new ventures or "start-ups." License agreements are used to allow others to exploit any form of IP, such as patents, copyrights, trade secrets, and so on. Because this study is concentrated on technology-based economic development, the focus is patent law; however, much of this applies also to copyrights, trademarks, and trade secrets.

[36] Unless otherwise noted, the information in this section was taken from Dix, Molly O'Donovan, and Thomas R. Culver. 2004. "Establishing and Structuring IP Management Processes: Issues and Models" *IDE, The Journal of Law and Technology*, 44(4): 543-663.

Patents are a critical component of any IP management policy because they initiate the following:

- Provide the holder with a legally-recognized property right in return for public disclosure of the invention.
- Are often used as a metric to evaluate innovation at the institution.
- Are important to faculty and student innovators.
- Trigger special legal considerations and requirements.
- Lead to licenses, which generate revenues that must be appropriately shared.

Similarly, new ventures are significant because they achieve the following:

- Act as an expression of entrepreneurship at an institution.
- Motivate faculty and student entrepreneurs.
- Create potential conflicts of interest (COI) and conflicts of commitment (COC).
- Require investment to create wealth for stakeholder.

Because patents and new ventures that exploit them are assets created from faculty or student innovations within the university, the issues of ownership and control of these assets becomes critical. Successful and strategic management of patents and new ventures requires careful consideration of several important questions, including the following:

- Who will own the rights to the patent?
- Who will make decisions about patenting and licensing?
- Who will fund the process of patenting and licensing?
- How will revenue from any resulting licenses be distributed?
- What level of involvement will the institution have with spin-offs and start-ups?
- How will venture stakeholders manage COI and COC associated with faculty and student start-ups?
- What financial and management stake will the institution hold in a start-up?

Many of these questions hinge upon the concepts of ownership and control.[37] When developing IP management philosophies and policies, it is wise to distinguish ownership from control in terms of the responsibilities that each carries: Ownership imparts legal responsibilities, whereas control imparts management responsibilities. Ownership is a legal issue determined by the existence (or lack) of employment agreements, inventorship, and institutional policies that cover utilization of institutional funds and

[37] Mark G. Bloom, *A Tutorial on Technology Transfer at U.S. Colleges and Universities*, Concord, NH (July 2001) (paper provided as support for presentation given at the 10th Annual Franklin Pierce Law Center, Advanced Licensing Institute).

resources. Control is a more practical issue that defines who makes decisions. For example, a controlling entity will need to make decisions about investment in IP protection, commercialization strategies, and negotiation of terms in any kind of transfer of rights. As described later in this report, because of the prevalence of federal government funding, universities also must follow the Bayh-Dole Act and its requirements concerning ownership and commercialization.

5.1.1 Bayh-Dole in a Nutshell[38]

The Bayh-Dole Act, initially passed by Congress in 1980,[39] applies to any contract, grant, or cooperative agreement between any federal agency and any contractor (public or private) for the performance of experimental, developmental, or research work where the federal government provides any of the funding. Although the contractor (including a university) has the right to claim title to inventions resulting from government-funded work, a number of requirements must be followed:

- Inventors must agree to promptly disclose their inventions to institutional authorities. Failure by the institution to notify the government within two months of disclosure may result in title passing to the government—although the government claims title infrequently. If a university does not act to elect to retain title within two years, the right to own the invention will vest with the government. Inventors who wish to retain title to their inventions must petition the funding agency in order to obtain title.
- Whether the university or inventor (via petition), the titleholder must file for patent within one year of electing title or lose the rights to the government.
- The government retains certain royalty-free use rights to the invention that can impact the licensing of technologies into government-dominated markets such as aerospace and defense by reducing the commercial market.
- The patent holder can license but not assign ownership of the patent to others. Licensees must agree to exploit the patent using production facilities within the United States, unless not feasible.
- Inventors must receive a share of the royalties paid by licensees to the patent holders.

The many requirements of Bayh-Dole (which are federal law) make patent management of university inventions complex, especially where research is partially funded by the federal government and partially funded by other entities. Potential conflicts include

[38] Unless otherwise noted, the information in this section was taken from RTI's general knowledge and articles used as background, including the Bloom article op. cit.; T.B. Valoir, *The Bayh-Dole Act: 8 Points Every Company Should Know*, News Source 15-17 (2002); S.L. Bertha; *Intellectual Property Activities in U.S. Research Universities,* 36 IDEA 513 (1996).

[39] Pub. Law 96-517 (1980), amended by Pub. Law 98-620 (1984), 35 USC 200-121.

issues of ownership, use rights to patents, rights of assignment, and disposition of licensing revenues.

5.1.2 Internal Revenue Procedure 97-14 in Brief

In 1997, the Internal Revenue Service promulgated Procedure 97-14 that places limitations on the use of university facilities that are funded by tax-exempt bonds. The intent of the Procedure is to prevent private research sponsors from receiving a direct benefit from the use of tax-exempt bonds. The Procedure states: “Any license or other use of resulting technology by the sponsor is permitted only on the same terms as the recipient would permit that use by any unrelated, non-sponsoring party.” The intent is that the sponsor will pay a competitive price.

In practice, universities tend to read this restriction very broadly and use it as a negotiation point with sponsoring companies. Companies feel that universities should not use this Procedure to limit pre-licensing terms in research agreements unless that university can show the direct benefit that the company would receive from the facilities or equipment financed by a tax-exempt bond.[40] (See sidebar in **Section 5.6.2**.)

5.2 Intellectual Property and Technology Transfer in the North Dakota University System

Viewed nationally, the North Dakota University System (NDUS) is in the fairly early stages of developing IP management and technology transfer policies, procedures, and practices. The two major research universities in the state have relatively new full-time staffed technology transfer offices—UND at 2 years, and NDSU at 11 years. (NDSU formed a research foundation [NDSU/RF] to manage the university’s patents in 1989, but did not staff the technology transfer function until 1995.) For the most part, many of the major U.S. research universities had technology transfer offices permanently staffed and fully operational by the early 1990s.

Although fairly new to technology transfer and commercialization, both institutions have done a good job of rapidly educating the university communities about IP and the benefits derived from protecting and commercializing new discoveries. UND generated 35 invention disclosures from 2004 to present, versus a total of 5 in the previous three years and increased its patent filings from 5 in 2000–2003 to 20 from 2004 to the present. NDSU averaged about 10 disclosures a year prior to FY2003 but has ramped up since then with 19 in FY2003, 47 in FY2004 and 45 in FY2005. Both communities appear to be open to building on the experience of more mature technology transfer organizations

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[40] Killoren, Robert and Butts, Susan. 2003. “White Paper on Industry-University Research in our Times.” Washington, DC: The National Academies. http://www7.nationalacademies.org/guirr/IP_background.html.

in other states. IP policies and template agreements have been generated based on proven best practices—which have helped to boost both institutions up a steep learning curve.

NDSU is the more mature program and continues to gain sophistication. The office uses standardized license/equity agreements and has provided the community with guides on starting companies and another on IP issues. NDSU licenses provide commercial companies with rights to NDSU intellectual property in return for some form of consideration, which in some ventures can be an equity position for the university. UND is a newer player but in a two-year time frame has established an IP commercialization office, revised the UND IP policy and implemented processes, and has formed the UND Research Foundation to carry out its commercialization activities. The Research Foundation is currently in the process of forming two start-up companies based on licenses to university IP.

Given the complexity, uncertain outcome, time, and investment needed to take early-stage technologies from academic laboratories and turn them into products and services ready for the commercial marketplace, many years of active involvement in technology transfer and development of rather large license portfolios are necessary before a school is likely to realize substantial success and financial return from licensing and venture-creation activities. **Table 5.1** presents historical data relating the age of a university technology transfer office and the related growth curves for active licenses, licensing income generated, patents issued, and average start-up formation.

Table 5.1. Average results for U.S. universities reporting technology transfer office (TTO) age, FY1999

TTO Age (years)	Schools in Age Range	Cumulative Active Licenses (Avg)	Licenses Generating Income (Avg)	U.S. Patents Issued (Avg)	Start-ups Formed (Avg)
0–5	27	18	10	6	1
5–10	32	67	31	17	1
10–20	54	146	61	28	2
20 +	18	275	126	52	6

Source: Dix and Culver, op. cit.

5.3 Benchmark Statistics Related to Technology Transfer and Licensing Metrics

Following are several charts presenting comparisons of various licensing metrics across several universities that are peer institutions to UND and NDSU in some respect (geography, size, land grant, etc.). The institutions featured are as follows:

- University of Iowa
- Iowa State
- University of Kansas
- Kansas State
- University of Minnesota
- University of Oklahoma
- Oklahoma State

Data were generated from information publicly available via the Association of University Technology Managers (AUTM).[41] All charts show data for FY2000 and FY2004 for the various institutions. Specifically, the information combined into **Figure 5.1** demonstrates the following:

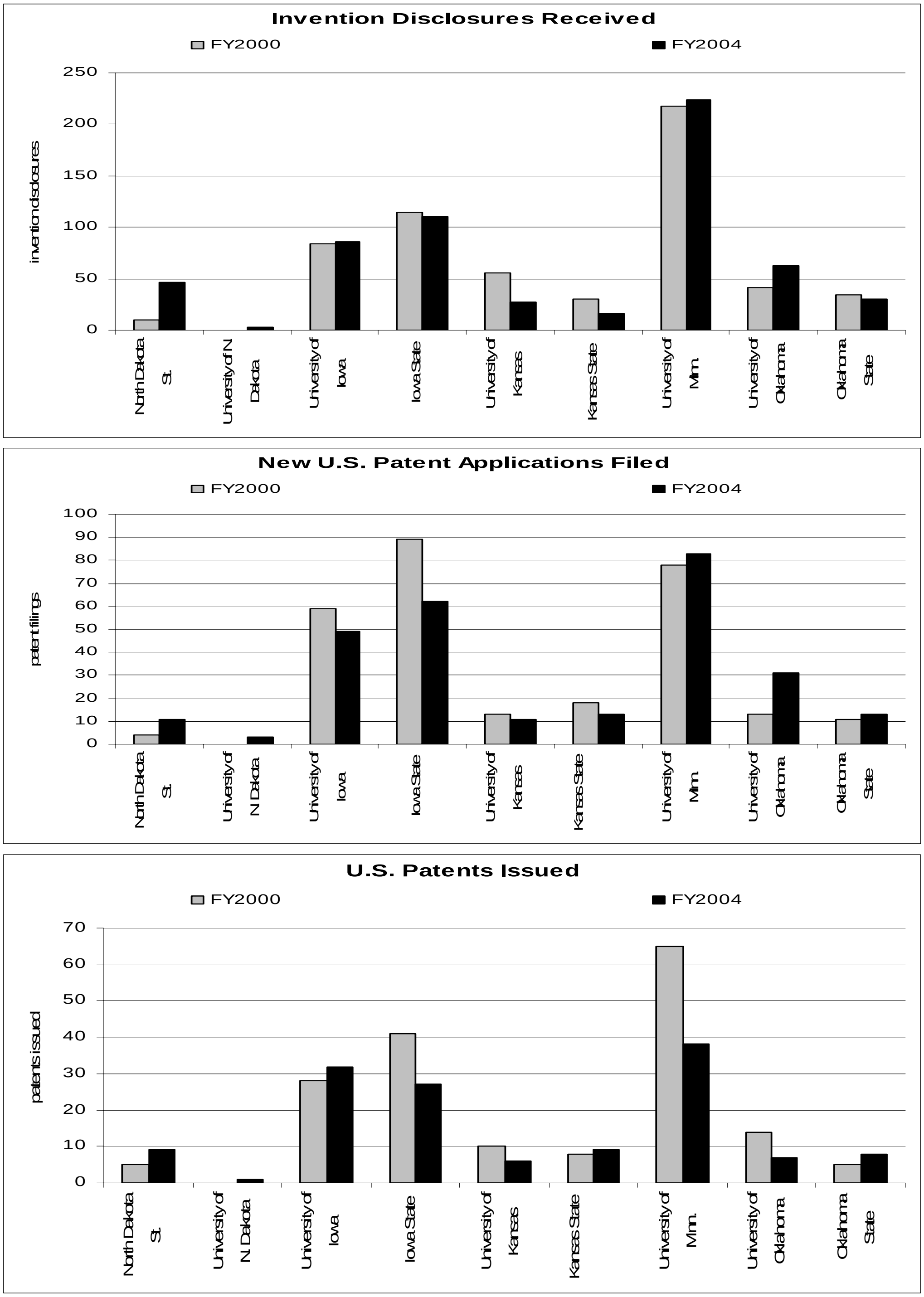
- **Invention Disclosures Received** – a trend showing that universities are receiving a greater number of reports of IP assets prior to filing for patent protection. This shows the late start and growth curve for North Dakota whereas at some other institutions the early push has started to already reach steady state or decline because they have caught up with early backlogs.
- **New U.S. Patent Applications Filed** – a trend in investment to protect intellectual assets by patenting. Again, this shows the beginning status and upswing in North Dakota investment where most others, except University of Oklahoma, have either tapered off or remained steady as the backlog of patent applications turns into issued patents (generally a two-year process).
- **New U.S. Patents Issued** – a trend in patent application filings that are successful in issuing as patents. In reality, this is a snapshot of patent-filing activity for the late 1990s, reflecting the time a patent takes to issue.

[41] http://www.autm.net

Figure 5.2 shows the following:

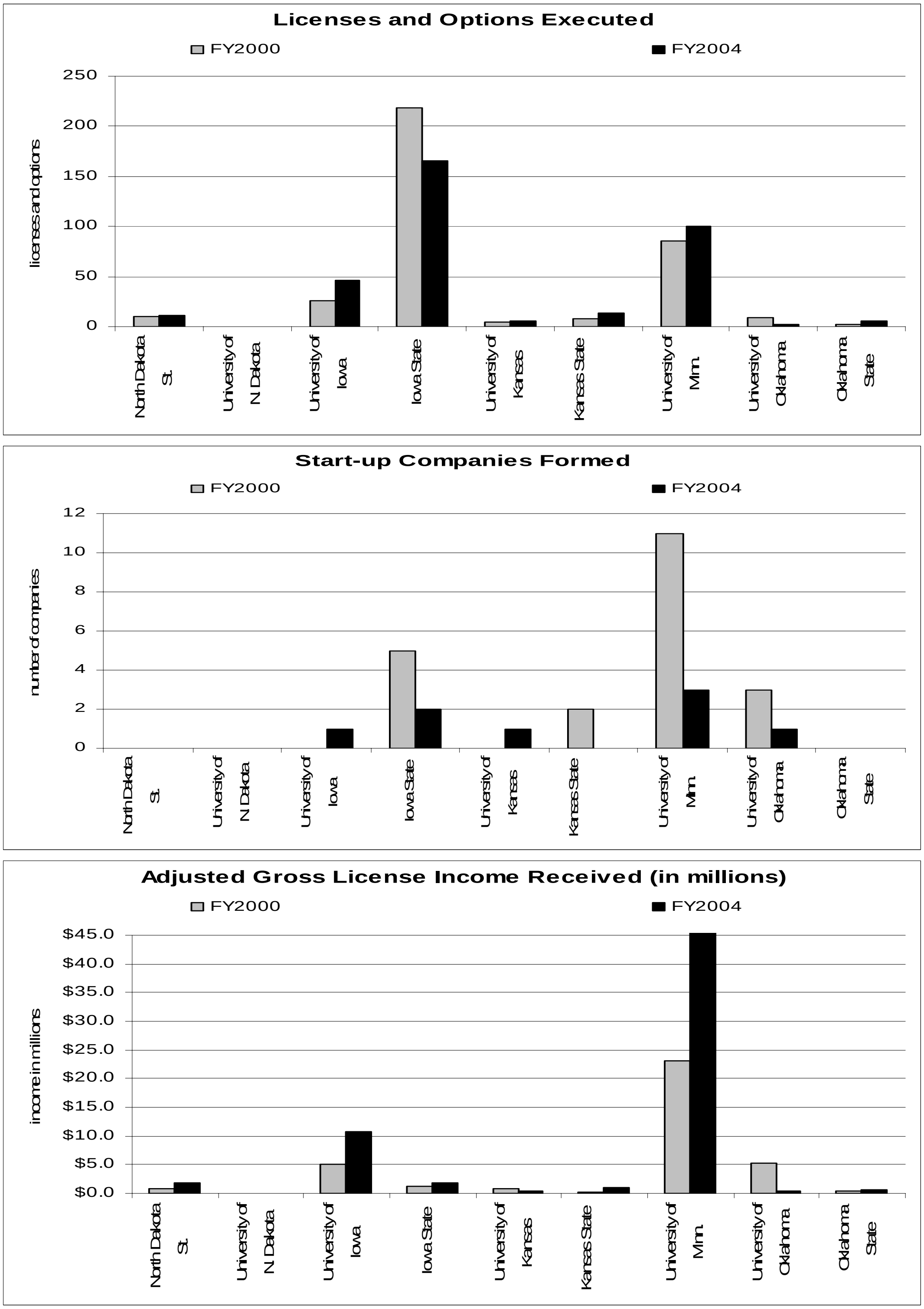
- **Licenses and Options Executed** – shows trend in licensing deal flow.
- **Start-up Companies Formed** – adjusting for the 2000 pre 9/11, IT start-up data, the recent variation is not great among this group of schools.
- **Adjusted Gross License Income Received -** This illustrates that licensing revenue is very lumpy; a small number of licenses generate a very large percentage of the license income. This suggests why a portfolio approach is so crucial.

Figure 5.1. Invention disclosures, patent applications, and patent issues, FY2000 and FY2004



Source: AUTM *U.S. Licensing Survey, FY2004: A Survey Summary of Technology Licensing (and Related) Performance for U.S. Academic and Nonprofit Institutions, and Technology Investment firms*, Stevens, Ashley J., Toneguzzo, Frances and Dana Bostrom, (eds.) and data supplied by UND.

Figure 5.2. Licenses, start-ups and license income FY2000 and FY2004



Source: AUTM *U.S. Licensing Survey, FY2004: A Survey Summary of Technology Licensing (and Related) Performance for U.S. Academic and Nonprofit Institutions, and Technology Investment firms*, Stevens, Ashley J., Toneguzzo, Frances and Dana Bostrom, (eds.) and data supplied by UND.

When considering the preceding charts in terms of the NDUS and its technology transfer and commercialization programs, there are some basic things to keep in mind. First, many years of active involvement are needed to realize substantial metrics; second, the presence of a medical school can hugely increase performance values, and third, the occurrence of a "blockbuster" license that returns unusually high revenues makes a difference. **Table 5.2** shows the impact of a medical school on licensing income.

Table 5.2. Licensing income data for U.S. academic institutions with and without medical schools, 1999

	Without Medical Schools	With Medical Schools
Total licensing income generated	$136.5M	$539M
Average revenue per active license	$67,837	$108,282
Licensing revenues as a percentage of total research spending	2.40%	3.00%

Source: Dix and Culver, op. cit.

Technology transfer requires a concerted and strategic investment of time and resources before licensing and entrepreneurial activities may generate revenues. However, as noted in Lita Nelsen's survey of TTOs,[42] understanding both the economic and non-economic reasons for technology transfer is important. These reasons include the following:

- serving the public good with technology dissemination that provides new consumer and health-related goods and services
- attracting research funding from industry
- motivating faculty to be innovative
- educating faculty and students about industrial realities
- integrating innovation and entrepreneurship educationally
- promoting local economic development

To achieve all of these goals, a university needs to be an active participant, supporter, and partner in nurturing innovation and entrepreneurship and pursuing technology transfer. Enriched educational and professional experience for students and faculty, based on innovation and entrepreneurial activities, may be the best justification for an emerging technology transfer effort. These experiences will build a culture, legacy, and appeal that will set the stage for future economic benefit.

[42] Nelsen, Lita. *Licensing University Technology to Industry*, Research Review 6-13 (Jan. 1993) (summary of presentation given at the 1992 AUTM Conference).

Two examples of a proactive approach to creating new enterprises from university intellectual property too new to be evaluated and called best practices are listed here:

Vanderbilt University (VU)[43]—Vanderbilt's office of technology transfer works with investment professionals, angel investors, and experienced management teams to identify technologies that are appropriate for a commercialization strategy involving a start-up company. To foster this process, VU maintains the ability to co-invest in multiple rounds of financing on an *ad hoc* basis in compelling value propositions led by seasoned management teams. Typically, VU will initially participate as part of a syndicate in seed-stage rounds of financing totaling $500,000 to $1.5 million. Follow-on investments in subsequent rounds are considered as the companies advance and meet defined development milestones.

Criteria for investment include the following:

- potential for a technology or business concept to secure a portion of a large and growing market
- vetting by investment professionals and confirmation by a willingness to co-invest with Vanderbilt
- engaged inventor(s) with understanding of expectations from management and investors
- intellectual property that can be protected or has an obvious competitive advantage

The third criterion listed is critical as VU strives to avoid a situation of "self validation." Thus, the investment must have other majority shareholders. VU believes start-ups that can most effectively capitalize on appropriate access to Vanderbilt resources—to accelerate the development of a technology or diversify its applications—to be the most attractive for investment. Many of the companies that VU invests in have a license of VU technology but not necessarily. Also, not all are product based—some are service companies.

Historically, VU's effort started as the "Chancellor's Fund." However, it was never really a fund with specific funding applied, and thus they no longer have a formal name for the program. Instead, the office takes investment opportunities forward for consideration as higher-risk opportunities for the investment of the VU endowment. Thus these opportunities compete with others—that do not relate back to VU—for funding. Over the last five years, VU has invested $14–$15 million in 25 start-up and early-stage

[43] http://www.vanderbilt.edu/technology_transfer/Investors_overview.htm and interview with Peter Russo in the Vanderbilt Office of Technology Transfer and Enterprise Development.

companies. Like a typical venture capital group, they have about 10% that are "homeruns," about 20–30% "do well," 20–30% "hold their own," and 20–30% "die."

University of Virginia – Spinner Technologies, Inc. was founded in 2000 as a for-profit subsidiary of the UVA Patent Foundation. Since 1997, the number of invention disclosures at UVA has increased by more than 80%. Many of these inventions are too early-stage to be of interest to large, established companies, whereas small, flexible companies can innovate and develop new technologies much more quickly and effectively than can large companies, which often are better adapted to later-stage development. These large companies increasingly use acquisition or merger with start-ups as a means of obtaining innovations. Spinner will help the entrepreneurial faculty start up the company and then may sell some of its retained stock in successful start-ups to provide dividends to the Patent Foundation. The goal of UVA's Spinner Technologies is listed here:

> "… to form … start-up companies … that can be expected to sponsor research at UVA, create new jobs for UVA graduates and spouses, expand into new facilities at UVA's Research Parks, and ultimately become part of a broad regional technology-based economy that will bring UVA-developed inventions to the benefit of the public. This … environment may also lead to improved faculty retention and recruiting. More direct benefits may also result, as Spinner Technologies may sell some of its retained stock in successful start-ups to provide dividends to the Patent Foundation and to UVA, and successful start-ups will hopefully provide strong patent royalty returns to the Patent Foundation."[44]

5.4 North Dakota State Intellectual Property Laws and Regulations

Effective commercialization of new knowledge leading to the growth of high technology industries and the companies that populate them is reliant on strong IP laws. Laws are needed that protect an owner's ability to maximize exploitation through controlling decisions on how the IP will be used. Laws are also needed that ensure value will not be at risk or lost by the application of laws or regulations with unintended consequences. Each is necessary to provide a business environment that is conducive to attracting the entrepreneurs and companies that deal competitively in new knowledge markets. Although federal law controls the legal patent and copyright regimes (the innovations that seed new industries), state laws and regulations can have a significant impact on how

[44] http://www.spinnertechnologies.com/

they are used. A third category of IP—trade secrets—is wholly a matter of state law and within the purview of the state legislature to effect any changes to it or its applicability.

During its review, RTI found the legal climate in North Dakota to be generally favorable to growing new technology businesses. Notable is the legislature's perspective that control of issues dealing with IP developed at North Dakota universities and its subsequent commercialization or transfer should be vested in the SBHE. Positioning the authority and responsibility for these activities in an administrative unit that is closest to the actors (faculty, students, staff), compares favorably with states that have had a longer historical record of successfully engaging their public universities in formal technology transfer.

While North Dakota is doing much that is right in providing a favorable legal environment for new businesses, nonetheless, certain issues came to light during interviews held by RTI and as a result of its own independent review. These concerns with the law either have resulted, or may result, in barriers to growth. By pointing these out, we hope to make a contribution that will be valuable as the state looks to build a more dynamic environment for new technology companies.

5.4.1 The North Dakota Open Meetings and Open Records Law (N.D.C.C. §§44-04-17, 18).

This law has been identified as a possible inhibitor to companies' willingness to enter into licensing and other contractual relationships with the North Dakota universities for research and commercialization of the universities' intellectual property.

The NDSU Research Foundation (NDSU/RF), is a separate 501(c)(3) organization that engages in technology commercialization on behalf of NDSU. The question of whether NDSU/RF's business records were subject to the state's open-records law was raised by a release request made by the Dakota Resource Council (DRC). The records in question concerned a commercialization relationship the Foundation had established with Monsanto Corporation on behalf of NDSU and whether there was a related research relationship established between Monsanto and NDSU (it was found there was not in this case). The Foundation's assertion that it was not a public entity subject to the state's open-records law was dismissed by the state's attorney general.

The attorney general found that the Foundation, in taking ownership of and marketing NDSU inventions under authority delegated to it by the State Board of Higher Education, was acting as an agent of NDSU. It was, in fact, performing a governmental function on behalf of the university. This activity of NDSU/RF placed it within the statutory definition of a "public entity" (N.D.C.C. § 44-04-17.1(12)) and certain of the information the DRC was seeking fell within the statutory definition of a "record" (N.D.C.C. § 44-04-

17.1. (15)). Thus the DRC request did fall under the North Dakota Open Meetings and Open Records Law.

The finding that nonprofit organizations engaging in commercialization of the North Dakota universities' intellectual property are subject to the state's open-records laws means that certain commercial and proprietary information of university licensees may become subject to disclosure and release to the public. This may occur despite the confidential or proprietary nature of the information. Records subject to disclosure include all "information" stored, recorded, or reproduced, if it concerns "public business" and if it is a record of a "public entity." According to section 44-04-18 of the statute, "all records of a public entity are public records."

The law does provide certain exemptions to release. Under §44-04-18.4, a record is exempted if it is "confidential." It is confidential if it is proprietary and has not been publicly disclosed and it is a trade secret, proprietary, commercial or financial in nature. In addition, there is an exemption for research-related information developed or received by a university if it is the subject of a patent or if the university or an individual wishes to commercialize it. There is also an exclusion for proprietary information received from a research sponsor. While there are definitions provided in the statute for what is included as a "trade secret" and "proprietary information," the statute does not provide definitions for "commercial" or "financial" records.

The difficulty in parsing through which records of a public entity (such as NDSU/RF in its role as agent for NDSU, or any other organization within the state serving a similar function) would be exempt and which would not using imprecise statutory language, is not the whole story. Decisions as to what constitutes a releasable record is further complicated by a North Dakota Supreme Court case which found that although certain information may qualify as a trade secret under the Uniform Trade Secrets Act adopted by North Dakota (N.D.C.C. §47-25.1), in order to be protected from public release under the open-records law, it must fit into a specific exception to the law. (*Northern States Power Company v. North Dakota Public Service Commission et al*), 502 N.W.2d 240 (N.D. S. Ct., 1993).

In other words, to be protected from open-records release, the information must qualify as trade secret, proprietary, commercial, or financial **and be** subject to a specific legislated exception to the open-records law [emphasis added]. This situation is of concern to public agencies such as universities as well as to private companies seeking to do business with universities. Both must find a legislated exemption to protect nonpublic trade secrets that may have been released to a university or become part of a university record through a legitimate business relationship.

The vague statutory language raises the uncertainty that information that is both competition-sensitive and critical to companies will be publicly released and creates a risk for companies seeking to enter into research and commercialization arrangements with the North Dakota state universities. As a consequence, companies may decide to do business with universities in other states where this risk does not arise.

While no North Dakota company that we talked to was willing to state unequivocally that they would not license intellectual property from a North Dakota university because of this issue, we have spoken with a number of companies from around the country who currently work with other research universities. They assert that they reveal extremely sensitive and company proprietary information during their discussions with technology transfer offices at universities and the threat of public disclosure would have a chilling effect on their willingness to initiate discussions. For instance, the disclosure of technical information about a company's IP that might not yet be fully protected could constitute publication and prevent the issuance of a patent.

Other states have handled this issue in a variety of ways. Four alternatives that we have identified include the following:

1. boosting the exclusion definitions under §44-04-18.4
2. special legislative initiatives
3. promulgation of special rules by the State Board of Education
4. exploration of alternative structures for NDSU/RF

Boosting the exclusion definitions under §44-04-18.4

Several states have adopted more specific definitions of what constitutes public entity information that may be excluded from release under their open records or freedom of information statutes.

- Minnesota defines as excludable trade secret information which includes government data (information) classified as "nonpublic data" if it is the subject of efforts of a governmental organization that are reasonable under the circumstances to maintain its secrecy and derives independent economic value, actual or potential, from not being generally known … (Minnesota Statutes, 2005 Ch. 13, Sec. 37)
- Illinois exempts trade secrets and commercial or financial information where it is proprietary, privileged or confidential or where disclosure may cause competitive harm and also exempts certain information, including research data, obtained or produced by any public body when disclosure could reasonably be expected to produce private gain or public loss. Illinois adds drafts, notes, recommendations and memoranda pertaining to the financing and marketing transactions of the

public body to its definition of exempt information. (Illinois Public Act 093-0422, 5 ILCS 120/2)

- Indiana exempts from public disclosure, at the discretion of a public agency, records relating to negotiations created while negotiations are in progress. (Indiana Code 5-14-3)

Several states have considered it important to provide a degree of certainty under their open-records laws directly intended to protect the research and commercialization efforts of their universities.

- Georgia protects information of a proprietary nature, produced or collected by or for state institutes of higher learning or other governmental agencies in the conduct of or resulting from study or research on commercial, scientific, technical or scholarly issues, regardless of how funded. Protection from disclosure covers information provided by participants in research, research notes and data, discoveries, research projects and so forth, until the information is publicly disseminated. (Georgia Code Annotated §50-18-72(b))
- Indiana excepts information about research, including the research documents, conducted by or under the auspices of an institution of higher education from access as a public record and specifically excludes information concerning any negotiations with respect to research and received from another party involved in the research. (Indiana Code 5-14-3-4(6))
- Illinois specifically exempts course and research materials of faculty.
- Nebraska exempts trade secrets, academic and scientific research work which is in progress and unpublished, and other proprietary or commercial information which if released would give advantage to business competitors and serve no public purpose. (Nebraska Statutes Section 84-712.05)

Special legislative initiatives directed at protecting research and commercialization activities of state universities for a period of time

An excellent example of targeted legislation seeking to enhance university-industry relationships is found in Michigan. The law, enacted in 1995, continues in effect in Michigan. It provides an example of a statewide effort to lower risk to start-ups entering into technology transfer relationships with state universities that valuable information will be publicly disclosed. Michigan has found a way to make the business environment in the state more attractive for new companies without cost to the state.

The purpose of this proactive legislation entitled “CONFIDENTIAL RESEARCH AND INVESTMENT INFORMATION ACT, Act 55 of 1994” is set out in the preamble of the statute as … “ AN ACT to protect from public disclosure certain information obtained in research and related activities of public universities and colleges; to protect from public disclosure certain investment information received by a public university or college from an investment fiduciary or portfolio company; and to prescribe certain duties of public universities and colleges." The full text of this act, including comprehensive definitions of protected information, is attached as **Appendix C**.

The promulgation of special rules by the State Board of Higher Education (SBHE) or revision of existing rules to protect from disclosure certain university records

N.D.C.C. 15-10-17 §7 specifically reserves authority to the State Board of Higher Education to adopt certain rules to protect confidentiality of trade secret, proprietary, commercial and financial information consistent with the exemptions found under §44-04-18.4. Since 15-10-17§9 grants the SBHE the right to adopt rules promoting research, encouraging development of intellectual property and protecting and marketing university discoveries, it may be a reasonable exercise of the board's authority to add clarity to the rules it adopts pursuant to N.D.C.C. 15-10-17 §7. §611.6 of the SBHE's policies attempts to do this by referring to the exclusions under §44-04-18.4 for trade secret, proprietary, commercial and financial information and requires the institutions to adopt procedures to protect confidential information as not subject to the state's open-records law. However, due to the ambiguity over the definitions used, and in light of *Northern States Power Company* cited above, it may be beneficial for the SBHE to work with the attorney general's office to better identify the categories of university records that are not accessible under open-records.

Alternative Structures for the NDSU Research Foundation

- ***Restructuring NDSU/RF***

  The North Dakota Attorney General's finding that NDSU/RF is subject to the North Dakota Open Meetings and Open Records Law is based on a finding that the SBHE had delegated a public duty to the foundation and in that respect, the records pertaining to that public duty were subject to the Open Records Law.

  Although NDSU/RF was chartered as a separate nonprofit corporation in 1989, the Attorney General found that its purpose was essentially to carry out a governmental function (authority granted under N.D.C.C. §15-10-17(9)) with respect to protection and marketing of university employee innovations and discoveries) on behalf of a public entity (the State Board of Higher Education). The Attorney General, in determining that the activities of NDSU/RF constituted the delegation of a governmental function, emphasized the purpose and board structure of NDSU/RF as so closely tied to NDSU that in its technology commercialization functions it was acting as an agent for the university.

  NDSU/RF could be restructured to (1) serve purposes other than as a captive of NDSU by establishing autonomy in the scope and diversity of activities it is chartered to undertake, (2) greatly reduce the number of NDSU officers who have seats on the foundation's board in favor of board members representing broader interests, and (3) separate the activities and personnel of the two organizations (accomplished through a restructuring of the Nov. 27, 2000 cooperation agreement between the foundation and NDSU). Then, the activities of the foundation may take on an independent color that clarifies its activities and purpose as that of an independent entity. NDSU/RF would also benefit by an ability to provide a wider range of services on behalf of economic interests within the state.

- ***A Legislative Grant of Authority to the SBHE to Establish a Nonprofit Corporation***

The state of Colorado, by legislation, has granted governing boards of state-supported institutions of higher education or their commissions authority to incorporate private nonprofit corporations (Colorado Revised Statutes Sec. 23-5-121). This example recognizes the fact that the transfer of technologies from university research to the private sector potentially leading to economic expansion for the state of Colorado is an important public good. Pursuant to this authority, the Higher Education Commission in Colorado has established the Colorado State University Research Foundation.

An important section of the enabling legislation for the establishment of such nonprofit corporations provides that:

> "Such a corporation shall have all rights and powers of a private nonprofit corporation organized under the laws of this state and shall not be an agency of state government or a department or political subdivision thereof and shall not be subject to any provision of law affecting only governmental or public entities [except for affirmative action]."

In addition the statute states that an institutionally-related foundation is not public:

> "Institutionally related foundation" means a nonprofit corporation, foundation, institute, or similar entity that is organized for the benefit of one or more institutions and that has as its principal purpose receiving or using private donations to be held or used for the benefit of an institution. An institutionally related foundation shall be deemed not to be a governmental body, agency, or other public body for any purpose."

5.4.2 The North Dakota Open Meetings and Open Records Law (N.D.C.C. §§44-04-17.1(12)(a)).

As already noted, the issue of whether the NDSU/RF, a separately organized 501(c)(3) nonprofit organization is a public entity within the meaning of the North Dakota Open Meetings and Open Records Law has been recently settled in an opinion rendered by the state attorney general OPEN RECORDS AND MEETINGS OPINION, 2006-O-01. In a matter concerning public access to certain records maintained by the Research Foundation on behalf of the University, the attorney general found the link between the Research Foundation and the University to be one of delegated agency whereby the Research Foundation is acting as an agent performing a governmental function for the University (a public entity). At a minimum, this puts certain records of the Research Foundation within the definition public entity records (NDCC §§44-04017.1(12)(15)).

The attorney general's finding that a separate nonprofit organization carrying out certain activities related to state public entities becomes a public entity for those purposes places the organization at a disadvantage in engaging in competition-sensitive commercialization activities, a main function for which it may be established. As noted under Section 5.4.1 above, the fact that certain of its records covering negotiations with prospective business partners may be open to public access is a significant inhibitor to businesses wishing to associate with the universities.

Because of the implications of the attorney general's opinion, whether records of university research parks and incubators and other organizations within the state carrying on delegated activity will be considered subject to open records access is a question that raises uncertainties. These uncertainties should be resolved if the business climate in North Dakota is to be less risky for start-up companies and those in competition-sensitive industries such as IT and biotech.

5.4.3 North Dakota Law on Trade Secrets (N.D. Cent. Code §47-25.1).

North Dakota has adopted the Uniform Trade Secrets Act and utilizes the codified definition in various areas of state law such as an exception to the open-records law (§44-04-18.4.5.b.). However, protection for trade secrets from release as part of a public record has been diluted by the North Dakota Supreme Court (see *Northern States Power Company v. North Dakota Public Service Commission* above). Consequently, the protection for trade secrets typically expected by a company collaborating with a state university in research and commercialization is uncertain.

5.4.4 North Dakota Law In Restraint of Business (N.D. Cent. Code §9-08-01).

During interviews with the business community, concerns were raised that a provision of North Dakota's statute dealing with Unlawful and Voidable Contracts makes it more difficult for businesses located in North Dakota to protect trade secrets that may be exposed by departing employees. Indeed, §9-08-06 makes void any contract term that restrains anyone from exercising a lawful profession, trade, or business, with only two exceptions—neither of which involves protecting against release of employer trade secrets.

Businesses in North Dakota see this provision of contract law as responsible for a risky business environment. Employers cannot ensure through a noncompete clause in an employment contract that departing employees will not take with them to competitors ideas and other competition-sensitive information of their previous employer. To protect trade secrets, employers must depend either upon North Dakota trade secret law (N.D. Cent. Code §47-25.1) or enforcing other restraints in employment contracts having to do with using proprietary or confidential information of an employer outside of employment.

While the courts of many states favor reasonable requirements on noncompetition clauses in terms of time limitations and geographic limitations, only two states, North Dakota and California, prohibit them as a matter of state contract law. The potential detrimental effect to businesses located within the state is increased by a recent decision in the 11th Circuit Court of Appeals. This court found that a noncompete agreement held to be unenforceable under Georgia law, by application of the Full Faith and Credit Clause of the Constitution, must be held unenforceable by any other state *(Palmer & Cay, Inc. v. Marsh & McLennan Companies*, 2005 U.S. App. LEXIS 5243 (11th Cir. 2005).

Since high-technology businesses are typically concerned about losing cutting-edge ideas to their competitors, the unique position taken by North Dakota in prohibiting noncompetition clauses in contracts will be an issue for any company in a competitive industry wishing to locate in North Dakota.

5.5 State Board of Higher Education Policies Affecting Intellectual Property and Commercialization Efforts of North Dakota Universities

5.5.1 Section 611.2 Employee Responsibility and Activities: Intellectual Property.

Under authority granted to it by the State of North Dakota (N.D.C.C. §15-10 et seq.), the State Board of Higher Education (SBHE) is granted authority for administration of the major state universities and the right to set policies. §611.2 of the SBHE policies covering employee responsibilities, sets out the SBHE intellectual property policies for the institutions that come under its authority. In laying out its policies, the SBHE establishes the ground rules and delegates substantial autonomy to the constituent universities to implement them. It is clear that the SBHE, appropriately, does not desire to be the commercial or technology transfer engine for the universities. Overall, the SBHE policies on intellectual property are in the mainstream of those adopted by, or on behalf of, U.S. research universities. They are neither progressive nor conservative.

A comprehensive review of SBHE policies relevant to intellectual property and technology commercialization breaks into two separate areas that are important to this study. One has to do with the policies that encourage linkages with industry and are supportive of technology transfer and economic development. The other has to do with whether some of the policies represent best practices. The latter is not solely a matter of the policies themselves but also has to do with best practices in implementation by the universities in the North Dakota system.

SBHE policy areas that may be viewed as inhospitable or not encouraging of industrial partnerships

- ***Treatment of student inventions under the same rules as faculty and staff inventions (§611.2.7.b)***. By providing that any use of university facilities carries with it a right of first refusal on the part of the applicable university to acquire title to patents, the SBHE has limited the ability of companies to interact with students pursuing coursework in various engineering and design courses. Interviews with area companies indicated a desire to work more closely with students, but intellectual property policies of the universities were seen as barriers. By encouraging the universities to permit normal student use of facilities without forfeiture of patent title to the university, the potential for student involvement with companies increases.
- ***Limitation on assignment or transfer of intellectual property rights only to independent foundations created for managing and marketing institutional intellectual property (§611.10)***. Transferring title or "selling off" title to university-developed intellectual property to third parties is generally disfavored for many important reasons. These reasons, including losing the right to ensure the technology is used by the transferee or "buyer" for the benefit of the public, are pointed out elsewhere in this report. Nevertheless, there are circumstances under which it may be advantageous for the university to have some discretion in the matter. Certain programs of the federal government may require it as a condition of participation in the program, such as a congressional deviation from the Bayh-Dole Act which may require that industry hold title. Having the right to assign title may prove to be an advantageous strategy where a joint invention is made with another academic institution better able to license it, or it may be a

good business arrangement to put a patent into the hands of a patent marketing organization that is not a foundation. Granting the constituent universities the discretionary right to assign to a broader group of responsible licensing entities would provide more flexibility than currently appears to exist, provided restrictions against transfer by assignment under Bayh-Dole and under certain other federal tax and export control regulations are judiciously observed.

- ***Omitted from the SBHE policies are any principles encouraging university-industry partnerships***. Inserting a principles statement that recognizes the benefit to university faculty and students of industrial collaborations would help to set a tone that is receptive to forming the linkages necessary for economic development.

SBHE intellectual property policies that should be reconsidered in the light of best practices

- ***§611.2.2.k*****:** The definition of "work for hire" should be corrected and brought within §101 of the Copyright Act of 1976. Work for hire is a legal term which establishes the employer as the author of the work. It is incorrectly used in §611.2.2.k.
- ***§611.2.3.c***: The institutional "right of first refusal" to patent title is unusual in university policies. Most university policies establish an absolute right to title under certain circumstances. If those circumstances do not obtain, ownership either vests or is waived back to the inventor if he or she requests it. A right of first refusal in the university introduces an element of uncertainty into the legal disposition of ownership. The university's right of first refusal implies that even if title is vested in an inventor according to the policy, if the inventor subsequently wishes to transfer title to the invention to a third party, he or she may be required to offer title back to the institution on the same basis as offering it to a third party. Subsection c may be read as inconsistent or ambiguous in light of the waiver of title provision in subsection d. The policy should be modified to eliminate the university's "right of first refusal" in favor of a "first right of refusal" or "a right to acquire title," either of which require the university to take a specific action that settles the question of title with certainty.
- ***§611.2.3.d***: The practice of requiring a university to claim title to inventions within a set time limit, as this policy does under §611.2.3.d, is followed by some universities but not all. Many view a time limitation for making decisions on ownership as gratuitous (there being nothing under the law to require it *vis a vis* inventors) and believe it places the institution at both a disadvantage and some risk.

  The factors contributing to ownership decisions can be complex and are often dependent upon obtaining information from others who may or may not cooperate in the process. Making a mistake in determining ownership can have costly repercussions. If the university mistakes the source of funds used for the invention and as a result errs in its conclusion as to ownership, the result can be invalidation of a patent if federally funded or breach of contract if funded by an industrial partner.

There are also reasons why it may not be in the best interest of either the institution or the public to automatically default invention title to an invention to an inventor if the university decides not to patent, although this appears to be the practice under the current SBHE policy. By way of example, if the invention covers a research tool that is better left in the public domain for use or if patenting the invention might cut off a field of industrially sponsored research that the university would like to undertake, it would not be in its interest to permit patenting by the inventor.

A best practice with respect to making ownership determinations is to expect the university to use its best efforts to make an ownership assessment within a reasonable period of time, or to make it "diligently." A best practice in deciding on the reversion of patent title to the inventor is to leave it ***to the discretion*** of the institution. [emphasis added]

- ***§611.2. 3.d.1***: The minimum royalty share to be allocated to inventors is consistent with the lower threshold of most universities. However, the definition of "net royalties," which is the aggregated sum to be shared with inventors, includes subtracting from gross royalties "expenses incurred by the institution in conducting the research." "Docking" or reducing the inventor's share by research expenses is not common because of the following:

  1. The amount is often arbitrary to calculate.
  2. It may be so significant as to undermine any royalty distribution to inventors.
  3. It is an obvious disincentive for inventors.

  A best practice would be either to eliminate research cost recovery from the initial sharing formula with inventors and rely on use of the remaining percentage to cover any university costs or to explicitly set out which research costs will be subject to recovery prior to determining the net royalties for purposes of determining the inventor's share.

- ***§611.4***: There are several areas of the copyright policy that would benefit from further review. For instance, there is no exclusion from author or creator ownership for copyrights developed under institutional agreements with third parties (external agreements), although that exclusion appears throughout the patent section of the policy. It will hinder the ability of the universities to collaborate with industry if it is not clear that the institution has the right to require an assignment of copyrights developed under externally or third-party-funded agreements. While there appears to be some attempt in §611.2.4.c. to cover copyrightable works developed as a consequence of institutional agreements, it is unclear as to whether these are internal or external agreements.

- ***§611.2.4.b***: Permitting author ownership of copyrights developed with significant use of facilities or institutional resources should be further reviewed. Because no cap has been applied to the use determination, an author may personally benefit from substantial financial use of university facilities and resources. Reimbursement to the university for facilities use is handled from a share of royalties that the author may earn on his or her work. However, whether there will be any royalty return to the author is speculative at best. As a matter of fairness and good practice, it is suggested that

    1. The institution has the right to acquire title to copyrights developed with significant use of facilities; or
    2. A revision is made to the policy that places a dollar value cap on use of facilities or resources where the author(s) retain copyright; or
    3. The terms of significant use of facilities and resources is negotiated between the appropriate authority and the author(s) wishing to retain copyright.

- ***§611.2.6***: This section covering the ownership of copyrightable software omits treatment of software developed outside of the scope of employment. For instance, although software developed by administrative personnel hired to write or program software is considered within the scope of employment and is work for hire, faculty who write software generally are not considered as hired to write software. Software written by faculty is most likely not within the scope of employment and not work for hire. Since copyrights cannot be "treated" as work for hire under U.S. copyright law unless they come within the statutory definition of work for hire, a transfer by assignment will be required for the institution to own faculty copyrights. As a best practice, Section 6 of the policy should be expanded to deal with computer software developed by university personnel that is not within the scope of employment. Implementing the requirements found under §611.2.7.a.1. & 2. applicable to students would be appropriate to fix this situation.

- ***§611.2.7.a.1-3***: These sections deal with the ownership of student copyrights. The policy is unusual in that the university appears to have greater right to student copyrights than to the copyrights of nonstudents. Under the existing policy, if a student is working under a paid situation, the university will own the copyright. The policy applicable to nonstudent personnel does not use the fact of financial support as the sole determiner for the requirement to assign to the university. This inconsistency between student and nonstudent copyrights may be inadvertent. Nevertheless, it should be reconciled either by tightening the institution's ownership rights to copyrights of nonstudent personnel developed with university funds or limiting the university's rights of ownership over student copyrights to align with the university's rights to nonstudent copyrights.

Other SBHE policies affecting technology transfer and commercialization that might be improved

1. **§§611.4 and 611.5** set out SBHE policy with regard to conflict of interest and consulting. §§611.4 is specifically aimed at conflicts of interest occurring as a consequence of an individual who is an officer or employee of the Board of Higher Education. The policy also requires employees who are participating in research programs receiving federal funds to consult and abide by the federal laws and regulations that apply. §611.5 permits university employees to provide consulting and or other services to third parties outside the university to the extent they do not interfere with the individual's university work or constitute a conflict of interest. The institutions are granted authority to implement prohibitions on use of university property, equipment, etc. for consulting or private use or, conversely, to establish approvals for such use. However, few principles and little direction are provided by the SBHE as to establishing conflict of interest policies. It would be helpful both for university employees and for companies wishing to do business with individuals who also hold university positions to have guidelines established under SBHE auspices that will inform where lines are drawn as to acceptable versus non-acceptable practices. Many universities have implemented these and found them useful.
2. **§611.6** describes employee responsibility for the handling of confidential proprietary information. Since this section refers to the exclusions from open records set out at §44-04-18.4, it loops back to the issues related to the open-records law discussed earlier and is unclear as to information that may be or may not be subject to open-records. Even if the lack of clarity in open-records is not reconciled, under this section of the SBHE policies it would be helpful to clearly establish an obligation of confidentiality on the part of employees for nonpublic, proprietary, or trade secret information disclosed to them by an organization that is not a public entity.

5.6 Other Intellectual Property and Technology Transfer Issues and Findings

Beyond the legal issues presented and discussed in **Sections 5.4 and 5.5**, RTI also became aware of operational issues related to the state's management of intellectual assets within the university system. These findings resulted from interviews with university administrators, companies, faculty both still in the North Dakota system and formerly with the North Dakota system, legislators, economic development professionals, and technology transfer professionals in technology transfer offices, incubators, research parks, incubators, etc. Specifically, this section will address some key facts and findings, as follows:

- Intellectual property is complex and like any business opportunity requires investment to maximize the beneficial outcome (see **Section 5.6.1**).
- A healthy long-term strategy is to build relationships with both small and large companies from North Dakota and elsewhere (see **Section 5.6.2**).
- North Dakota's current commercialization structure creates some conflicts of interest that should be designed out with future growth (see **Section 5.6.3**).
- University culture changes are needed to continue to exploit the state's investment in research for optimal exploitation and future benefits (see **Section 5.6.4**).
- Intellectual property awareness is needed at various levels, including faculty, investors, and legislators (see **Section 5.6.5**).
- Implementation of policies should be reviewed for consistency and alignment with intent (see **Section 5.6.6**).

5.6.1 Intellectual property is complex and like any business opportunity requires investment to maximize the beneficial outcome

The "old adage" among technology transfer specialists is "Technology transfer is a contact sport." Technology transfer is largely about relationships as the transfer rarely is solely based on the transfer of intellectual property rights but more often includes transfer of "know-how" and in some cases legally protected trade secrets. Thus any technology transfer effort requires the following:

- identifying a potential commercialization partner(s)
- attracting a partner(s) of interest
- jointly agreeing on the scope of the relationship(s)
- mutually valuing the assets transferred as part of the partnership(s)
- structuring interface opportunities for successful knowledge transfer

In any business, the creation of a product or asset is only the beginning of the value extraction process. After development, businesses must still invest in marketing (creating awareness and value extraction strategies), sales, and client management. Similarly, North Dakota must adequately fund the exploitation of the intellectual property its universities create and protect, or the base investment will not produce a satisfactory return on investment (ROI).

The university system has invested in 1) research, 2) education about IP that has generated a pipeline of invention disclosures, and 3) IP protection, including patent prosecution and maintenance. Now North Dakota must invest in the people and tools to accomplish the following:

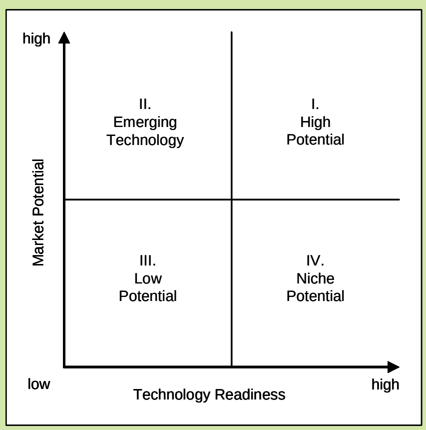
- Continue to motivate faculty to submit high-quality invention disclosures.
- Filter invention disclosures to ensure the best possible investment of patent filing and commercialization resources.
- Efficiently manage resources to maximize return on the investment in IP, including developing and implementing appropriate marketing strategies and facilitating partnerships.

When advising university clients about IP investments, RTI uses an analysis of the commercial potential in unison with consideration of the development status to focus resources on appropriate commercialization strategies. This analysis helps to consider opportunities based on a risk (low if well developed) to reward (high if commercial potential exists) analysis. **Figure 5.3** illustrates this analysis.

Figure 5.3. Quadrant chart analysis

Quadrant I: High potential for commercial/licensing success. Typical recommendations for technologies in Quadrant I will be to pursue commercialization and IP protection.

Quadrant II: Emerging technology in a sizable market. Recommendations for technologies in Quadrant II will assess whether moving forward on the technology readiness scale is warranted by the technology's ability to capture a significant portion of the market. If it is believed that the technology, with additional investment, can be shifted to Quadrant I, then the recommendation will be to pursue commercialization and IP protection. If it is believed that the technology will not make it to Quadrant I, even with additional investment, then the recommendation will be to discontinue support. If RTI cannot make the recommendation based on the assessment, at a minimum, key issues will be identified.



Quadrant III: Low potential for commercial/licensing success based on an emerging technology in a limited market. Typical recommendations in Quadrant III will be not to pursue commercialization or IP protection. For technologies in this quadrant, the best case is to move to Quadrant I; however, typically this is unlikely for technologies placed in this quadrant.

Quadrant IV: Niche potential may exist based on a developed technology in a limited market. Technologies that fall in Quadrant IV are far down the development cycle yet do not have significant commercial potential. For these cases, the recommendation will be based on whether a commercial success/license can be accomplished with limited investment. Thus, if a willing partner exists and has already been identified, the recommendation may be to move forward. However, if no willing partner exists, the cost to attract a partner and execute an agreement may not warrant investment based on limited financial upside.

Source: RTI International

5.6.2 A healthy long-term strategy is to build relationships with both small and large companies from North Dakota and elsewhere

As in any investment portfolio, the best practice is a diversified portfolio. A good technology transfer program should also be diversified and should include building relationships with companies of varying sizes as well as locations. Relationships with large companies that are not local can have as favorable a long-term impact on local economies as working with local companies. It is not uncommon for large companies located anywhere in the United States or abroad to begin modest long-distance relationships with universities. If successful, companies may locate a few people near the research institutions with which they are working and then ultimately create a larger presence in terms of a research capability to be near the research teams with whom they are working in the university. It will be important for North Dakota to avoid the perception that it is creating preferences for North Dakota companies since that may cause well-established companies to look elsewhere for partnership opportunities. Preferences limit the universities' ability to exploit their assets in a way that ensures maximum advantage back to the university and state. If the best commercial partner is chosen, then the greater the likelihood of successful product development and the greater the opportunity for meaningful royalty return to the university. Also, even when working with an out-of-state company, it is likely that if a healthy relationship develops, the company may ultimately fund research at the university, bring research jobs to the state, and possibly bring manufacturing jobs to the state to be near the research.

The best situation is where the commercialization manager is able to consider various partners and make the best judgment on a case-by-case basis. Instead of preferences, the way to create better opportunities for North Dakota companies is to provide programs offering them other advantages that improve their ability to compete and make them more attractive partners. As North Dakota grows, especially if clusters develop, the ability for the university to partner locally will continue to improve.

A best practice to consider is the Centennial Campus at North Carolina State University (NCSU), which offers an opportunity for companies of all sizes to be better integrated with the university. The key is to create a linkage whereby both the companies and the university benefit from the relationship. Often sponsored research is part of the relationship, and thus the requirements of IP ownership must be considered. **Table 5.3** presents the views of both sides in simple terms.

An example of this kind of relationship is beginning to emerge at NDSU with Alien Technologies, related to RFID technology. In the original relationship, NDSU subcontracted to Alien for research on a Department of Defense (DoD) program. The first phase could be categorized as cooperative research that was conducted "virtually" and with site visits. Then Alien leased space for about 30 employees to be near NDSU and started construction on a facility that will ultimately house an expected 200–300 people, which are all new jobs for North Dakota. The relationship may well spark the development of specific job skill training on one of North Dakota's community colleges and will start to bring an area of high-tech expertise to the state, which in turn will bring supporting players like suppliers and other entities interested in aligning with Alien and the university.

Table 5.3. A comparison of industry and university views

University View	Company View
Must use caution when creating terms to avoid issues with private business use of bond-financed facilities—if mismanaged may invalidate tax exemption	Seek special skills, equipment—looking to fill resources gap
Love the concept of IP and the possibility for prestige and income, but in reality IP is not a critical part of the core values of the university—education and publication are far more important	IP is key strategic asset—protects product development investment, controls competition, is asset for cross-licensing, enables product and/or licensing revenue
Ownership is legally driven by inventorship and rarely is research developed solely with industry funds—Bayh-Dole implications	Want to own what they pay for and exclusivity is typically critical
Revenue Procedure 97-14 creates a "safe harbor" for certain types of activities if the sponsor pays a "competitive price for its use"	Recognizes need to protect tax-exempt status but sometimes feels this issue is used as a smokescreen or shield in negotiations to limit some discussions artificially
Not interested in granting a sponsor rights to all background technology because it ties it up with one partner, gives additional (potentially unpaid for) benefits, can impact researchers not benefiting from the sponsored research	If paid for the research and can't benefit from the discoveries because of blocking technology, then that is not fair and they will most likely not be back to sponsor any other research
University must publish but can delay for a short period of time and/or can agree not to publish confidential information owned by others	Industry understands the need to publish but may seek "reasonable" limitation on publication rights, especially dealing with the inclusion of confidential information that affects patent rights
Typically controls prosecution; however, allows comment by industry partner and may allow industry to choose prosecuting law firm if firm will recognize university as the ultimate client	Industry should be able to direct patent prosecution because of awareness of competitive environment and may pay for some portions depending on exclusivity

Source: Based on a presentation by John Ritter, Dir. Patents & Licensing, Princeton University, and Scott Bluni, Sr. Patent Counsel, Boston Scientific, at the combined meeting of the Licensing Executive Society and the Association of University Technology Managers, May 2006.

North Carolina State University (NCSU) Centennial Campus

North Carolina State University (NCSU), the land-grant university in North Carolina, has had a long history of outreach and extension. Twenty years ago, that culture of outreach was extended into industry-university collaboration. Land-locked in the middle of downtown Raleigh, in 1984 the campus was bursting at the seams. Chancellor James Poulton approached Governor Jim Hunt about donating land to increase the size of the NCSU campus. Hunt challenged Poulton to think of a new model for the campus. A vision of a research park designed to create close collaboration between NCSU students, researchers, and their corporate peers was created. The initial donation was 350 acres. Today Centennial Park has grown to 1,300 acres, and is an international success story for university research parks. Centennial Campus currently has over 50 non-university entities—both corporate tenants and federal government agencies—that total more than 1,600 employees. In addition 1,200 faculty and staff and over 2,000 students are actively involved in research projects on campus. Tenants include a mixture of well-known large corporations (ABB was the first tenant in 1991, now Red Hat, GlaxoSmithKline, and Analog Devices are among the larger tenants); government agencies such as NOAA, USDA, and the U.S. Forestry Service; plus dozens of small to medium enterprises, each with an average of 15 employees.

All tenants, whether originally located in NC or elsewhere, are drawn to Centennial Campus for the access to the research facilities and capabilities that exist at NCSU. All tenants have to be collaborating with NCSU in some manner. Most are working closely with masters and Ph.D. students. Other types of corporate interactions include sponsoring research, collaborating with faculty, contracting for services from faculty, and access to university labs and equipment. Centennial Campus also has a special program for start-ups: access to interns in the University Scholars program. Centennial Campus, University Scholars, and the start-up company each pay one-third of the internship. There is an incubator on campus also to support either faculty start-ups or community entrepreneurs wanting access to NCSU technology or expertise. NCSU's Office of Technology Transfer is also on Centennial Campus. Their role is to manage IP issues with corporate tenants, address student involvement issues, and facilitate the transfer of technology from the university to industry partners.

Centennial Campus leaders state that proximity has been the key aspect of growth. Not just proximity to the main campus, which has bus routes and bicycle paths to facilitate transfer of students and researchers, but also proximity to related organizations at Centennial Campus. The research park plan is laid out as neighborhoods—focused in areas such as education, materials, information technologies, life sciences—so that university faculty, students, companies, and government agencies co-exist in the same buildings. Most of the construction of those buildings was conducted via debt financing that was allowed by special permission from the North Carolina legislature. Any profits from the financing go into the Centennial Trust Fund, which manages the property.

Source: Information in this section gathered from Centennial Campus literature and RTI interviews with Centennial Campus leaders in April 2005.

A concept that RTI heard from various sources in North Dakota was "why not offer royalty-free licenses to North Dakota companies to foster greater local economic development." While on the face this sounds like a straightforward and good idea, it really is complex in nature and in general is not considered to be advantageous to either the university or state's economic development efforts for many reasons:

1. Most successful partners are best vetted by their ability to invest in an asset. Their investment becomes a motivator for success, which is what both the university and state want.

2. A royalty-free, non-exclusive grant assumes that a license to other companies on the same technology in the same field of use would also be on the same terms since the technology will have been valued as royalty-free. (See sidebar on tax-exempt bonds.)
3. The university-based inventors have a legal right to share in the royalty income, which in this situation would be $0 because there would be nothing for the university to share. Thus, in any situation where this is being considered, the inventors and their department would need to agree.
4. Without a vested partner and royalty income, the cost of patent prosecution might not be fiscally wise and thus the better route might be to publish and let the North Dakota company patent improvements beyond the information put in the public domain by a publication.

Tax-exempt Bonds

1. The Tax Reform Act of 1986 (35 U.S.C. 287)

- The Tax Act limits the ability of government or others, e.g., universities, to divert use of tax-free funds to private benefit, e.g. to benefit those engaged in a trade or business.
- By tax-free funds, we mean tax-exempt bonds used to build, repair, or upgrade research facilities at universities, including facilities to be used for university/industry research collaborations.
- Revenue Procedure 97-14 sets forth the conditions under which research would not be considered private benefit under the Tax Act by establishing safe harbors for determining when corporate-sponsored research agreements do not give rise to private business use. Specifically: “Any license or other use of resulting technology by the sponsor is permitted only on the same terms as the recipient would permit that use by any unrelated, non-sponsoring party (that is, the sponsor must pay a competitive price for IP use), *with the price paid for that use determined at the time the license or other resulting technology is available for use* (italics added). Although the recipient need not permit persons other than the sponsor to use any license or other resulting technology, the price paid by the sponsor must be no less than the price that would be paid by any non-sponsoring party for those same rights.”
- The problem arises when private business use activities in buildings the construction or remodeling of which is funded in whole or in part by tax-exempt bonds exceeds the threshold set by the IRS. Exceeding the threshold puts the tax-exempt status of the bonds at risk.
- A further complication arises because this threshold is ill-defined and the definition of private business use is extremely complicated in the context of whether it is space, money, and time that must be the basis for evaluation. It would be better left to a qualified tax attorney to determine what a particular institution’s threshold and liability are at any given point in time.
- Private business use toward the threshold is cumulative over the entire term of the bond issue so that an accounting procedure would need to be put in place to track this, and may still be a questionable number based on the ambiguity of the definitions.

Tax-exempt Bonds

Some examples of private business use in buildings funded by tax-exempt bonds that would accrue toward the threshold

- Research agreements where the company is granted a royalty-free license (In some circumstances, we do grant royalty-free non-exclusive licenses to sponsors, so we are already contributing to the threshold)
- Research agreements where the company owns the inventions
- Research agreements where the royalty to be paid on inventions is stated in the research agreement that was signed before the inventions were made (again we sometimes establish caps)
- An agreement to lease a research laboratory to a company for their use
- An advanced technology center where the industrial advisory board decides what research is performed or how it is performed
- An advanced technology center where the companies jointly own inventions that arise
- A professor beginning a company in his or her academic laboratory and working on company projects there

Consequences of bonds losing their tax-exempt status

- It seems likely that after a series of lawsuits the university would have to pay the tax burden on all of the outstanding bonds, not just those used for the building where the sponsored research was carried out.

2. Unrelated Business Income Tax (UBIT)-Operational Test under 501 (c)(3) of the Internal Revenue Code

To satisfy the operational test, an organization must be deemed to operate exclusively for its specified non-exempt purpose. A key element in the operational test is the requirement that the organization benefit the public at large. The IRS considers an organization that benefits private interest in anything more than an insignificant or incidental extent to have failed the test. While some form of private benefit is unavoidable, any benefit that accrues to a private individual, group, or organization must be merely incidental to the organization's service to the public.

Assignment of rights in IP

- Assignment of IP by the university or Iowa State University Research Foundation, Inc. (ISURF), versus licensing, would be treated as a sale, which may trigger UBIT and require ISURF to pay taxes on the value of the IP and the university to pay taxes on the research dollars received.

Further consequences of assigning rights in IP to a sponsor

- The principal investigators on the project would have to sign off on this arrangement, agreeing to no income sharing. Case law has shown that researchers do have a right to benefit from their IP. Consequently, their approval would be important.
- Since the company would own the IP, graduate students could not work on the project because they would not be able to publish their results (a thesis is a publication), or the publication would be severely limited.
- Absolutely no federal funds could be used for supplies, equipment, personnel (including faculty salaries), or research.
- ISURF would not be able to reclaim the IP if the company failed to commercialize it. Since we are responsible for ensuring that our IP is made available for use by society through commercialization within a reasonable period of time, our public good mission would not be met.

Tax-exempt Bonds

Advantages of the university retaining rights in IP

- Preserves the link between the inventor and the licensee, which encourages the continuing transfer of know-how and expertise necessary for the commercial development of the basic invention.
- Provides incentives for university scientists to work with industry, invent, disclose, and cooperate in the patenting process.
- Involvement in the patenting process is an important link between universities and industry.
- Ensures utilization of patented technology through due diligence requirements under license agreements.
- Ensures the ability for the university to license to others if the licensee's business fails or the licensee is no longer interested in commercializing the technology.

Source: Bullets are based on "Iowa State University Research Foundation, Inc. (ISURF) and Office of Intellectual Property and Technology Transfer (OIPTT Working with Industry on Sponsored Research Agreements." See www.techtransfer.iastate.edu and www.ospa.iastate.edu. Sidebar is an abbreviated version of the appendix from the same.

Additional insight from other universities can be found at:
http://www.unlv.edu/policies/ubit.html
http://fa.ufl.edu/tax/unrelated-business-income-tax.asp
http://research.ifas.ufl.edu/cm/UnrelatedBusinessIncomeTax-SponsoredResearch.ppt#257,2, Introduction

5.6.3 North Dakota's current commercialization funding creates some conflicts of interest that should be designed out with future growth

At present multiple people in the NDUS are part-time in various jobs that relate to commercialization. Because of the size and funding of the operations, this was justifiable in the preliminary development to attain the benefit of having the various organizations adequately staffed. However, conflicts of interest are inherent in some of these situations. This is not to say that anyone in any of these positions has acted unethically; in fact, they strive to "wear two hats" appropriately at all times. With future growth this "dual-role" structure needs to be eliminated as the complexity in managing the dual roles is inefficient. Also, perceived conflict of interest damages the credibility of the individuals and organizations. Examples include the following:

- NDSU Director of Technology Transfer is also Executive Director of NDSU Research Foundation; staff is also split between the two offices.
- UND Director of Technology Transfer and Commercialization is also Director of the University Research Foundation.
- Associate VP for the Center for Nanoscale Science and Engineering is also the VP for Interdisciplinary Research.

A resource of interest on recognizing and managing conflicts of interest is provided in the following sidebar.

Separation of Technology Transfer Activities from Business Development/Start-up Initiatives[45]

Increasingly, technology transfer offices are engaged in promoting economic development or assisting faculty inventors in writing business plans, obtaining financing, establishing management schemes, or placing start-up ventures in institutional or state-run incubator facilities. Most often these forms of assistance are directed toward companies where the institution has taken an equity position in lieu of some other consideration that it would normally receive from a third party. Inevitably, several potential conflicts might arise in such situations. The university should ask itself:

- Has it chosen the best vehicle to fulfill its Bayh-Dole mandate of bringing the invention to societal benefit as quickly as possible?
- Can it objectively monitor the diligence of the licensee company in developing the technology?
- Is it biased toward a faculty member's company as a potential licensee versus a third-party licensee?
- Is the university receiving fair market terms?

Some institutions have addressed these issues by formally separating licensing and commercialization of intellectual property activities from business and economic development by establishing independent organizations for these purposes—like NDUS research foundations.

Management of institutional conflicts of interest is by its very nature more complex than that of individual conflicts of interest. External relationships to sponsors and supporters of the institution, the local community's acceptance of economic development activities, the institution's obligations as a charitable organization receiving preferential tax treatment, and the institution's perception of its teaching, research, and academic missions all impact how potential conflicts of interest are managed. Current federal regulations for managing individual conflicts of interest can be instructive, but they suffer from the difficulty of objectively assessing the adequacy of institutional management schemes. At this time, several management options that some institutions have already implemented include the following:

- Reduce or eliminate involvement by institution employees in institution-associated company activities.
- Actively manage and review conflicts using external reviewers or independent managers.
- Build organizational firewalls so that potentially conflicted parties do not interact on these matters. For example, institutional technology transfer offices should not be in the decision chain of identifying or managing conflict.

Cautions and Reminders

The examples and issues presented above do not necessarily constitute inappropriate conflicts of interest. Each situation must be judged on the facts and merits of the relationship with an eye to what reasonable individuals outside the affected community might consider to be appropriate. Some activities that could protect institutions as they consider their involvement in technology transfer and economic development activities would consist of the following:

- Rely on written policies.
- Strive for impartiality.
- Seek alternative arrangements external to the institution.
- Anticipate situations that could be perceived as compromising research and fiduciary integrity.
- Publicize and open the decision-making process.

[45] Taken from Recognizing and Managing Personal Financial Conflicts of Interest, *Council on Governmental Relations*, Winter 2002. www.cogr.org/

5.6.4 University culture changes are needed to continue to exploit the state's investment in research for optimal exploitation and future benefits

RTI's interviews highlighted that in North Dakota everyone is "pulling in the same direction" and everyone thinks the COE program is resulting in positive impacts on many fronts. However, certain "growing pains" were documented and if addressed, will improve the success of North Dakota's upswing in research funding in the years to come. In some cases things are already improving, yet the issues were worth documenting:

- Filing invention disclosures and investing time in supporting patent prosecution was equated to "professional suicide" for untenured professors. The system does not yet adequately recognize the value of protecting IP, and in tenure review these efforts are not given the same weight as peer-reviewed papers. Similar comments were made about participating in SBIR/STTR activities.
- Faculty are encouraged to do the following:
  - Write proposals for grants (with no funding for the writing process).
  - Bring in research work (with no reduction in teaching load, or administrative support for related research administrative tasks).
  - Continue to bring in more research while completing existing research commitments and teaching—functionally the faculty are "running out of facilities" and "burning out."
- Use of sabbaticals is virtually non-existent because the teaching needs must be met and therefore entrepreneurial activities (let alone traditional sabbatical benefits) are constrained.

5.6.5. Intellectual property awareness is needed at various levels, including faculty, investors, and legislators

Intellectual property is a very specialized area of the law, and in NDUS's case, its inherent link to high-tech developments adds to the complexity. Beyond the obvious need to continue to educate faculty about the value of protecting IP so that the university can best manage assets to generate returns such as royalty income, relationships that result in research, opportunities for students, start-ups, North Dakota jobs, etc., is the need to educate investors. At present North Dakota investors are comfortable with agricultural opportunities and traditional business investments. However, when dealing with early-stage technology development and related IP issues, the need for limited disclosure and the fact that the asset is intangible makes it harder to create confidence in investors. With education and as successes result in positive returns, this problem will diminish.

5.6.6 Implementation of policies should be reviewed for consistency and alignment with intent

NDUS has done a good job of creating general policies as a preliminary step in ramping up technology transfer and commercialization. As with legislation, policies should continually be revisited and revised to meet the changing needs of the system and changes in applicable laws and federal regulations. Implementation needs to be reviewed for consistency and fairness, and most importantly, to ensure that applications of policy align with the intent in creating the policy. A second benefit from policy review is that it generally feeds into the education objectives discussed previously. Anecdotal situations highlight the need for this effort:

- One company described a situation where, when working with a group of university researchers, a company requested faculty to sign nondisclosure agreements. Several faculty were ready to do so without understanding that they did not have authority to bind their university to a nondisclosure agreement. It was only the knowledge of one university representative that kept this group from inappropriately signing the agreements.
- RTI was told that it is very difficult for undergraduate students doing senior design projects to collaborate with outside companies because the IP terms of the agreements required by the technology transfer office were onerous and unacceptable to the companies. Other universities have solved the problem of ownership of IP resulting from student class design projects by “brokering” agreements that recognize both the company’s interest in controlling the solution to the design problem it has submitted to the students and the contribution of the students who may be inventors. Part of the resolution would be a change in SBHE policy, or the application of it, to recognize student ownership of inventions made by them in a classroom setting and permit the students to decide on appropriate disposition of those inventions. A key to this kind of solution is the need to educate the faculty advisors and the students on intellectual property and the issues related to ownership and rights.
- It is apparent that issues exist relating to use of research tools licensed into the universities under restrictive academic-use-only licenses that are nevertheless used by faculty for non-academic consulting. RTI recommends that NDUS should educate its faculty and students to increase the correct use of others’ intellectual property in light of the following:
    - NDUS is in jeopardy of breaching the licenses and may be subject to liability under the terms of the license or to termination of the license altogether.
    - Personal use by their researchers for non-academic endeavors creates an unfair competitive advantage for those individuals over commercial service providers who must pay higher prices to get access to the research tool.

  - Individuals who are using the research tools without the legal right to do so are jeopardizing rights to their own work and placing the companies they are consulting for at risk as well.
- Comments indicated that faculty are given time to consult, yet efforts to set up these agreements are so complex and confrontational that the opportunity is not what it is intended to be. This meshes with the universities' views that the university "will not do work for hire." RTI recommends that the system reconsider this hard stance and consider the practices of university systems with a more flexible view. In many cases preliminary work for hire is the genesis of a larger relationship where IP is generated and will be owned by the university. Functionally, there are times when pure consultancy is suitable and beneficial, and simple agreements should be in place for use in these cases. Once the relationship and role of the university increases, more complex agreements that stake the university claim to IP are appropriate.
- Collaboration with industry is a key economic driver for the university and surrounding region. The parties must be willing to consider the conflicting needs of each other and seek a compromise so that beneficial relationships can be built. Some issues and compromises include IP rights, revenue sharing, right to publish and timing, as well as exploitation of the asset. **Table 5.3** above summarized the inherently conflicting positions.

The Research University and "Work for Hire"

It is often said that U.S. research universities do not do "work for hire." That is, they do not undertake research pursuant to a contract with a "buyer" of their research services where the bargained-for exchange is ownership of the research results for a purchase price that becomes profit to the research organization ("contract research"). Rather, universities undertake research for the primary purposes of teaching and to advance science. However, occasionally there is a distinction to be made where the results of the research are not important, but the "doing" of it is. By way of example, the information or data used in conducting the research (sample testing, clinical trials) is not important to science and not of publishable quality, but the educational value in performing the research is significant. In these special cases, the university may gain more than it loses by carefully considering conditions under which a "work for hire" principle may be modified to meet educational goals.

5.7 Intellectual Property and Technology Transfer Conclusion

North Dakota has done an excellent job of ramping up IP management by creating policies and procedures, educating researchers, generating invention disclosures, and filing for patents. On the agricultural side, there is a good level of sophistication with technology transfer and commercialization. On the technology side, the level of sophistication in technology transfer and commercialization is growing. As with any emerging effort, the major research universities within NDUS now must revisit the application of their policies and procedures as the level of effort and various situations arise. Some of the best practices presented might offer a good basis for revisions within the NDUS policies and procedures.

6. Entrepreneurship

6.1 North Dakota Entrepreneurship in Context

Between 2003 and 2004, North Dakota had a modest gain in new businesses (1.89%), with a large percentage of this gain in small businesses (see **Table 6.1**). The healthiest small business growth was in seen in these industries: educational services (7.14%), mining (4.90%), and real estate (4.53%).

Small businesses are vital to North Dakota's economy. There were an estimated 59,158 small businesses in North Dakota in 2004, and of those, 18,522 had employees. The number of small businesses with employees has risen slightly (2.6%) over the past five years from 18,077 in 2001. The number of self-employed persons numbered 52,633 in 2004.[46]

The number of high-technology establishments[47] is relatively small in North Dakota, estimated to be only 1,000 in 2004, representing 4.12% of North Dakota's total establishments. These 1,000 high technology establishments employ 14,072 people,[48] an average of 14 people per establishment. (This is up from 554 firms and 13,140 employees in the high-technology sectors identified in the 2002 Economic Census.) As shown in **Figure 6.1**, North Dakota's percent of high-technology establishments is very low compared to the nation and compared to the average of the other EPSCoR states.

[46] U.S. Small Business Administration Office of Advocacy, Small Business Profile: North Dakota. www.sba.gov/advo.

[47] This is based on a definition of high technology established by the U.S. Department of Commerce, comprising 39 NAICS codes. This definition is widely used to facilitate comparisons between states.

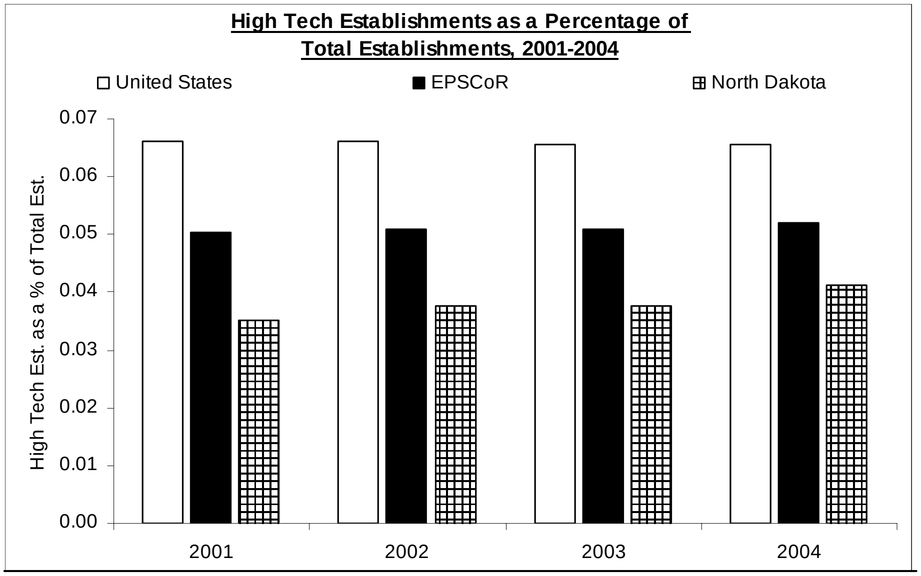
[48] Policy One Research, Inc., tabulations from US Census Bureau, County Business Patterns.

Table 6.1. New business formations in North Dakota, 2003–2004

Industry	# of Firms	Numeric Change 2003-2004	Percent Change 2003-2004	# of Firms with Less than 100 employees	Numeric Change 2003-2004	Percent Change 2003-2004
Agriculture, Forestry, Fishing & Hunting	482	11	2.30%	482	11	2.30%
Mining	192	9	4.90%	187	9	4.90%
Utilities	127	-3	-2.30%	121	-3	-2.30%
Construction	2,719	84	3.20%	2,712	80	2.95%
Manufacturing	812	16	2.00%	759	12	1.58%
Wholesale Trade	2,331	50	2.20%	2,319	47	2.03%
Retail Trade	3,231	0	0.00%	3,162	0	0.00%
Transportation and Warehousing	1,070	-1	-1.00%	1,061	0	0.00%
Information	406	-5	-1.20%	393	-5	-1.27%
Finance and Insurance	1,654	59	3.70%	1,643	59	3.59%
Real Estate and Rental and Leasing	713	32	4.70%	707	32	4.53%
Professional and Technical Services	1,708	48	2.90%	1,697	45	2.65%
Management of Companies and Enterprises	88	3	3.50%	84	3	3.57%
Administrative and Waste Services	1,029	13	1.30%	1,007	15	1.49%
Educational Services	112	8	7.14%	112	8	7.14%
Arts, Entertainment and Recreation	363	4	1.10%	355	3	0.85%
Accommodation and Food Service	1,783	-1	-0.10%	1,770	-3	-0.17%
Other Services (except Govt)	1,891	22	1.20%	1,883	20	1.06%
Private Sector Firms Only	22,170	407	1.90%	21,832	397	1.82%

Source: North Dakota Labor Market Information Center, Employment and Wages, 2004. www.state.nd.us/jsnd.

Figure 6.1. High-technology establishments as a percentage of total establishments, 2001–2004



Source: Based on EPSCoR data tracking by Policy One Research, Inc. tabulations from US Census Bureau, County Business Patterns.

6.2 Entrepreneurial Support in North Dakota

North Dakota has quite a few entrepreneurial support organizations, covering a broad geography. The Small Business Development Center network, for instance, has 12 locations. Other important elements of the network include the Institute for Business and Industry Development (IBID) run by NDSU, the Manufacturing Extension Partnership, the Women's Business Center, and the Entrepreneurial Center of North Dakota. The Center for Innovation at the University of North Dakota is both an incubator and a source of technical assistance for entrepreneurs, and the incubator at the NDSU Technology Park is currently under construction.

Our assessment of these organizations, however, is that with the exception of the university-based programs, there is limited expertise for the support of high-growth or technology-based entrepreneurial companies. These companies require assistance with a wide range of challenges not usually faced by small businesses, including hurdles in technology commercialization such as FDA testing for drug development and requirements for prototyping and testing of devices and software. Furthermore, the financing requirements of high-growth companies (see **Section 7**) whose primary asset is intellectual property are extremely different from small businesses with buildings, inventory, and accounts receivable. High-growth companies tend to require more financing, and often, equity financing. Skills required to negotiate with equity investors, especially professional venture capital organizations, are unique to this industry.

Therefore, we believe that the existing small business support networks, while providing an important service for North Dakota's small businesses, are lacking the experience necessary to support the emerging high-growth entrepreneurs.

The university programs are limited by resources. IBID, for instance, has two employees who work only 17 hours per week. The Center for Innovation, known for having expertise in angel investing and SBIR, for instance, also has a limited staff. Only two of the companies currently in residence at the Center appear to be technology companies. The new NDSU incubator was planned with the assistance of a very capable and well-known consultant and shows promise, but the choice of manager will be key.

It is not clear how much expertise exists in the community at large. The state has only two patent attorneys, both affiliated with firms from outside North Dakota. We suspect this is also true for corporate attorneys and accountants who might have high-technology expertise. On the other hand, there are a number of highly visible, large companies such as Microsoft, Phoenix, Bobcat, and others whose executives may be willing to be mentors to emerging high-technology entrepreneurs.

6.3 Importance of Technology Business Incubation

Technology incubators are an economic development tool to support and nurture new technology-based firms. These firms are a target for economic development because they are believed to grow faster than their large business counterparts, generating more jobs and more innovation.[49] Some challenges faced by smaller technology firms—notably, low survival rates—are believed to be offset by incubation, through the delivery of shared tenant services, including access to capital and business networks, and specialized university-related services.[50]

The National Business Incubation Association[51] defines an incubator as follows:

> "Business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services."

Critical components are management assistance and guidance, technical assistance, consulting as well as rental space, flexible lease agreements, shared basic business services and equipment, technical support, and assistance in obtaining financing.

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[49] Sherman, H., and D.S. Chappell. 1999. "Methodological Challenges in Evaluating Business Incubator Outcomes." *Economic Development Quarterly* 11(4): 313–21.

[50] Lalkaka, R. 1996. "Technology Business Incubators: Critical Determinants of Success." *Annals of the New York Academy of Sciences* 798: 270–90. Mian, S.A. (1996). "Assessing Value-added Contributions of University Technology Business Incubators to Tenant Firms." *Research Policy* 25: 325–335.

[51] http://www.nbia.org

Best practices[52] in business incubation include the following:

1. Provide comprehensive business assistance programs that include needs assessment processes and coaching and facilitation for clients, and monitor client progress using milestones.
2. Provide a network of individual advisors from the private and academic sectors that are available to assist clients. May be for free or reduced fees. Have volunteer mentors for clients. Have a pool of resources for advisory boards for clients.
3. Provide access to debt and equity capital. Establish links with angels, venture capitalists, and banks as well as other service providers willing to provide services.
4. Proactively encourage client networking and interaction.
5. Develop relationships with technologists and technology transfer offices; manage conflicts among the parties.
6. Establish linkages with universities and/or federal laboratories to leverage these assets for clients.
7. Provide flexible space and amenities for clients. Ensure sufficient leasable space for financial sustainability for the incubator.
8. Provide effective governance and staffing for incubator operation. Run the incubator like a business.
9. Screen potential clients and move clients toward graduation.
10. Regularly evaluate incubator program.

Technology incubators, such as the one planned for NDSU's Technology Park, need to leverage the nearby research institution's expertise and facilities and affiliate with the research institution to be successful.[53] State incubation programs such as the one operated by the Maryland Technology Development Corporation (TEDCO) (see sidebar) can provide a coherent approach to supporting a state's technology entrepreneurs.

[52] Excerpted from "Best Practices in Action: Guidelines for Implementing First-Class Business Incubation Programs," by Chuck Wolfe, Dinah Atkins and Hugh Sherman, published by NBIA 2001. Also, augmented by best practices on www.nbia.org. See also Best Practices section in "Does Technology Incubation Work: A Critical Review of the Evidence", by David A Lewis. NBIA 2002.

[53] Incubating Technology Business: A National Benchmarking Study, by Louis Tornatzky, Hugh Sherman, and Dinah Atkins, NBIA 2003.

Statewide Incubator Support Program, Maryland

The goal of the Maryland Technology Incubator Program is to support the growth of innovative companies through business incubation. Since 2001, the Maryland Technology Development Corporation (TEDCO) has been instrumental in building a network of incubators in the state. But it is also a vehicle for supporting technology-based entrepreneurs in all communities in Maryland as evidenced by the growth in the number of rural incubators since the program's inception. In addition, the incubators increase the state's reputation as a location for technology enterprises.

The incubator program fulfills these TEDCO goals by building the incubator infrastructure in Maryland as opposed to directly assisting companies. The objective is to contribute to the development of new incubators, renovate older incubators, and assist in the development of best practices in the management of the incubators and in the provision of services to incubator clients.

The Maryland Technology Incubator Program has three state-funded elements:

- Feasibility Study Grant Program
- Incubator Development Fund
- Support for best practices initiatives through the Business Assistance Fund

The Feasibility Study Grant Program assists higher education institutions and local economic development organizations to create and expand technology incubators. At the completion of a feasibility study, the recipient has an indication of whether or not there is sufficient entrepreneurial demand in his or her community to support a proposed incubator.

The Incubator Development Fund is designed to develop technology-oriented business incubators around the state. These funds are for capital expenditures to either build or renovate incubator space.

The Business Assistance Fund is designed to assist the incubators with providing the best possible services to their client firms.

TEDCO also celebrates the entrepreneurs that succeed through Maryland's incubators by sponsoring an annual Incubator Company of the Year Award.

Source: www.marylandtedco.org

6.4 Entrepreneurial Communities

Current thinking is that an entrepreneurial community, defined as an integrated system of entrepreneurs, support organizations, money, customers, service organizations, surrounded by supporting public policy is essential to growing and maintaining a significant number of high-growth entrepreneurial companies in a region. Entrepreneurial regions grow in a well-documented pattern, jump-started by the presence of a university or a successful entrepreneurial company and nurtured through a supportive climate and culture.

Entrepreneurial “hot spots,” a term coined by Massachusetts Institute of Technology researcher David Birch, have several elements in common:

- The respect of entrepreneurs and entrepreneurship by local businesses and community and political leaders
- Celebration of entrepreneurs and entrepreneurial success in the community and the media
- The commitment of successful entrepreneurs to give back to their community
- Acceptance of risk takers, seeing failure of ideas, not people
- An ethic of information sharing[54]

Our observations are that North Dakota has some challenges in this regard because of the culture of risk aversion and discomfort with displays of wealth. Both could discourage potential entrepreneurs from thinking about starting companies. On the other hand, the strong business support for investment in the New Economy evidenced from our discussions with business leaders and with the North Dakota Chamber of Commerce suggests that perhaps some elements of the “old” culture may be eroding.

An exemplar organization that North Dakota may want to study in more detail is the North Carolina Center for Entrepreneurial Development (CED). As described in the accompanying sidebar, CED has celebrated entrepreneurship and trained entrepreneurs in the Research Triangle Region for over 20 years and is believed by many to be an essential element to the Triangle’s success in entrepreneurship.

[54] The National Commission on Entrepreneurship. 2001. “Building Entrepreneurial Communities.” http://edwardlowe.org/index.peer?page=ENTcommunity, accessed May 17, 2006.

Center for Entrepreneurial Development, North Carolina

The Center for Entrepreneurial Development's (CED's) mission is to identify, enable, and promote high-growth, high-impact entrepreneurial companies and accelerate the entrepreneurial culture of the Research Triangle and North Carolina. Organized in 1984, CED is a private, nonprofit organization that is funded entirely from membership, sponsorships, and donations. It was formed by service organizations such as attorneys and accountants and has never received any state support.

With more than 4,000 members representing over 1,100 companies, CED is the largest entrepreneurial support organization in the nation. Over 8,000 people participate in CED's programs annually. These programs are in four areas: education, capital formation, mentoring, and communications.

CED sponsors ongoing training programs for entrepreneurs in a wide range of topics. Starting with their FastTrac-Tech program and continuing through an ongoing series of seminars on more detailed topics, CED has educated several generations of successful entrepreneurs.

The capital formation programs include the annual venture capital conference that introduces local entrepreneurs to investors from across the United States, and regular surveys and reports that track venture capital investments in the region.

Mentoring is an important element of CED's programs because they link seasoned professionals with entrepreneurs and bring knowledge and connections to help those in new ventures define and refine their ideas.

Communications is critical to supporting an entrepreneurial climate. CED celebrates the successes of the Triangle's community through annual tradeshows in information technology and biotechnology, through annual awards programs, and through weekly news briefs for the local and national media.

Source: www.cednc.org

7. Access to Capital

Financing high-growth technology companies is a substantially different challenge than funding other small businesses or, for that matter, existing companies. High-growth technology entities have several characteristics that create these challenges. These characteristics include the following:

1. Intellectual property is the major asset of the company. Especially in the early stages of these companies, the innovations that potentially will lead to commercial products and services are the only assets the company owns. The companies are usually operating in leased space with minimal equipment, and, being pre-revenue, lack the accounts receivables and other assets usually required for bank financing. In some cases, the IP is still in the process of being patented and developed, and so its commercial value is limited.
2. Technology companies typically have a higher risk profile than other small companies. Risk comes from several characteristics. One source of risk is the unknown associated with the technology itself. Will it work? Can it be scaled up? A second source of risk is the market, especially if the technology is creating a new market. Will the market accept this product? Will the market be willing to pay a price that allows the company to make a profit? A third source of risk is time. Technology products can take a very long time to get to market. This is especially true with biotechnology and other life science technologies, which have long regulatory cycles. It can take 6 to 8 or more years to bring a technology to market, perhaps 20 years for a vaccine or pharmaceutical.
3. Technology companies are often built around innovation that is not easily understood by lay persons. This means that there can be a substantial communications issue between an entrepreneur seeking financing and those in the financial community.

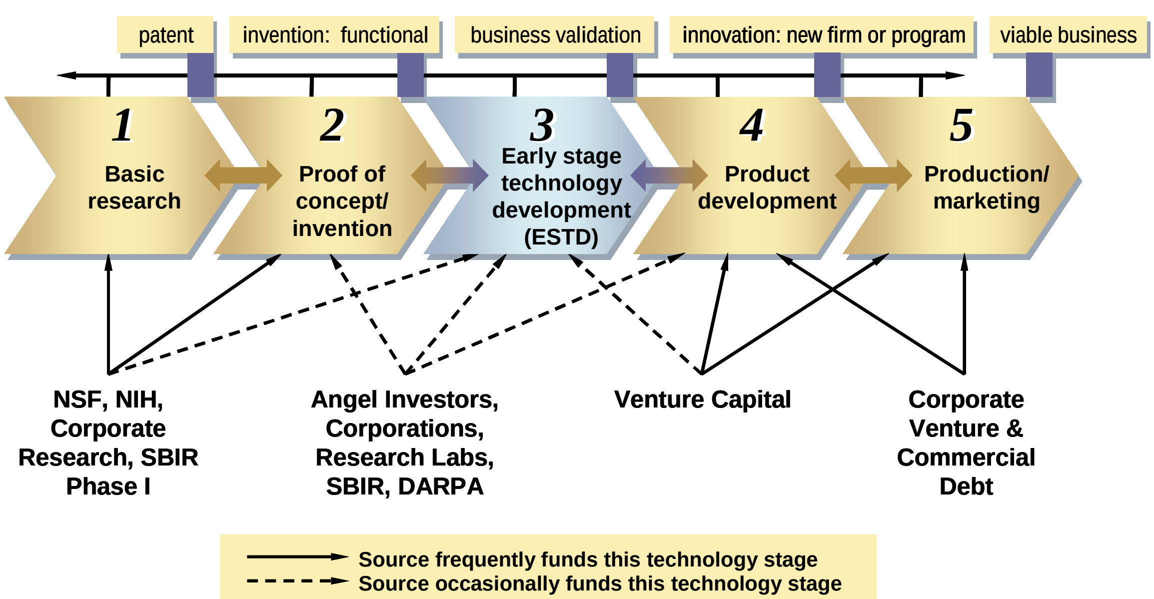
Therefore, high-growth technology companies typically go through a number of unique stages of financing, described below.

- Seed-stage financing: This is capital normally provided by the entrepreneur and "friends and family." The objective of seed-stage financing is to set up the corporation, and do basic R&D, including proof of concept. For technology that is coming out of a university, R&D has typically been done on grant or contract funding that was won by the inventor in his/her role as a university employee. Some federal programs such as SBIR/STTR and the Advanced Technology Program can be used for the proof-of-concept stage.

- Early-stage funding: Product development, getting an idea from proof of concept to initial customer sales, is extremely difficult to finance. This can occasionally be funded by federal programs and some angel investors.
- First-round venture funding: Advanced product development and product marketing funding is often obtained from venture capitalists and/or angel investors. However, investors at this stage require verification of the technical feasibility of the innovation, and indications of market acceptance. The existence of credible customers who will speak to the importance of the product is essential. Venture capital is available to companies who do not have the size, assets, and operating histories to receive financing from debt or public markets.
- Follow-on venture funding: Depending upon the technology involved, companies may need more than one round of venture funding.
- Initial public offering (IPO) or merger and acquisition (M&A): At some stage, companies typically go to the public markets through an IPO or sell to another company (M&A). At this point, the company is typically very mature and also has access to debt financing for buildings, equipment, and cash flow.

This process is depicted in **Figure 7.1**. As can be inferred from the previous discussion, there is a well-documented gap in funding available for high-growth technology companies, and that is Stages 2 and 3—proof-of-concept and early-stage technology development. Our focus in this section will be on state programs that seek to address this gap: SBIR/STTR programs, seed-stage or gap financing, and investment tax credits.

Figure 7.1. Financing a high-growth technology company



7.1 Small Business Innovation Research and Small Business Technology Transfer Program

The federal government has two set-aside programs for small business to engage in federal R&D with the potential for commercialization. Both the Small Business Innovation Research (SBIR) and Small Business Technology Transfer Program (STTR) tap into a congressionally mandated amount (0.30% in FY2004) of the federal extramural R&D budgets. Ten agencies[55] have SBIR and STTR programs.

Small businesses with less than 500 employees, who are at least 51% U.S.-owned and independently operated are eligible to apply for grants to conduct feasibility studies (Phase I) and R&D (Phase II) on topics defined by the participating agencies. The objective is to reach commercialization (Phase III) either through the commercial sales of the resulting product or service, or through federal sales.

The sizes of SBIR/STTR awards are set by legislation: $100,000 for Phase I and $750,000 for SBIR Phase II ($500,000 for STTR). The only difference between the two programs is that STTR requires the small business to have a U.S. research institution as its partner.

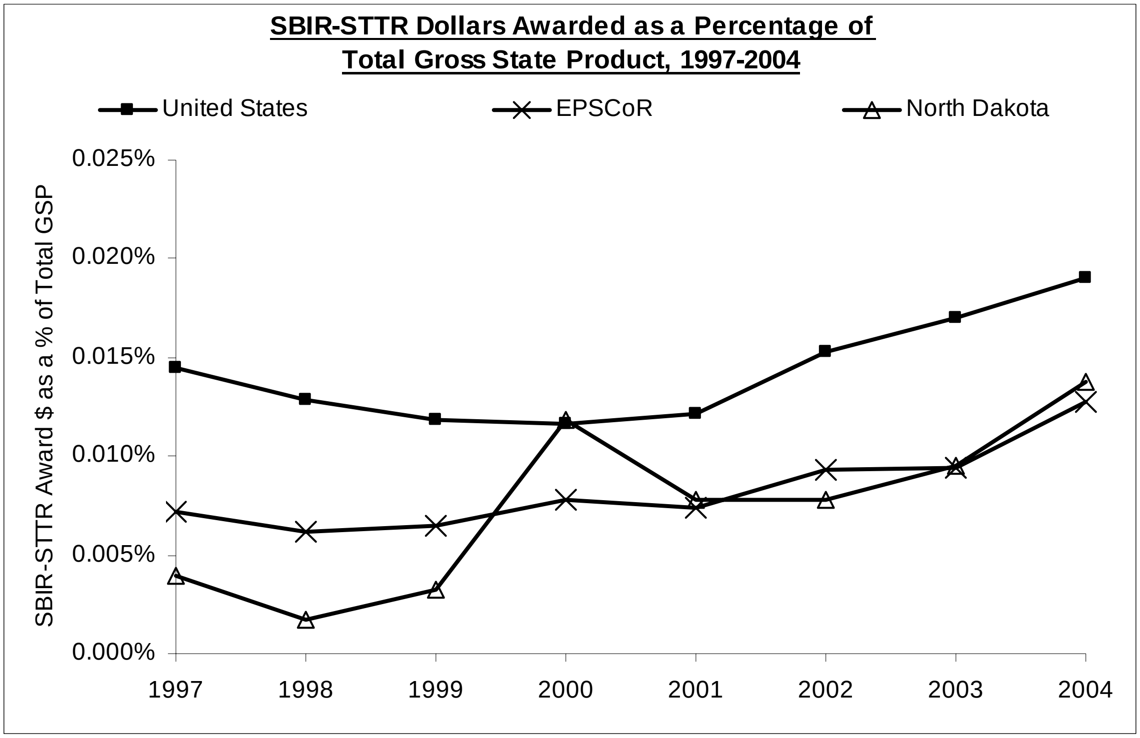
SBIR/STTR awards are an important source of funding for early-stage technology companies for several reasons. First, the funding is for the stage of R&D that is very difficult to fund with other sources as it occurs before a concept is proven and before a company has revenues from the innovation. Second, because SBIR/STTR awards are grants that do not have to be paid back, they do not dilute future rounds of financing. Third, SBIR/STTR awards are widely used in the professional venture capital arena as a “marker” for good technology. Since the awards are extremely competitive and are made only after substantial technical review, venture capitalists see SBIR/STTR awards as a signal that the technology has been validated.[56] Phase II awards are more important because they are only made after the successful completion of Phase I.

North Dakota has done an adequate job in supporting the SBIR/STTR program. As shown in **Figure 7.2**, North Dakotans have won about the same number of SBIR/STTR awards per gross state product as the other EPSCoR states. The Center for Innovation is widely known in North Dakota for the assistance it provides for SBIR/STTR applicants, and has received support from the SBA FAST program.

[55] DoD, HHS, NASA, DOE, NSF, USDA, DOC, EPA, DOT, and ED.

[56] Lerner, Josh. 1999. “The Government as Venture Capitalist: The Long-run Impact of the SBIR Program.” *Journal of Business*. 72(3): 285-318.

Figure 7.2. SBIR/STTR awards compared to other states



Source: Based on EPSCoR data tracking by Policy One Research, Inc., tabulation of SBA data.

Table 7.1 shows that the number of awards in North Dakota has risen by over 57% from 2000 to 2004. However, note that several states with more intensive resources devoted to SBIR/STTR support—notably Louisiana, Maine, Nevada, and Oklahoma—have seen awards rise by over 200%. The absolute number of awards in North Dakota is still third-lowest among the states and beats only South Dakota and Alaska. North Dakota can do better.

Table 7.2 shows the dollar amounts of these awards. Again, North Dakota has a gain, almost 46%, but the EPSCoR states and the nation experience growth closer to 100%. The largest gains have been made by Hawaii, Maine, Nevada, and Oklahoma. It has recently been discovered that some agencies, notably the National Institutes of Health (NIH), have been giving Phase II awards that are substantially higher than other agencies.[57] Therefore, states with larger NIH winners will likely see larger gains in SBIR/STTR award funding.

[57] U.S. Government Accountability Office, “Small Business Innovation Research: Information on Awards Made by NIH and DOD in Fiscal Years 2001 through 2004.” April 2006. GAO-06-565. http://www.gao.gov/new.items/d06565.pdf

Table 7.1. Number of SBIR & STTR awards by EPSCoR states, 1997–2004

Area	1997	1998	1999	2000	2001	2002	2003	2004	%Chg 00–04
United States	5,103	4,573	4,887	4,788	4,944	6,184	6,617	7,190	50.17%
EPSCoR	345	318	396	393	452	509	560	622	58.27%
North Dakota	7	4	5	7	7	9	9	11	57.14%
Alabama	102	77	95	89	89	108	127	141	58.43%
Alaska	2	3	2	5	5	2	7	1	-80.00%
Arkansas	4	3	10	8	10	9	19	23	187.50%
Hawaii	14	19	27	20	17	22	18	21	5.00%
Idaho	4	6	9	10	14	15	15	18	80.00%
Kansas	11	15	19	16	21	20	22	24	50.00%
Kentucky	11	8	13	19	15	17	12	23	21.05%
Louisiana	8	10	7	11	18	13	16	23	109.09%
Maine	5	8	19	14	14	19	26	29	107.14%
Mississippi	7	2	13	11	7	13	14	18	63.64%
Montana	11	13	20	25	33	37	34	37	48.00%
Nebraska	19	8	5	9	12	10	12	11	22.22%
Nevada	12	8	9	8	15	27	26	31	287.50%
New Mexico	89	84	97	82	101	94	95	105	28.05%
Oklahoma	13	17	12	14	21	27	27	43	207.14%
South Carolina	8	10	9	19	23	29	33	23	21.05%
South Dakota	7	9	7	5	5	12	9	3	-40.00%
West Virginia	3	6	5	10	9	14	26	25	150.00%
Wyoming	8	8	13	11	16	12	13	12	9.09%

Source: Based on EPSCoR data tracking by Policy One Research, Inc., tabulation of SBA data

Table 7.2. Total SBIR & STTR award dollars by EPSCoR states (in millions), 1997–2004

Area	1997 $	1998 $	1999 $	2000 $	2001 $	2002 $	2003 $	2004 $	%Chg 00–04
United States	$1,193.58	$1,118.47	$1,090.49	$1,133.33	$1,220.99	$1,596.46	$1,860.90	$2,223.30	96.17%
EPSCoR	$77.60	$69.04	$75.95	$95.58	$93.30	$122.13	$131.03	$189.76	98.54%
North Dakota	$0.65	$0.30	$0.56	$2.14	$1.47	$1.56	$2.05	$3.12	45.98%
Alabama	$29.29	$21.26	$17.09	$26.51	$16.42	$32.22	$34.51	$40.64	53.29%
Alaska	$0.16	$0.26	$0.16	$1.58	$0.73	$0.08	$1.33	$0.07	-95.57%
Arkansas	$0.32	$0.90	$1.30	$2.54	$1.05	$2.13	$2.86	$6.41	152.39%
Hawaii	$2.43	$2.46	$3.54	$4.73	$3.32	$4.05	$4.36	$15.90	235.86%
Idaho	$0.94	$0.58	$1.31	$1.09	$1.88	$4.32	$3.12	$4.50	314.41%
Kansas	$2.47	$4.63	$3.22	$3.25	$3.49	$5.21	$5.04	$5.58	71.64%
Kentucky	$4.01	$1.83	$2.90	$3.09	$2.86	$5.01	$1.89	$8.15	163.97%
Louisiana	$0.94	$1.84	$0.82	$2.18	$3.07	$3.24	$2.97	$3.93	80.64%
Maine	$1.58	$1.32	$2.18	$2.97	$3.36	$2.76	$4.94	$9.61	223.63%
Mississippi	$1.28	$0.13	$1.89	$3.66	$0.66	$3.28	$2.54	$4.76	30.03%
Montana	$0.89	$3.36	$4.02	$6.12	$7.93	$7.27	$8.18	$9.60	56.89%
Nebraska	$2.38	$1.17	$0.95	$2.58	$2.57	$1.87	$1.35	$6.07	135.31%
Nevada	$2.32	$2.55	$1.73	$2.01	$4.52	$7.46	$5.95	$11.77	485.23%
New Mexico	$18.99	$19.56	$24.51	$19.21	$23.37	$20.85	$21.62	$27.57	43.47%
Oklahoma	$3.37	$3.14	$3.47	$2.82	$3.91	$5.79	$6.31	$11.76	316.87%
South Carolina	$1.34	$1.25	$1.73	$3.79	$5.74	$7.51	$8.61	$8.39	121.57%
South Dakota	$0.76	$0.97	$1.64	$1.12	$0.72	$2.40	$2.20	$0.71	-36.38%
West Virginia	$1.24	$0.71	$1.74	$2.15	$3.75	$1.34	$9.03	$8.30	285.96%
Wyoming	$2.25	$0.83	$1.18	$2.05	$2.47	$3.75	$2.18	$2.93	42.90%

Source: Based on EPSCoR data tracking by Policy One Research, Inc., tabulation of SBA data

Almost all of the states have some programs that support SBIR/STTR applicants. In 2000, the FAST program was signed into law as part of the SBIR reauthorization. This program, established under SBA, is a competitive grant program to assist states with their SBIR/STTR support. However, the program was only funded for three years and has not been funded recently.

Nevertheless, states continue to invest to support SBIR/STTR applicants in their states. Several of the states whose growth rates are remarkable have the most comprehensive SBIR/STTR support programs.

Maine Technology Institute (MTI) (www.mainetechnology.org), for instance, provides no-cost assistance to Maine companies. They help companies identify opportunities within the federal agencies that are congruent with their own business plans and technical interests, teach proposal preparation, and assist with the management of awarded funds. This assistance is done both one-on-one and through regularly scheduled seminars. In addition, MTI offers "Phase 0" grants for up to $5,000 to offset the cost of proposal preparation. Companies that receive these grants are required to complete a Phase I proposal. MTI's own evaluation has documented that one-half of MTI-assisted companies have won an award. This is substantially higher than the 1:10 ratio that is the national norm.

Oklahoma, another state with a higher-than-average success rate in SBIR/STTR wins, offers financial assistance to ease the SBIR/STTR process. Through the Oklahoma Center for the Advancement of Science and Technology (OCAST) (www.ocast.state.ok.us), they will grant a company up to 50% of the cost of proposal preparation (a maximum of $3,000/year) for Phase I proposals, and up to $25,000 or 50% of a company's Phase I award to assist with the transition to Phase II. Quite a few states provide ongoing information to their companies. One good example is the newsletter prepared by Wyoming (http://uwadmnweb.uwyo.edu/SBIR/newsletter.html).

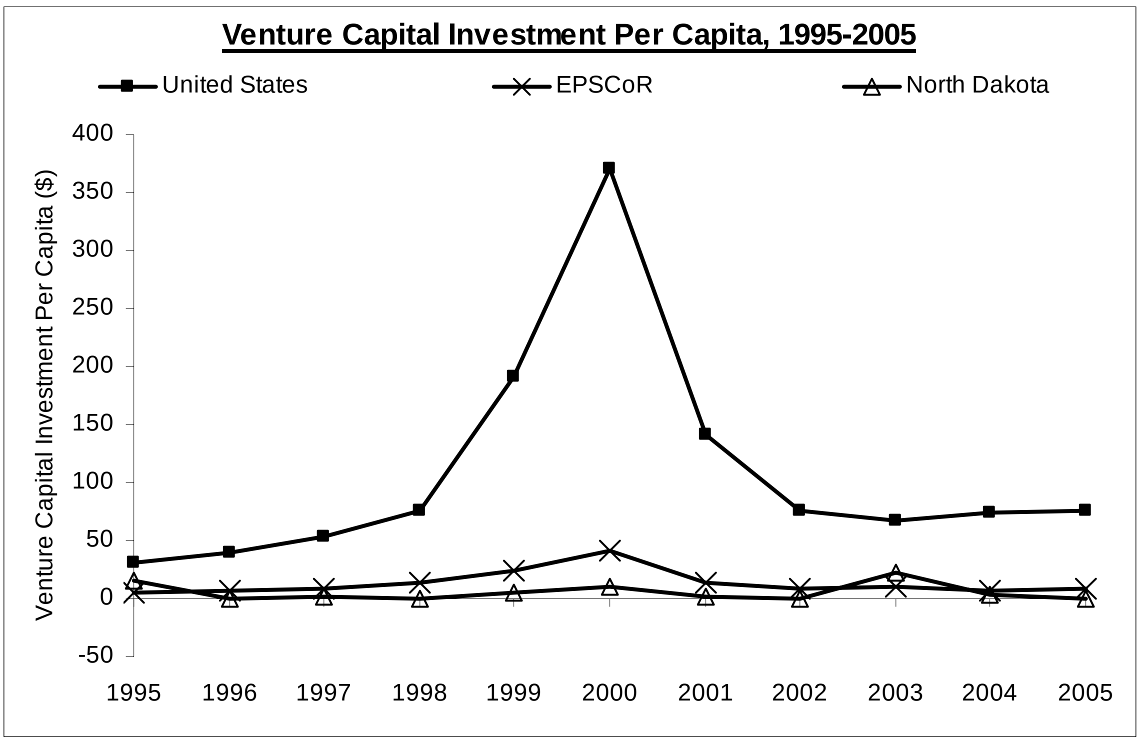
A number of states hold annual conferences to inform small businesses about the SBIR/STTR program, to introduce federal SBIR program managers from the various agencies, and to provide specific technical assistance. The Florida SBIR/STTR conferences are a good example.
(http://www.floridasbdc.com/Events/SBIR/SBIRconference.asp)
A list of current SBIR conferences is available at
http://www.sbirworld.com/conferences/index.asp?mnuConf=1.

7.2 Seed-stage Grants, Angel Networks and Venture Capital

North Dakota receives very little venture capital funding, like many other rural states. Venture capital investment in the United States is highly concentrated in California, Massachusetts, and a handful of other states. For instance, in the first quarter of 2006, Silicon Valley (CA) received 36.56% of all venture capital investments, followed by New England with 15.5%, and Los Angeles with 6.41%. A total of $5.625 billion was invested in the quarter.[58] Note also that investments in seed-stage companies totaled only $187 million nationally last quarter, representing only 3.32% of the total deals.

As shown in **Figure 7.3** and **Table 7.3**, North Dakota has averaged less than one deal per year over the last 10 years, about the same as the average of the EPSCoR states. This suggests to us that North Dakota should use state funds to invest in pre-seed or seed-stage deals to improve the likelihood that these companies will grow and, perhaps, eventually attract venture capital investments. We focus here on programs at three other EPSCoR states: Maine, Kansas, and Oklahoma. It should be noted that a variety of evaluation programs have documented paybacks to states of around 10 times their investments when new revenues, new investments into the companies, and other economic impacts are taken into consideration.

Figure 7.3. Venture capital investment per capita, 1995–2005



Source: Based on EPSCoR data tracking by Policy One Research, Inc., tabulation of Pricewaterhouse Coopers Moneytree data

[58] Pricewaterhouse Coopers Moneytree report, http://www.pwcmoneytree.com/moneytree/nav.jsp?page=region.

Table 7.3. Venture capital deals 1995–2005

Area	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	%Chg 96-05
United States	1,872	2,469	3,079	3,550	5,396	7,812	4,451	3,054	2,877	2,991	3,039	23.09%
EPSCoR	52	70	96	111	100	151	91	81	64	71	51	-27.14%
North Dakota	2		1	1	1	1	1		2	1		
Alabama	11	7	16	15	9	25	16	11	9	3	2	-71.43%
Alaska												
Arkansas	2		2	2	3	4	3	5	3	1	2	
Hawaii		2	4	3	2	2	5	2	6	4	4	100.00%
Idaho	1	1	2	3	2	4	2	2	5	2	2	100.00%
Kansas	3	8	6	3	8	21	9	6	2	9		
Kentucky	9	7	14	15	16	12	4	4	3	5	3	-57.14%
Louisiana	8	3	12	11	10	15	11	8	1	3	1	-66.67%
Maine	2	5	3	11	11	15	6	5	3	4	2	-60.00%
Mississippi	1	4	1	2	2	3	3	3	4	3	2	-50.00%
Montana		2			3	3	2		1		2	0.00%
Nebraska	2	5	2	3	2	5	7	3	2		1	-80.00%
Nevada	1	2	7	10	8	10	4	6	6	5	7	250.00%
New Mexico	2	5	3	4	6	8	4	7	5	8	16	220.00%
Oklahoma	2	7	5	11	7	9	6	4	2	11	1	-85.71%
South Carolina	6	12	14	16	9	11	5	5	4	5	1	-91.67%
South Dakota					1	1	1	2	1	3	1	
West Virginia			2	1		2	2	8	5	3		
Wyoming			2							1	4	

Source: Based on EPSCoR data tracking by Policy One Research, Inc. compilation from SBA data.

A study just released[59] by the National Association of Seed and Venture Funds (NASVF) highlights the important role of state financing programs. Forty-four states participated in the study and reported 151 different programs, totaling $5.80 billion. The biggest focus of state programs is on seed-stage investing, with 33% of the state programs doing pre-seed deals and 57% doing seed-stage deals. Typically state programs are targets in specific industry sectors such as biotech, medical devices, software, telecommunications, or

[59] National Association of Seed and Venture Funds, State Venture Capital Program Study, May 2006. www.nasvf.org.

industrial/energy. The primary focus of the state investments is to create new jobs and grow the economy; return on investment is secondary.

Best practices are illustrated in the accompanying sidebars on the Maine Technology Institute, the Oklahoma Center for the Advancement of Science and Technology, and Kansas Technology Enterprise Corporation, and summarized below:

1. Choose investments on a competitive basis using peer and/or expert reviewers considering both technical and commercialization aspects of the proposal.
2. Keep amounts invested modest so that the state can invest in a fairly large number of projects each year. The objective is to have a portfolio approach, allowing for some projects that fail, some that are spectacularly successful, and a large number that do well.
3. Have some payback mechanism for projects that are successful, but do not penalize failure.
4. Create incentives for companies to work with local universities to enable spillover.
5. Maintain integration with other aspects of technology commercialization; i.e., companies that receive multiple sources of assistance such as grants and incubator assistance and SBIR assistance tend to perform better.
6. Target industry sectors that are either existing or emerging strengths of the state.

Maine Technology Institute (MTI)

Maine Technology Institute (MTI) (www.mainetechnology.com) is a private nonprofit organization funded by the state of Maine and managed through the Department of Economic and Community Development (DECD). Funded through annual appropriations by the legislature, MTI exists to “encourage, promote, stimulate and support research and development activity leading to the commercialization of new products and services in the state’s technology sectors.” Since FY1999–00, MTI has had annual appropriations of around $5.5 million annually with the exception of a $9.5 million appropriation in FY2005–06.

MTI operates the following grant programs:

- Seed grant program – offers up to $10,000 on a competitive basis to support early-stage product development, business planning, commercialization, or development
- Development awards – investments of up to $500,000 on a competitive basis to support new products and development

MTI conducts annual evaluations of its programs. The 2005 evaluation[60] found the following:

- MTI recipients saw employment grow by 11%.
- For every dollar of MTI assistance, over $26 is leveraged in external financing.
- 46% of MTI-funded research projects have led to new products and 24% of projects have resulted in products that are already offered for sale.
- 45% of MTI-funded projects have or will seek patent protection for the results of their research. 84% will seek other IP protection such as trade secrets, trademarks, and copyrights.

[60] http://www.mainetechnology.com/?cat_id=260&year=2005&press_id=172

Oklahoma Center for the Advancement of Science and Technology (OCAST)

Oklahoma Center for the Advancement of Science and Technology (OCAST) (www.ocast.state.ok.us), is a state entity funded by legislative appropriations and governed by a board of directors. The mission of OCAST is to "to foster innovation in existing and developing businesses by:

- supporting basic and applied research
- facilitating technology transfer between research laboratories and firms and farms
- providing seed capital for new innovative firms and their products
- fostering enhanced competitiveness in small and medium-sized firms in Oklahoma."

Funding programs delivered by OCAST include those listed below:

- Oklahoma Health Research – up to $45,000/annually ($100,000 for new Oklahoma scientists) for seed funds for projects related to human health. Available for public or private research entities, nonprofit research foundations, or Oklahoma firms.
- Oklahoma Applied Research Support – up to $45,000/annually for proof of concept and $300,000 for accelerated projects for the development of technology with the possibility of producing a commercial product. Available for public or private research entities, nonprofit research foundations, or Oklahoma firms.
- OCAST Technology Business Finance Program – up to $100,000 pre-seed funding and early-stage risk financing for Oklahoma companies. This is administered through i2E, a nonprofit organization. Applicants must be in the process of commercializing advanced technology, defined as a state-of-the-art, proprietary product, process, material, design, and/or know-how. Firms must be technology-based, sufficiently innovative to provide a competitive advantage in the marketplace and have the potential for significant, high-performance growth. They must also exhibit significant potential for high sales per employee, substantial value added per employee, wage levels 35–40% higher than average, and other indicators related to the generation of wealth for Oklahoma's economy. Firms must be located in, or must have relocated to, and be primarily domiciled in Oklahoma prior to the receipt of program funds.

OCAST investments have returned over $15 of outside investment for every $1 of state funds.[61]

Kansas Technology Enterprise Corporation (KTEC)

The Kansas Technology Enterprise Corporation (KTEC) (www.ktec.com) is a public-private partnership established by the State of Kansas to promote technology-based economic development. KTEC offers a full range of programs, including three investment programs:

- Applied Research Matching Funds provides up to $125,000 to Kansas companies that are developing new technologies. Companies must possess innovative technology, the opportunity to create new jobs in Kansas and create wealth in Kansas.
- Technology Commercialization Seed Fund invests up to $250,000 in companies with potentially commercializable technology.
- Seed Capital Funds are formed by Kansas incubators in partnerships with local angel investors and/or local universities to make investments in promising young technology companies.

KTEC also regularly evaluates its investments. According to their 2004 annual report, their $152 million of investment that year yielded a return of $13.1 for each dollar of state funds.[62] Since 1984 when KTEC was founded, their efforts have led to the creation of $1.3 billion in increased sales, 14,153 jobs created or saved, 384 company start-ups, and $4.37 million in equity returns.

[61] http://www.ocast.state.ok.us/Portals/0/docs/brochures/2006-ImpactReport.pdf
[62] http://www.ktec.com/pdf/annual_report/ar2004.pdf

7.2.1 Angel Networks

Another aspect of providing financing for companies in a state is to support angel networks. Angels are high-net-worth individuals who choose to invest some of their funds in young, high-growth companies.

According to the University of New Hampshire Center for Venture Research,[63] the leading authority on angel investors, approximately $23 billion in angel investments were made in 2005, up 2.7%. Angels continue to be the largest source of early and seed-stage capital, with 55% of the investments in the start-up stage.

Statistics on angels are notoriously difficult to come by, but we can try to get a handle on the number of potential angel investors in North Dakota. The Securities and Exchange Commission limits the sales of certain equity offerings to accredited investors. Accredited investors have a net worth of over $1,000,000 and/or an annual income of over $200,000 in each of the last two years. According to the U.S. Census, 5,000 individuals in North Dakota had a net worth of over $1 million in 2001.[64]

Since angels are private citizens with their own investment goals and since angel investing is already regulated by the Securities and Exchange Commission, most states limit their involvement with angels to encouraging the formation of angel networks and/or supporting qualified investments with tax credits (see R&D tax credits section).

The National Association of Seed and Venture Funds has the most active national program in this area, offering a course around the country called "Seed Investing as a Team Sport." The course, which has been offered in North Dakota through the Center for Innovation, is a seminar designed to educate investors in the basics of angel investing. Local and regional resources support this course as a means to make potential high-net-worth individuals more sophisticated about how to be angels.

7.3 Seed Capital Investment Tax Credits

One incentive that many states, including North Dakota, use to encourage angels and angel investors to invest in local companies is a seed capital investment tax credit. At least nine states currently have these credits, which generally range from 15–50% of the amount invested and can be taken against the investor's state income tax. The first credits were enacted by the Finance Authority of Maine over 20 years ago.

North Dakota's Seed Capital Investment Tax Credit (§57-38.5) has a maximum of $250,000, with no more than one-third taken in a single tax year. The credit can be

[63] http://wsbe.unh.edu/cvr/
[64] IRS, Statistics of Income Division, December 2005.

carried forward up to four years after the year the investment was made. The total amount of tax credits allowed in North Dakota each year is $2,500,000.

This tax credit is quite similar to the credits available in other states. All have some maximum for the taxpayer and often also have a maximum for the entire program and for each year. In all cases, the investments must be made by qualified investors (as defined by the Securities and Exchange Commission) in qualified companies. The definition of qualified companies varies by state, but are generally high-growth, high-technology businesses in the state. There are some unique provisions, such as Arizona's refusal to grant tax credits for investments in companies that perform human cloning or embryonic stem cell research. **Table 7.4** compares the details of several state seed investment tax credits.[65]

Table 7.4. Seed investment tax credits

	North Dakota	Arizona	Wisconsin	Kansas
Percent of investment that can be claimed as a credit	100%	30% except 25% in bioscience or rural	100%	50%
Maximum tax credit that can be claimed by taxpayer per year	$250,000		$500,000	$50,000
Is credit transferable?	No	No		Yes
Carry-forward?	Yes, up to 4 years	Yes, up to 3 years		Yes
Maximum tax credit for program	$2,500,000 per year	$20,000,000 over 5-year period	$3,000,000 per year or $30 million total	$2,000,000 per year or $20 million total

Sources: Arizona: http://www.azcommerce.com/innovation/angelinvestor_taxcredit.asp; Wisconsin: http://commerce.wi.gov/Act255/BD-Act255-venturecapitalseedfund.html; Kansas: http://www.ksrevenue.org/taxcredits-venture.htm.

7.4. Debt Capital

North Dakota has a wide array of debt and debt-like programs available for mature companies and strategic industries. These are managed through the Department of Commerce and the Bank of North Dakota.

The North Dakota Development Fund makes investments of up to $300,000 through direct loans, participation loans, subordinated debt, and equity investments. Loans must be secured with a first or second mortgage in fixed assets, equipment, inventory, or other collateral. Normally the amount of funds available is dependent upon the number of new

[65] Other states that have similar tax credits are Maine, Louisiana, Indiana, Ohio, and Iowa.

jobs that will be created. The rules call for $20,000 per full-time equivalent (FTE) employees in rural areas and $10,000 per FTE in urban areas. For start-up companies, a low-interest loan is available for up to $100,000 with a 1:1 match required from other private or public funds. The North Dakota Development Fund did 54 projects last year for a total of $5–6 million. They have not done any early-stage or pre-revenue deals.

The Bank of North Dakota also offers a variety of commercial loans:

- Business Development Loan Program
- SBA Main Street Purchase Program
- Beginning Entrepreneur Loan Guaranty Program
- Pace Fund
- Biodiesel Pace Program
- Match Program
- BND Loan Participation

These loan programs have several requirements in common. In general, the interest rates offered are below market rates, a feature made possible by the unique position of the Bank of North Dakota as a state-owned bank. On the other hand, these loans require "acceptable business assets" for collateral, personal guarantees by the entrepreneur, and are focused on working capital, fixed asset financing such as equipment or real property, and inventory.

The Bank of North Dakota also offers the New Venture Capital Fund. The intent of this program is to provide flexible financing through debt and equity investments for new or expanding businesses in the state of North Dakota. The criteria called out are as follows:

- a successful and experienced management team
- cooperative management
- a market of "favorable size, growth and competitive characteristics"
- adequate capital being raised
- companies working to commercialize university-developed technology within NDUS

In addition, the criteria call for companies to have completed product development and market acceptance as "evidenced by growing sales."

These types of debt programs are common among the states and represent the mainstream of business financing, especially as organized to facilitate the attraction of businesses to the state. However, these programs are not aimed at the seed-stage or pre-revenue technology-based ventures that have the opportunity to drive North Dakota's future economy. The existence of these excellent programs does not, in our view, support technology commercialization, although they have an important role in North Dakota's existing economy.

The New Venture Capital Fund could be changed to focus on earlier-stage investments by relaxing the criteria that calls for companies to have completed product development and to have demonstrated market acceptance. A recent NASVF report suggests that seed-stage investors should look for companies "with strong, proprietary technology, elegant products that solve big problems, a homogenous base of customers with a clear shot to decision makers, a strong management team, and a viable strategy for achieving liquidity."[66]

[66] The National Association of Seed and Venture Funds. 2006. "Seed and Venture Capital: State Experiences and Options: 2006." www.nasvf.org.

8. Cluster-based Economic Development

8.1 Technical and Industry Overview

Since the focus of government support of technology commercialization is to support the technology-based industries or clusters in a state or region, RTI looked at the current status of these clusters in North Dakota.

According to the North Dakota Job Service data, firms in North Dakota are highly focused on services with almost 60% of firms in retail and wholesale trade, construction, government, and accommodations and food service. Employment is concentrated in government (19.65%), healthcare and social assistance (13.99%), retail trade (12.86%), accommodations and food service (8.47%), and manufacturing (7.66%). These figures are shown in **Table 8.1**.

The number of firms and employment in high-technology industries constitute a much smaller part of the North Dakota economy. According to the 2002 Economic Census conducted by the US Census Bureau, employment in the high-technology industries totals just 554 firms and 13,140 employees.[67] A list of high-technology industries in North Dakota as well as the number of firms and employees for each is shown in **Table 8.2**. The National Science Foundation finds that in 2002, the high-technology share of all business establishments in North Dakota was 3.29%, with employment at 5.78% of total employment. They also note that new high-technology business formations were only 0.17% of all business establishments.[68] More recent 2004 data estimate that the number of high-technology establishments is 1,000, representing 4.12% of North Dakota's total establishments. These 1,000 high-technology establishments employ 14,072 people.[69] This means that the number of extremely small high-technology firms has increased in North Dakota between 2002 and 2004.

[67] The National Science Foundation now publishes the annual Science and Engineering Indicators. In this publication, they define high-technology industries as those where the proportion of employees in both research and development and all technology occupations is at least twice the average proportion for all industries. This definition and list of NAICS codes is found in NSF, Division of Science Resources Statistics, *Science and Engineering Indicators 2006*. Arlington, VA:. (NSB 06-01). February 2006. This note is based on earlier work by the Bureau of Labor Statistics: Heckler, D. 1999. "High-technology employment: A broader view." *Monthly Labor Review*. 122(6):18.

[68] NSF, Division of Science Resources Statistics, *Science and Engineering Indicators 2006*. Arlington, VA:. (NSB 06-01). February 2006. Chapter 8, State Indicators.

[69] Policy One Research, Inc., tabulations from US Census Bureau, County Business Patterns.

Table 8.1. Employment by industries in North Dakota, 2006

Industry	Number of Firms	Percent of Firms	Annual Average Employment	Percent of Employment
Agriculture, Forestry, Fishing & Hunting	495	2.04%	2,873	0.89%
Mining	193	0.79%	3,538	1.10%
Utilities	127	0.52%	3,335	1.04%
Construction	2,779	11.44%	17,018	5.30%
Manufacturing	815	3.35%	24,589	7.66%
Wholesale Trade	2,349	9.67%	18,367	5.72%
Retail Trade	3,226	13.28%	41,293	12.86%
Transportation & Warehousing	1,081	4.45%	8,405	2.62%
Information	409	1.68%	7,698	2.40%
Finance & Insurance	1,649	6.79%	14,913	4.64%
Real Estate & Rental & Leasing	720	2.96%	3,208	1.00%
Professional & Technical Services	1,733	7.13%	9,955	3.10%
Management of Companies	88	0.36%	3,014	0.94%
Admin & Support & Waste Mgmt Services	1,056	4.35%	11,480	3.58%
Educational Services	115	0.47%	1,452	0.45%
Health Care & Social Assistance	1,478	6.08%	44,916	13.99%
Arts, Entertainment, and Recreation	372	1.53%	3,533	1.10%
Accommodation & Food Services	1,816	7.48%	27,188	8.47%
Other Services	1,901	7.83%	11,250	3.50%
Total Private Ownership	22,402	92.22%	258,025	80.35%
Total Government	1,891	7.78%	63,083	19.65%
Federal Government	496	2.04%	10,092	3.14%
State Education	19	0.08%	8,831	2.75%
State Non-Education	389	1.60%	8,350	2.60%
Local Education	245	1.01%	19,242	5.99%
Local Non-Education	742	3.05%	16,568	5.16%
Grand Total	24,293	100.00%	321,108	

Source: North Dakota Job Service Quarterly Census of Employment and Wages, 2006. www.state.nd.us/jsnd.

Table 8.2. High-technology industries in North Dakota, 2002

NAICS Codes that Constitute High-technology Industries in North Dakota	Number of North Dakota Firms	Percent of Total High-technology Firms	North Dakota Employment
3331 Agricultural, construction and mining machinery manufacturing	58	10.47%	(2500-4999)
5415 Computer systems design and related services	99	17.87%	2351
3344 Semiconductor and other electronic component manufacturing	7	1.26%	(1000-2499)
5413 Architectural, engineering and related services	176	31.77%	1621
5416 Management, scientific and technical consulting services	138	24.91%	1492
5112 Software publishers	10	1.81%	1272
3363 Motor vehicle parts manufacturing	14	2.53%	(500-999)
3361 Motor vehicle manufacturing	1	0.18%	(500-999)
3346 Manufacturing and reproducing magnetic and optical media	2	0.36%	(500-999)
32411 Petroleum refineries	2	0.36%	(250-499)
6117 Educational support services	6	1.08%	(250-499)
5417 Scientific research and development services	25	4.51%	(250-499)
3362 Motor vehicle body and trailer manufacturing	11	1.99%	(250-499)
3391 Medical equipment and supplies manufacturing	18	3.25%	(100-249)
3353 Electric equipment manufacturing	7	1.26%	(100-249)
3336 Engine, turbine, and power transmission equipment manufacturing	3	0.54%	(100-249)
3332 Industrial machinery manufacturing	8	1.44%	(100-249)
3251 Basic chemical manufacturing	13	2.35%	105
811212 Computer and office machine repair and maintenance	14	2.53%	99
	554	100.00%	13,140*

Source: List of NAICS codes that constitute high-technology industries from NSF, op. cit. Only NAICS codes where there are firms in North Dakota are shown. Data on North Dakota firms and employment by these NAICS codes from 2002 Economic Census, www.census.gov/econ/census02. Total employment estimated by taking the midpoint where only employment ranges are given. Ranges were given in the original data where disclosure would violate the confidentiality of individual companies.

The following are examples of leading companies in the five largest high-technology clusters:

- 3331 Agricultural, construction and mining machinery manufacturing
  - Bobcat Company
  - Buhler
  - CNH America
- 5415 Computer systems design and related services
  - SEI Information Technology
  - Techwire Solutions
  - Wishek
  - Northstar
  - StrataCom
- 3344 Semiconductor and other electronic component manufacturing
  - Phoenix International Corporation
  - DCR
- 5413 Architectural, engineering and related services
  - Applied Engineering
  - Packet Digital
- 5416 Management, scientific and technical consulting services
  - DMS Health Group
  - Eide Bailly
  - Pracs Institute
- 5112 Software publishers
  - Aatrix Software
  - Microsoft Business Solutions
  - Atlas Business Solutions
  - REMCO
  - Vertical Solutions

North Dakota's occupations follow closely with these industries, offering a different way to look at North Dakota's specialties. While the current top ten occupations in North Dakota are related to the service sector (see **Table 8.3**), the occupations with the highest projected growth include at least three (shown shaded in grey) that could be considered high-technology (**Table 8.4**).

Table 8.3. Top ten occupations in North Dakota, 2006 by number employed

Ranking	Occupational Grouping	Number Employed in North Dakota, 2006
1	Office and Administrative Support	54,080
2	Sales and Related Occupations	35,500
3	Food Preparation and Serving-related Occupations	30,360
4	Transportation and Material-moving Occupations	26,280
5	Education, Training and Library Occupations	20,940
6	Production Occupations	20,230
7	Construction and Extraction Occupations	18,600
8	Healthcare Practitioners and Technicians	18,170
9	Installation, Maintenance and Repair	15,160
10	Management Occupations	14,600

Source: www.state.nd.us/jsnd.

Table 8.4. Top ten occupations by percent total growth projected for 2002–2012

Ranking	Occupation	2002 Employment	2012 Employment	Percent Total Growth
1	Industrial Engineers	221	328	48.4%
2	Management Analysts	253	374	47.8%
3	Coating, Painting and Spraying Machinery Operators	335	465	38.8%
4	Computer Software Engineers: Applications	335	465	38.8%
5	Medical Assistants	193	267	38.3%
6	Network Systems and Data Communications Analysts	266	366	37.6%
7	Physician Assistants	191	260	36.1%
8	Electro-mechanical Technicians	70	95	35.7%
9	Medical Records and Health Information Technicians	601	814	35.4%
10	Vocational Education Teachers	215	290	34.9%

Source: www.state.nd.us/jsnd.

The North Dakota universities, especially North Dakota State University and the University of North Dakota, have a variety of technology expertise. Technology strength is illustrated by the Centers of Excellence and by high levels of grants and contracts in particular fields. For instance, a large percentage of NDSU's external awards are to the Agricultural Extension and Experiment Station, with the largest amounts in FY2004[70] going to plant sciences ($4,744,471), and veterinary and microbiological sciences ($3,673,636). Other areas with strong external funding are the Center for Nanoscale Science and Engineering (CNSE) ($21,683,305) and the Upper Great Plains Transportation Institute ($5,573,231). At UND, the Energy and Environmental Research Center received $21,284,751 in grants and contracts in FY2004; the School of Aerospace Sciences received $8,662,977; the School of Engineering and Mines, $1,055,496; and the School of Medicine and Health Sciences, $17,210,355.[71]

We also examined the patent portfolio of the state. We looked at all issued patents assigned to a North Dakota citizen or entity from 1976 to the present. This covers all patents available for electronic searching in the US Patent and Trademark Office database. We found a total of 491 patents, with 135 of these patents having expired. To try to understand the innovation that is occurring in North Dakota, we categorized the patents by technology area.[72] This analysis is shown in **Table 8.5**. Of the 356 patents, 108 are mechanical (30.5%), 34 are chemical (9.6%), 33 are agricultural (9.3%), and 30 are in biotechnology (8.5%). Note that 19 are in energy and environment (5.4%), representing work being done both at the Energy and Environmental Research Center and a company, Nanotek Instruments.

The source of the innovation is also shown in this table. Sixty-six of the patents are from universities, university entities, or joint projects with industry. This represents 18.5% of the total patents issued and assigned in North Dakota, a number that clearly shows the youth of the university technology transfer efforts.

Based on these analyses, we conclude that North Dakota's current strengths in high-technology industry include agricultural machinery (which could be classified as advanced manufacturing), computer systems design, semiconductor and related manufacturing, and software (which could all be combined into information technology). We note, in addition, that several areas of technology strength in the R&D sector, such as agricultural biotechnology, energy and environment, chemicals and materials, such as nanotechnology, could be the basis for supporting emerging clusters.

[70] North Dakota State University, Sponsored Programs Administration, Annual Report: External Funding Awards – 2004.
[71] The University of North Dakota. Abbreviated Annual Report of Sponsored Program Activity, Fiscal Year 2005.
[72] Patents do not correlate directly with knowledge production because some types of knowledge cannot be patented and some knowledge creators do not chose to patent their inventions. However, this is a decent indicator of innovation and one that is widely used in the literature on knowledge spillovers.

Table 8.5. Patents assigned to North Dakotans by technology: 1976–2006

Technology Area	Number Issued to Industry or Individuals	Number Issued to Universities or University-related Organizations	Number Issued Jointly to Universities and Industry
Agricultural	23	10	
Biotech	3	25	2
Chemicals	10	24	
Electronics	8*		
Energy	7		
Environmental	5	7	
Materials	5	2	
Mechanical	108		
Medical	12**		
Manufacturing Equipment	9	1	
Other	40		
Photonics	1		
Sensors	1	1	
Software	2	2	
Telecommunications	1		
Test and Measurement	5	13	
Transportation	21	1	
Total	288	66	2

Source: Analysis by RTI International based on data from the US Patent and Trademark Office.
* These patents are old, although not yet expired.
** These patents are almost all on dental technologies.

8.2 Cluster Strategies

The North Dakota Department of Commerce has set as its "Targeted Industries" advanced manufacturing, energy, technology (including life sciences, polymers and coatings, and bio-terrorism), value-added agriculture, and tourism. These targets are based upon the recommendations of a strategic planning study done in 2002. This study employed standard location quotient and shift-share analyses of highly integrated groups of industries defined by strong vertical and horizontal linkages through supply chains.

During the current interim, the Commissioner of Commerce is preparing a report for the Economic Development Committee on "the process used and factors considered by the commissioner in identifying target industries on which economic development efforts are focused and the special focus target industry (NDCC § 54-60-11)."

In contrast, many states are focusing on a cluster-based strategy for economic development that looks at a state's industries in a broader context. **Table 8.6** shows a cross-section of states and their industry clusters. An industry cluster is defined as a group of firms and related economic actors and institutions that are located near one another and draw competitive advantage from that proximity and its attendant connections.[73] The difference between clusters and targeted industries is subtle, but important. Cluster strategies focus on the interactions among members of a cluster, including the sources of innovation that drive technology-based clusters. Therefore, a cluster strategy depends upon the identification of not only the firms in a cluster, but the key innovation assets and other institutions that support it. Cluster strategies go beyond economic development subsidies and recruitment, and instead focus on improving the competitiveness of the group of firms and institutions. A recent Brookings Institution report describes three key lessons for economic development and practice that emerge from cluster thinking:

1. Build on the unique strengths of a region rather than try to be like other regions.
2. Go beyond analysis and engage in dialogue with cluster members.
3. Develop different strategies for different clusters.[74]

Common practice for the identification of existing clusters involves a number of analytical techniques, most designed to describe geographic variations in employment using either the older Standard Industrial Classification (SIC) system or the newer North American Industry Classification System (NAICS) to categorize industry. This is a useful first step, but has some important limitations. Many firms and industries, for instance, have a range of products but are assigned to only one category. Secondly, many clusters are not contained in a single industry classification. For instance, a cluster called telecommunications may include firms as diverse as telephone equipment manufacturers and telemarketing centers, which are in completely different industry categories.

[73] Cortright, Joseph. 2006. "Making Sense of Clusters: Regional Competitiveness and Economic Development. Washington, DC: The Brookings Institution. www.brookings.edu
[74] Ibid.

Table 8.6. Targeted industry clusters for selected states

North Dakota	Connecticut	Maine	Wisconsin
Advanced Manufacturing	BioScience	Precision manufacturing	Biotechnology
Energy	Aerospace	Biotechnology	Information technology
Technology	Software/Information Technology	Information technologies	Medical devices
Value-added Agriculture	Metal Manufacturing	Forestry and agriculture	Paper
Tourism	Maritime	Aquaculture and marine technologies	Plastics
	Plastics	Composite materials	Printing
		Environmental technologies	Small engine manufacturing

Sources: For Connecticut, http://www.ct.gov/ecd/cwp/view.asp?a=1100&q=249794. For Wisconsin, http://www.ct.gov/ecd/cwp/view.asp?a=1100&q=249794. For Maine, http://www.mainetechnology.com/?cat_id=259.

Many analysts now go beyond location quotient and shift-share analyses and use input-output relationships to identify the buyer-supplier relationships inherent in clusters. On the other hand, these analyses are based on estimates from 20-year-old data on trade relationships between sectors and do not include services, an important part of today’s economies.

Some leading regions have tried to understand the innovation assets that are driving growth in their economies and the market and technology trends that are operating in their clusters in order to identify specific targets for emerging clusters.

This analysis will find the intersection of the following:

- university, nonprofit, government lab, industry R&D strengths
- regional clusters
- industry and technology trends

The resulting focus areas can be used to achieve the following:

- Drive targeted investments in R&D.
- Focus recruitment of companies to build a cluster.
- Support the growth of companies in the cluster.
- Identify and build the required infrastructure.

Capturing the future of industry in a region as opposed to describing what currently exists is exemplified by the strategic planning activities undertaken three years ago by the Research Triangle Regional Partnership (RTRP). RTRP won an Excellence in Economic Development award from the U.S. Department of Commerce, Economic Development Administration, for best strategic plan in 2004 for “Staying on Top: Winning the Job Wars of the Future.” (See sidebar below.)

Research Triangle Regional Partnership

"Staying on Top: Winning the Job Wars of the Future" is the Research Triangle Region's competitiveness plan, developed by a CEO task force and implemented voluntarily by more than 70 partner organizations[75] across the 13-county Research Triangle Region.

It spells out a five-year, $5 million action agenda to create 100,000 new jobs in the region and boost employment in all five counties. Key strategies are as follows:

- Promote the growth of industry clusters where the region has a competitive advantage.
- Use a balanced approach of targeted recruitment, global branding, business creation, and existing business retention.
- Integrate higher education into economic development efforts.
- Develop creative, inclusive approaches to rural prosperity.
- Create agile leadership networks to respond to market challenges, changes, and opportunities.

The strategies are designed to support the growth of these 10 industry clusters:

- Pharmaceuticals
- Biological Agents/Infectious Diseases
- Agricultural Biotechnology
- Pervasive Computing
- Advanced Medical Care
- Analytical Instrumentation
- Nanoscale Technologies
- Informatics
- Automotive Parts Manufacturing
- Logistics and Distribution

Cluster strategies include a wide range of activities. For instance, the National Governors Association suggests that the most important activities are those that speed up the transfer of ideas, innovations, and information within the cluster.[76] Other activities that the NGA suggests include the following:

- Organize and deliver government-supported services to clusters.

[75] RTI International is a partner in this effort and has been involved with two projects. The first was to complete the innovation assets inventory and to help the team identify the ten targeted clusters. Second, RTI is currently engaged in the development of Cluster Leadership Networks to support three of the ten clusters: Informatics, Advanced Medical Care and Biological Agents/Infectious Disease.

[76] National Governors Association, 2002. “A Governor’s Guide to Cluster-based Economic Development.” www. nga.gov.

    - Aggregate, collect, and sort data by clusters.
    - Encourage and support multi-firm activities.
- Target investments to clusters.
    - Invest in cluster R&D and innovation.
    - Establish cluster-specific technology centers or parks.
    - Support cluster-based entrepreneurial activity.
    - Market clusters and build cluster-based markets.
- Strengthen networking and associative behavior.
    - Establish or recognize cluster organizations.
    - Facilitate external connections.
    - Encourage intercluster communications.

North Dakota should inventory its innovation assets, that is, its research capacity, both within its universities and its industry; compare these assets with the current industry clusters in the state; and consider the market and technology trends in these areas.

This analysis should be the basis for the refinement of technology clusters, both existing and emerging, that can be the subject of the alignment of all other programs—COE, incubation, grants, etc. We recommend that the Department of Commerce perform the following:

- Organize and deliver government-supported services to clusters.
- Target investments to clusters.
- Strengthen networking and associative behavior within each cluster and across the clusters.

9. Organizing to Support Science and Technology-based Economic Development

To provide an appropriate focus on science and technology, most states have now established an organization that provides policy guidance and/or direct technical assistance to technology companies. **Appendix D** contains a list of the organizations that are the lead science and technology entities for the states. All of the states except Montana, South Dakota, and North Dakota have some entity designated by their legislature to focus on building a science and technology-based economy.

The large majority, 37 of the 47 states with a science and technology lead organization, chose to house this science and technology organization in a state entity, almost all within the department of commerce or economic development or some equivalent. In eight cases, the states created private, nonprofit organizations, and in two cases, private/public partnerships were chosen.

The organizations have a wide range of responsibilities and budgets. The two smallest, the Office of Innovation in the Maine Department of Economic and Community Development (see sidebar) and the North Carolina Board of Science and Technology in the Department of Commerce, have only two to three staff, including a science and technology advisor to the governor, and a very small budget. These are primarily policy organizations with missions related to advising the governor and commerce department on issues relating to science and technology. These organizations provide research and evaluation of existing programs as part of the advising role.

The largest organizations, on the other hand, have both policy and programmatic roles. These programmatic roles include support for Center of Excellence programs, EPSCoR oversight, entrepreneurship, access to capital, and industry cluster activities. Occasionally, other programs such as the Manufacturing Extension Partnership are included. The Third Frontier Commission in the Ohio Department of Commerce (see sidebar), the Oklahoma Center for the Advancement of Science and Technology, and the Ben Franklin Partnerships are three examples of large programs.

Maine Office of Innovation

The Maine Office of Innovation (http://www.maineinnovation.com), Department of Economic and Community Development, was formed in 2004 after the disbanding of its predecessor, the Maine Science and Technology Foundation. The mission of the Office is to advance Maine's economic well–being and expand employment opportunities by encouraging and coordinating the state's R&D activities and fostering collaboration among its higher educational and nonprofit research institutions and the business community.

The Office consists of a director, a policy/program coordinator, and a part–time administrative assistant. The director also serves as the state science and technology advisor whose responsibilities include advising the governor on issues related to science, engineering, and technology. The policy/program coordinator is responsible for managing the Office's legislative program, managing the Office's contracts for R&D programs and activities, and providing advice and research on initiatives and reports of the Office.

The Office oversees the Maine Technology Institute and the Technology Centers programs, and monitors and evaluates other state-funded R&D programs and activities such as the Biomedical Research Fund and the Marine Research Fund.

The Third Frontier Commission, Ohio

The Third Frontier Commission (http://www.thirdfrontier.com) in the Ohio Department of Commerce was formed in 2003 to implement an ambitious project to expand Ohio’s high-tech research capabilities and promote innovation and company formation. This is a 10-year, $1.6 billion initiative guided by a focus on Ohio research and industry strengths. The Third Frontier’s goals are to achieve the following:

- Increase the quantity of high-quality research that has commercial relevance for Ohio.
- Expand the availability of investment capital needed to form and grow new companies.
- Grow and nurture an increasingly experienced pool of entrepreneurial management talent supported by organized systems of services and networking.
- Expand the availability of capital and assistance to support product innovation in established companies.
- Attract new-to-Ohio company activity that grows and strengthens the function of specific clusters of excellence.

Programs include the Wright Centers of Innovation providing grants for world-class R&D platforms, Wright Projects providing grants for capital improvements to support commercialization, Biomedical Research and Commercialization Grants supporting collaboration among Ohio companies, university and nonprofit researchers, Engineering and Physical Science Research and Commercialization Grants also promoting collaboration, Third Frontier Fuel Cell Program for research collaborations, Pre-Seed Fund Initiative providing grants to funds to invest in Ohio businesses, The Ohio Research Commercialization Grant Program to match SBIR/STTR/ATP funds, Product Development Assistance Program to deliver product development assistance to Ohio companies, the Innovation Ohio Target Loan Fund to modernize certain targeted industry sectors, Third Frontier Internship Program for college internships, and The Third Frontier Network to support a supercomputing network.

10. Recommendations

10.1 Technology Commercialization Recommendations

10.1.1 Research Capacity

- North Dakota should continue to fund Centers of Excellence, and explore other programs to link universities and industry in collaborative R&D.
- North Dakota should consider using EPSCoR funding in conjunction with state matching for recruitment and start-up of not only brand new faculty but also more senior faculty.
- North Dakota could benefit from amending their R&D tax credit for private companies. To ensure that this credit encourages increased R&D in the state to boost the economy, the credit should only be allowable on new or increased R&D expenditures. Additionally, to allow small companies and start-ups to receive equal benefit, the credit rate should be higher on the first increment of increased expenditure. Finally, if the state wishes to encourage specific types of R&D expenditures, the credit could be higher for specific fields, such as biotechnology. The credit could also be structured to be higher for companies operating in distressed areas.

10.1.2 Technology Transfer

- North Dakota should avoid creating penalties for licensing or commercialization to non-North Dakota companies; instead, create programs that support high-tech companies in North Dakota, such as those that support entrepreneurs (see Section 10.1.3 below) or provide early-stage capital (see Section 10.1.4 below).
- Universities and/or NDUS should establish mechanisms to finance technology transfer functions and activities so that staff will not have to split time between both, creating potential conflicts and definite inefficiencies.
- NDUS should create programs that reward entrepreneurship and interaction with industry. These activities should be celebrated, not seen as risk to tenure and promotion. Examples are sabbaticals for entrepreneurial activity, positive consideration given to patenting, and partnering with industry and entrepreneurial activity in tenure and promotion decisions.

10.1.3 Entrepreneurship

- North Dakota should invest in a high-quality program to support an entrepreneurial climate, train high-growth entrepreneurs, and enable mentorship connections within the community. This program should be part of a network that includes the existing and planned entrepreneurial support organizations, and should support those organizations in achieving their goals.

10.1.4 Access to Capital

- North Dakota should institute at least one or potentially a series of grant or investment programs targeting young, potentially high-growth technology companies in the state to bridge the gap between university research funding and commercial venture capital. This should include modifying the criteria for New Venture Capital Fund at the Bank of North Dakota to enable investments in early-stage companies.
- North Dakota should increase the resources dedicated to supporting SBIR/STTR applicants and winners to provide more technical assistance, outreach, and grants for proposal preparation.

10.1.5 Cluster-based Economic Development

- North Dakota should inventory its innovation assets, that is, its research capacity, both within its universities and its industry, compare these assets with the current industry clusters in the state, and consider the market and technology trends in these areas.
- This analysis should be the basis for the refinement of technology clusters, both existing and emerging, that can be the subject of the alignment of all other programs—COE, incubation, grants, etc. We recommend that the Department of Commerce perform the following:
    - Organize and deliver government-supported services to clusters.
    - Target investments to clusters.
    - Strengthen networking and associative behavior within individual clusters and among the clusters.

10.1.6 Organizing to Support Science and Technology-based Economic Development

- The North Dakota legislature should establish a dedicated Office of Science and Technology in the Department of Commerce to advise the Governor on science and technology-related policy and to manage programs such as the Centers of Excellence and other initiatives that may be promulgated. The Office should be responsible for tracking the success of science and technology initiatives through an annual benchmarking process and through ongoing evaluations of any public investments in R&D.

10.2 IP Recommendations

10.2.1 North Dakota's Open Meetings and Open Records Laws

For the issues arising from North Dakota's Open Meetings and Open Records laws, we see four potential solutions:

1. *Boosting the exclusion definitions under §44-04-18.4*

   Concrete examples of definitional fine-tuning might include the following:

   - Defining "commercial information" to cover negotiations involving research or commercial prospects which, if released, would give advantage to business competitors or cause competitive harm
   - Expanding the definition of "proprietary information" (§44-04.18.4.(3)) to include information "generated for or through negotiations with a sponsor of research or a commercial prospect"
   - Expanding the definition of "trade secret" (§44-04.18.4.(2)(b)) to include discoveries or innovations subject to a "pending or anticipated patent application" to prevent premature disclosures that will result in (i) eliminating the opportunity for worldwide patenting due to the disclosure and (ii) potentially violating federal law requiring the patenting of "subject inventions" developed with federal financial assistance prior to publication (35 USC 202)

2. *Special legislative initiatives directed at protecting research and commercialization activities of state universities for a period of time*
3. *The promulgation of special rules by the State Board of Higher Education or revision of existing rules to protect from disclosure of competitively sensitive information in university records*
4. *Restructuring the NDSU/RF to be more independent of the university, or legislatively establishing research foundations that are not public entities*

RTI suggests that the appropriate authorities within the state of North Dakota, including participants from the state attorney general's office and stakeholders on all sides of the open-records debate, convene to consider these options. We believe that all of these options will achieve the goal of providing both in-state and out-of-state agencies, universities, and businesses with a higher degree of confidence that proprietary information and commercially sensitive information will be protected from disclosure under the open-records law for a reasonable period of time.

10.2.2 Research Foundations as Public Entities

RTI believes that an effort should be made to investigate the overall effect of the attorney general's opinion relative to 501(c)(3) organizations that as part of their function engage in activities on behalf of state agencies. While the function of a nonprofit organization is generally not to act as a shelter to avoid laws that would be otherwise applicable to agencies of the state, as nonprofits with missions dedicated to the public interest, it is often beneficial to limit unintended consequences by using a 501(c)(3). Due to the complexity of this issue and the wide range of state agency activities that may be carried out by separate nonprofit organizations under delegated agency, we believe a separate review should be undertaken by appropriate authorities to determine whether establishing firewalls to shelter certain records of the nonprofit organizations is within the public interest. This review could also discuss the restructuring of NDSU/RF as an operational solution.

10.2.3 Trade Secrets

North Dakota should clarify §44-04-18.4 to exempt from disclosure under open-records, any and all trade secret information, within the meaning of N.D.C.C. §47-25.1, belonging to a business organization that is in the possession of a public entity.

10.2.4 Noncompete Agreements

An absolute prohibition on noncompetition is most likely unnecessary to protect an individual's right to employment. The courts of most states already use judicial restraint in limiting the reach of employment-related noncompetition clauses. Replacing the existing provision of North Dakota law with one that recognizes the enforceability of noncompetition clauses subject to reasonable limitations and restraints would clarify the employer-employee relationship where issues of conflict of interest and post-employment competition are found to frustrate a positive business climate.

Efforts should be made to encourage North Dakota business groups to study comparative laws in peer states and propose a legislative solution. By way of example, see Georgia Code §13-8-2.1 found to be exceeded in *Palmer & Cay, Inc. v. Marsh & McLennan Companies* (see **Section 5.4.4**). An alternative to consider may be legislation that would permit companies doing business in specialty fields or engaging in economic development programs that are most likely to suffer harm from conflict of interest and competition from departing employees to avoid §9-08-01. This could be accomplished by adding a third exception to that effect to the existing two exceptions under §9-08-01.

10.2.5 SBHE Policies

Overall, the SBHE policies on intellectual property are in the mainstream of those adopted by, or on behalf of, U.S. research universities. However, a few policies do not encourage university-industry partnerships and should be reconsidered. These include the following:

1. *Treatment of student inventions under the same rules as faculty and staff inventions (§611.2.7.b*). By encouraging the universities to permit normal student use of facilities without forfeiture of patent title to the university, the potential for student involvement with companies increases.
2. *Limitation on assignment or transfer of intellectual property rights* <u>*only to*</u> *independent foundations created for managing and marketing institutional intellectual property (§611.10)*. Granting the constituent universities the discretionary right to assign to a broader group of entities would provide more flexibility than currently appears to exist.
3. *Omitted from the SBHE policies are any principles encouraging university-industry partnerships*. Inserting a principles statement that recognizes the benefit to university faculty and students of industrial collaborations would help to set a tone that is receptive to forming the linkages necessary for economic development.

Several SBHE polices should be re-examined in the light of best practice:

1. ***§611.2.2.k*****:** The definition of "work for hire" should be corrected and brought within §101 of the Copyright Act of 1976. Work for hire is a legal term that establishes the employer as the author of the work. It is incorrectly used in §611.2.2.k.
2. ***§611.2.3.c***: The institutional "right of first refusal" to patent title is unusual in university policies. The policy should be modified to eliminate the university's "right of first refusal" in favor of a "first right of refusal" or "a right to acquire title," either of which require the university to take a specific action that settles the question of title with certainty.
3. ***§611.2.3.d***: The practice of requiring a university to claim title to inventions within a set time limit, as this policy does under §611.2.3.d, is followed by some universities but not all. A best practice in deciding on the reversion of patent title to the inventor is to leave it ***to the discretion*** of the institution. [emphasis added]
4. ***§611.2. 3.d.1***: The minimum royalty share to be allocated to inventors is consistent with the lower threshold of most universities. However, the definition of "net royalties," which is the aggregated sum to be shared with

inventors, includes subtracting from gross royalties "expenses incurred by the institution in conducting the research." A best practice would be either to eliminate research cost recovery from the initial sharing formula with inventors and rely on use of the remaining percentage to cover any university costs or to explicitly set out which research costs will be subject to recovery prior to determining the net royalties for purposes of determining the inventor's share.

5. ***§611.4***: Copyright policy. It will hinder the ability of the universities to collaborate with industry if it is not clear that the institution has the right to require an assignment of copyrights developed under externally or third-party-funded agreements.
6. ***§611.2.4.b***.: Permitting author ownership of copyrights developed with significant use of facilities or institutional resources should be reviewed. We suggest that changes be made so that
    a. The institution has the right to acquire title to copyrights developed with significant use of facilities; or
    b. A revision is made to the policy that places a dollar value cap on use of facilities or resources where the author(s) retain copyright; or
    c. The terms of significant use of facilities and resources is negotiated between the appropriate authority and the author(s) wishing to retain copyright.
7. ***§611.2.6***: This section covering the ownership of copyrightable software omits treatment of software developed outside of the scope of employment. The policy should be expanded to deal with computer software developed by university personnel that is not within the scope of employment. Implementing the requirements found under §611.2.7.a.1. & 2. applicable to students would be appropriate to fix this situation.
8. ***§611.2.7.a.1-3***: These sections deal with the ownership of student copyrights. The policy is unusual in that the university appears to have greater right to student copyrights than to the copyrights of nonstudents. It should be reconciled either by tightening the institution's ownership rights to copyrights of nonstudent personnel developed with university funds or limiting the university's rights of ownership over student copyrights to align with the university's rights to nonstudent copyrights.
9. ***§§611.4 and 611.5*****:** Set out SBHE policy with regard to conflict of interest and consulting. §§611.4 is specifically aimed at conflicts of interest occurring as a consequence of an individual who is an officer or employee of the Board

of Higher Education. It would be helpful both for university employees and for companies wishing to do business with individuals who also hold university positions to have guidelines established under SBHE auspices that will inform where lines are drawn as to acceptable versus non-acceptable practices.

10. ***§611.6*:** Describes employee responsibility for the handling of confidential proprietary information. It would be helpful for the SBHE to clearly establish an obligation of confidentiality on the part of employees for nonpublic, proprietary, or trade secret information disclosed to them by an organization that is not a public entity.

Appendix A

North Dakota Individuals Interviewed for This Study

Peter Alfonso, Vice President for Research and President, University of North Dakota Research Foundation, University of North Dakota

Dennis Anderson, Licensing Associate, North Dakota State University

Barry Batcheller, President, Appareo Systems

Steven Benson, President, MicroBeam Technologies

Rick Berg, Senator and Chair, North Dakota Economic Development Committee, Legislature

Philip Boudjouk, Vice President for Research, Creative Activities and Technology Transfer, North Dakota State University

Linda Butts, Director of Economic Development and Finance, North Dakota Department of Commerce

Howard Dahl, President, Amity Technology

Justin Dever, Special Assistant to the Commissioner, North Dakota Department of Commerce

Rick Duquette, City Administrator, City of Grand Forks

Tom Erickson, Associate Director for Research, Energy and Environmental Research Center

Chuck Evans, General Counsel, University of North Dakota

Julie Evans, General Counsel, University of North Dakota

Douglas Freeman, Head of Department of Veterinary and Microbiological Sciences, North Dakota State University

David Givers, Co-Project Director, EPSCoR

Bruce Gjovig, Director, Center for Innovation, University of North Dakota

Shane Goettle, Commissioner, North Dakota Department of Commerce

Ken Grafton, Director, North Dakota Agricultural Experiment Station

Tony Grindberg, Executive Director, North Dakota State University Research and Technology Park

Gerald Groenewold, Director of Energy and Environmental Research Center, University of North Dakota

Nic Hacker, Senator, North Dakota Legislator

John Harju, Associate Director for Research, University of North Dakota

Carsten Heide, Intellectual Property Management and Technology Commercialization, Energy and Environmental Research Center, University of North Dakota

Ray Holmberg, Senator, North Dakota Legislature

Tara Holt, Director, Women’s Business Center

Robert Humann, Senior Vice President, Bank of North Dakota

John Jambois, President, Tectron Products

Bor Jang, Dean of the College of Engineering and Computer Science, Wright State University (former Dept. Chair NDSU)

Gary Johnson, Assistant Vice President for Research, University of North Dakota

Jim Johnson, Patent Attorney, Marsh, Fischmann & Breyfogle, LLP

Rick Johnson, General Counsel, North Dakota State University

Ronald Johnson, Dean of Business Administration, North Dakota State University

Joel Jorgenson, President and Founder, Packet Digital

Mary Kae Kelsch, Assistant Attorney General, Office of Attorney General Bismarck

Valrey Kettner, Assistant Vice President for Sponsored Programs Administration, North Dakota State University

Jenya Kozliak, College of Arts and Sciences, University of North Dakota

Scot Long, Vice President, North Dakota Development Fund

Ron Marsh, School of Aerospace Sciences, University of North Dakota

Christine Martin, State Director, Small Business Development Center Network

Douglas McDonald, Founder, CEO Praxis

Jim Melland, General Manager, Sure Foot

Brad Myers, School of Law, University of North Dakota

Bonnie Neas, Associate Vice President – Federal Government Relations and Director – Center for High Performance Computing, North Dakota State University

Matt Nilles, Graduate Director of School of Medicine and Health Sciences, University of North Dakota

Mark Nisbet, Chair, Centers of Excellence Commission

Leon Osborne, President, Meridian Environmental Technology

Jim Petell, Director of Technology Transfer and Commercialization/ Registered Patent Agent, University of North Dakota

Wayne Seams, Chemical Engineering Professor, University of North Dakota

Pat Seaworth, General Counsel, North Dakota University System

David Schmidt, Grants and Contracts, University of North Dakota

Craig Schnell, Provost and Vice President for Academic Affairs, North Dakota State University

Craig Silvernagel, Entrepreneurship Director, University of North Dakota

Brenda Sorenson, Marketing Director, Center for Innovation, University of North Dakota

Wilbur Stolt, Director of Libraries, University of North Dakota

David Straley, Vice President of Government Affairs, North Dakota Chamber of Commerce

Ken Svedjan, Representative and Chair, House Appropriations, North Dakota Legislature

Orval Swenson, Research Director, Agsco, Inc.

Klaus Theissen, President and CEO, Grand Forks Region EDC

Connie Triplett, Senator, North Dakota Legislature

Kathleen Tweeten, Director, North Dakota State University Extension Service

Brian Walters, President, Greater Fargo/Moorhead Economic Development Corporation

Dean Webster, Coatings and Polymeric Materials, North Dakota State University

Dale Zetocha, Executive Director, North Dakota State University Research Foundation

Delore Zimmerman, Red River Valley Research Corridor

Appendix B

North Dakota Centers of Excellence

SCHOOL—CoE	FOCUS—Partners	FUNDING	CoE FUNDED	WHEN
North Dakota State University				
Center for Technology Enterprise		2003	Yes	Pre-formal COE
Tech Incubator CoE	At R&T Park includes Appareo Entrepreneurship	$5.4 million Phase I (9/05) $1.75 million grant DoC EDA $200K City of Fargo $100K NDSU Research Found. $500K cities and EDC	Yes	Pre-formal COE
Adv. Electronics Design & Manf. Ctr.	Research w/ NDSU partners: RFID for cold-chain shipments (Alien) sensors for wireless (Crane)	$3 million (12/05) with match up to $9.5 million	Yes	Round 1
AgBiotechnology Center: Oilseed Development	Biofuels, lubes, healthcare Monsanto, Archers Daniel Midland, Dakota Skies	$2 million (1/06) with match or $10.7 million	Yes	Round 2
Center for Surface Protection	Surface coatings for product durability Tecton, Marvin, Akzo…	$2 million (1/06) with match of $4 million	Yes	Round 2
Beef Systems Science CoE	USDA established with ND Rural Elec Coop and ND Stockman's Assoc.	$800K (2003) as leverage for $1 million grant from US Dept. of Ag.	Yes	Pre-formal COE
Bismarck State College				
National Energy CoE	Energy + environment and use of coal. Reliant Energy, Westmoreland Coal, MN Power, etc.	$3 million (12/05) with match up to $13 million	Yes	Round 1
University of North Dakota				
Center of Innovation	Commercialization	$800K (2003) as State's first CoE	Yes	Pre-formal COE
Energy and Environ. Res. Ctr Hydrogen. Technology (10 CoEs within)	2004 Natl. Ctr. Hydrogen Tech by DoE H and fuel cell tech., ePower, Kraus, Basin Elec., Phoenix Ind.	$2.5 million (12/05) with match of $20 million+ (4/06)	Yes	Round 1

SCHOOL—CoE	FOCUS—Partners	FUNDING	CoE FUNDED	WHEN
CoE in Life Sciences & Adv. Tech. (COLESAT)	Commercialization, Alion, Avianix, Aragen, Prologic, Imclone, Cirrus... houses Ctr for Infect. Disease, Proteomics, Genomics, and Bioinformatics incl emergency preparedness	$3.5 million (1/06) with match of $10 million+	Yes	Round 2
Unmanned Aerial Vehicle and Simulation Applications CoE	UAV human factors, payload sensors, ground-based cockpits, training LM, Aliion S&T, Cirrus Aircraft, Frasca	$1 million (1/06) with match of $4.2 million	Yes	Round 2
UND School of Med. & Health Sciences				
CoE in Neurosciences	Neurodegeneration, neurogenetics,	$10.4 from NIH for Ctr of Biomed Excellence (COBRE) – 5 yr. grant	No NIH	NA
Dickinson State University				
Ctr. for Entrepreneurship and Rural Revitalization – Inst. for Tech. and Business	Commercialization, Killdeer Mountain Manufacturing	$1.1 million with match of $2.9 million	Yes	Round 3
Lake Region State College				
Technology Optimized Agriculture	No. Am. Ag + net margins	$450K (12/05) with match up to $1.3 million	Yes	Round 1
Valley City State University				
Inst. for Customized Business Soln. (ICBS)	IT enterprise application consulting – use Ent. Appl. Model (EAM), GEM, Eagle Creek SW, Eide Bailly, MeritCare	$1 million (1/06) with match of $4.9 million	Yes	Round 2
Williston State College				
Petroleum Safety and Tech. Ctr.	Oilfield technologies, Hess, Halliburton, Baker, Schlumberger…	$400K (1/06) with match of $1.3 million	Yes	Round 2

SCHOOL	**ITEM of INTEREST**
North Dakota State University	
	Partner with UMN in Homeland Security Ctr. For Food Protection and Defense
	Core Member of FAA General Aviation Center (CGAR) focused on inspection, maintenance, advanced materials, crashworthiness, technology transfer
Cankdeska Cikana Community College	
	2002 USDA National Center of Excellence for Rural Economic Development
Minot State University	
ND Ctr. For Persons with Disabilities CoE (NDCPD)	Programs for infants, families, Native Americans
Rural Crime and Justice Center	Local and fed. Law Enforcement
Center for Extended Learning	Local and military
Applied Business Center	Entrepreneurship
Jamestown College	
Meidinger CoE in Business	Regional focus

Appendix C

Michigan Statute: Confidential Research and Investment Information Act, Act 55 of 1994

CONFIDENTIAL RESEARCH AND INVESTMENT INFORMATION ACT
Act 55 of 1994

AN ACT to protect from public disclosure certain information obtained in research and related activities of public universities and colleges; to protect from public disclosure certain investment information received by a public university or college from an investment fiduciary or portfolio company; and to prescribe certain duties of public universities and colleges.

History: 1994, Act 55, Imd. Eff. Apr. 5, 1994;—Am. 2004, Act 86, Imd. Eff. Apr. 22, 2004.

The People of the State of Michigan enact:

390.1551 Short title.

Sec. 1. This act shall be known and may be cited as the “confidential research and investment information act”.

History: 1994, Act 55, Imd. Eff. Apr. 5, 1994;—Am. 2004, Act 86, Imd. Eff Apr. 22, 2004.

390.1552 Definitions.

Sec. 2. As used in this act:
(a) “Commercial information” means information regarding the purchase and sale of goods and services, including, but not limited to, information regarding marketing strategy, production data, assessments of goods and services, mineral exploration records, and compilations of data regarding commercial activity.
(b) “Financial information” means information regarding finances, including, but not limited to, assets, income, liabilities, net worth, bank balances, financial history or activities, or creditworthiness.
(c) “Intellectual property” means all original data, findings, or other products of the mind or intellect commonly associated with claims, interests, and rights that are protected under trade secret, patent, trademark, copyright, or unfair competition law.
(d) “Investment” means the utilization of money or other assets in the expectation of future returns in the form of income or capital gain.
(e) “Investment fiduciary” means a person who exercises any discretionary authority or control over an investment of a public university or college or renders investment advice for a public university or college for a fee or other direct or indirect compensation.
(f) “Investment information” means information that has not been publicly disseminated or that is unavailable from other sources, the release of which might cause a portfolio company or an investment fiduciary significant competitive harm. Investment information includes, but is not limited to, financial performance data and projections, financial statements, list of coinvestors and their level of investment, product and market data, rent rolls, and leases.
(g) “Portfolio company” means an entity in which an investment fiduciary has made or considered an investment on behalf of a public university or college.
(h) “Public university or college” means a university, college, or community college established under section 5, 6, or 7 of article VIII of the state constitution of 1963.
(i) “Record” means all or part of a writing, as that term is defined in section 2 of the freedom of information act, 1976 PA 442, MCL 15.232.
(j) “Trade secret” means information consisting of a valuable unpatented formula, pattern, device, or process, or other information that is used in a business and gives the possessor of the information a competitive advantage over those who do not know or use the information, and for which sufficient measures have been taken to guard the secrecy of the information and preserve its confidentiality, and that does not encompass information that is readily ascertainable by competitors or the general public without undue difficulty or hardship.

History: 1994, Act 55, Imd. Eff. Apr. 5, 1994;—Am. 2004, Act 86, Imd. Eff. Apr. 22, 2004.

390.1553 Information provided to public university or college by private external source; exemption from disclosure; conditions; affirmative duty to notify agencies; applicability of subsection (1) to information regarding sold or marketed product or process.

Sec. 3. (1) Except as otherwise provided in this section, trade secrets, commercial information, or financial information, including that information as it relates to computer hardware and software, that is provided to a

public university or college by a private external source and that is in the possession of the public university or college in the performance of a lawful function is exempt from disclosure as a public record under the freedom of information act, Act No. 442 of the Public Acts of 1976, being sections 15.231 to 15.246 of the Michigan Compiled Laws, if all of the following conditions are met:
(a) The information is used exclusively for research, testing, evaluation, and related activities.
(b) The information is clearly designated by the external source before or at the time it is received by the public university or college as being confidential.
(c) The public university or college has entered into an agreement to keep the information confidential, and the confidentiality agreement was authorized by the chief administrative officer of the public university or college, or his or her designee.
(d) A document containing a general description of the information to be received under the confidentiality agreement, the term of the confidentiality agreement, the name of the external source or person with whom the confidentiality agreement was made, and a general description of the nature of the intended use for the information is recorded by the public university or college within 20 regular working days after it is received, is maintained in a central place within the public university or college, and is made available to a person upon request. The description of the information to be received shall be sufficient to provide the public with the necessary information to understand the nature of the research or product involved in the confidentiality agreement.
(2) Subsection (1) does not apply to information that meets both of the following:
(a) Is otherwise publicly available.
(b) Is submitted as required by law or as a condition of receiving a government contract, license, or other benefit.
(3) To the extent that the information indicates a substantial likelihood that a person may be killed or injured by the use of the product or process, a public university or college has an affirmative duty to take reasonable measures to promptly notify appropriate local, state, and federal regulatory agencies of information regarding a product or process that is in the stream of commerce at the time the public university or college receives the information or actively uses the information in its research, and subsection (1) does not apply to the information. The affirmative duty described in this subsection is not intended to and does not create a separate or additional liability or cause of action outside of the remedies provided for in Act No. 442 of the Public Acts of 1976. A provision of a contract between a public university or college and another person that conflicts with this subsection is void for the purposes of this act as a matter of public policy. However, the affirmative duty described in this subsection does not apply to information described in this subsection if 1 or more of the following apply:
(a) There already exists a duty upon the manufacturer, distributor, seller, or owner of the product or process to disclose the information to a regulatory agency and the public university or college does not have actual knowledge that the information has not been disclosed in accordance with that duty.
(b) The hazards of the product or process are obvious to the user or consumer.
(c) The hazards of the product or process are disclosed to the user or consumer in recommendations, warnings, or other instructions supplied to the user or consumer by the manufacturer, distributor, seller, or owner of the product or process.
(4) To the extent that the information and its commercial value are capable of being adequately protected by copyright, patent, or trademark protection and are not encompassed by a pending, unissued patent application, subsection (1) does not apply to information regarding a product or process if the public university or college is selling or marketing the product or process to the general public.
History: 1994, Act 55, Imd. Eff. Apr. 5, 1994.

390.1554 Information in which interest held, or owned, prepared, used, retained by, or in possession of public university or college; exemption from disclosure; applicability of subsection (1) to information regarding sold or marketed product or process; applicability of § 390.1553(3).

Sec. 4. (1) Except as otherwise provided in this section, the following information in which a public university or college holds an interest, or that is owned, prepared, used, or retained by, or in the possession of, a public university or college, is exempt from disclosure as a public record under the freedom of information act, Act No. 442 of the Public Acts of 1976, being sections 15.231 to 15.246 of the Michigan Compiled Laws:

(a) Intellectual property created by a person employed by or under contract to a public university or college for purposes that include research, education, and related activities, until a reasonable opportunity is provided for the information to be published in a timely manner in a forum intended to convey the information to the academic community.
(b) Original works of authorship fixed in any tangible medium of expression created by a person employed by or under contract to a public university or college for purposes that include research, education, or related activities, until a reasonable opportunity is provided for the author to secure copyright registration, not to exceed 12 months from the date the work is first fixed in a tangible medium of expression.
(c) Records regarding a process, a machine, an item of manufacture, or a composition of matter, or any new and useful improvement of a process, a machine, an item of manufacture, or a composition of matter, until a reasonable opportunity is provided for the inventor to secure patent protection, not to exceed 5 years from the date the records are first made.
(d) Trade secrets or other proprietary information in which a public university or college holds an interest or that a public university or college owns that is determined by the public university or college to have potential commercial value, if a general description of the nature of the information and a description of the extent of the interest held by the public university or college in the information is made available to a person upon request.
(2) To the extent that the information and its commercial value are capable of being adequately protected by copyright, patent, or trademark protection and are not encompassed by a pending, unissued patent application, subsection (1) does not apply to information regarding a product or process if the public university or college is selling or marketing the product or process to the general public.
(3) Section 3(3) applies to information described in this section that is provided by a private external source.

History: 1994, Act 55, Imd. Eff. Apr. 5, 1994.

390.1554a Records received, prepared, used, or retained by investment fiduciary; confidentiality.

Sec. 4a. (1) Subject to subsection (2), a record received, prepared, used, or retained by an investment fiduciary in connection with an investment or potential investment of a public university or college that relates to investment information pertaining to a portfolio company in which the investment fiduciary has invested or has considered an investment that is considered by the portfolio company and acknowledged by the investment fiduciary as confidential, or that relates to investment information whether prepared by or for the investment fiduciary regarding loans and assets directly owned by the investment fiduciary and acknowledged by the investment fiduciary as confidential, is exempt from the disclosure requirements of the freedom of information act, 1976 PA 442, MCL 15.231 to 15.246, if at least annually the public university or college provides to its governing board, and makes available to the public, a report of its investments that includes all of the following:
(a) The name of each portfolio company in which the public university or college invested during the reporting period.
(b) The aggregate amount of money invested by the public university or college in portfolio companies during the reporting period.
(c) The rate of return realized during the reporting period on the investments of the public university or college in portfolio companies.
(d) The source of any public funds invested by the public university or college in portfolio companies during the reporting period.
(2) If a record described in subsection (1) is an agreement or instrument to which an investment fiduciary is a party, only those parts of the record that contain investment information are exempt from the disclosure requirements of the freedom of information act, 1976 PA 442, MCL 15.231 to 15.246.

History: Add. 2004, Act 86, Imd. Eff. Apr. 22, 2004.

390.1555 Ability to engage in independent projects not limited.

Sec. 5. This act does not limit the ability of a person employed by or under contract to a public university or college to engage in lawful projects independent of a public university or college, or prohibit such a person from disclosing information regarding those independent projects or from receiving pecuniary income from those independent projects.

History: 1994, Act 55, Imd. Eff. Apr. 5, 1994.

390.1556 Construction of certain provisions of act.

Sec. 6. The provisions of this act exempting information from disclosure shall be strictly construed.

History: 1994, Act 55, Imd. Eff. Apr. 5, 1994.

390.1557 Response to request for information; procedures.

Sec. 7. A person receiving a request under the freedom of information act, Act No. 442 of the Public Acts of 1976, being sections 15.231 to 15.246 of the Michigan Compiled Laws, for information exempt from disclosure under this act shall comply with the procedures and requirements of Act No. 442 of the Public Acts of 1976 in responding to the request and shall also provide to the person making the request a general written description of the information and a written explanation of the reason the request has been denied.

History: 1994, Act 55, Imd. Eff. Apr. 5, 1994.

Rendered Thursday, May 18, 2006 Page 4 Michigan Compiled Laws Complete Through PA 138 of 2006

Appendix D

State Science and Technology Entities

State	Lead S&T Entity	Web Site	Form
Alabama	Energy, Weatherization and Technology Division	http://www.adeca.state.al.us/EWT/default.aspx	State Entity
Alaska	The Technology Research and Development Center of Alaska	http://trendalaska.org/	Private Nonprofit
Arizona	Office of Innovation and Technology	http://www.azcommerce.com/innovation/default.asp	State Entity under Commerce
Arkansas	Arkansas Science and Technology Authority	http://www.arkansasscienceandtechnology.org/latestnews.htm	State Entity
California	California Office of Science and Technology	http://www.commerce.ca.gov	State Entity under Commerce
Colorado	Colorado Institute for Technology Transfer & Implementation	http://citti.uccs.edu/	Nonprofit established with University of Colorado
Connecticut	Connecticut Innovations	http://www.ctinnovations.com/site/initiatives/index.asp	State Entity
Delaware	Delaware Economic Development Office	http://www.state.de.us/dedo/business/business.shtml	State Entity
Florida	Enterprise Florida	http://www.eflorida.com/us/	State Entity
Georgia	Georgia Research Alliance	http://www.gra.org/homepage.asp	Private Nonprofit
Hawaii	High Technology Development Corporation	http://www.htdc.org/default.asp	State Entity
Idaho	Idaho Office of Science and Technology	http://technology.idaho.gov/	State Entity under Commerce
Illinois	Illinois Technology Development Corporation	http://www.illinoistechnology.com/	Private Nonprofit
	Bureau of Technology & Industrial Competitiveness	http://www.illinoisbiz.biz/dceo/Bureaus/Technology/	State Entity under Commerce
Indiana	Indiana Economic Development Corporation	http://www.in.gov/iedc/initiatives/	Public / Private Partnership
Iowa	Iowa Department of Economic Development	http://www.iowalifechanging.com/business/	State Entity
Kansas	Kansas Technology Enterprise Corporation	http://www.ktec.com/index_Flash.htm	Public / Private Partnership

State	Lead S&T Entity	Web Site	Form
Kentucky	Department of Commercialization and Innovation	http://www.ced.ky.gov/dci/	State Entity
Louisiana	Louisiana Economic Development	http://www.lded.state.la.us/led/industry_clusters/index.asp	State Entity
Maine	Maine Office of Economic Development	http://www.maine.gov/portal/business/econ-tech_initiatives.html	State Entity
Maryland	Maryland Department of Business & Economic Development	http://www.choosemaryland.org/	State Entity
Massachusetts	Massachusetts Technology Collaborative	http://www.masstech.org/	State Entity
Michigan	Michigan Economic Development Corporation	http://www.michigan.org/medc/index.asp?m=0	State Entity
Minnesota	Minnesota Technology	http://www.minnesotatechnology.org/	Private Nonprofit
Mississippi	Mississippi Technology Alliance	http://www.technologyalliance.ms/index.php	Private Nonprofit
Missouri	Missouri Department of Economic Development	http://www.missouridevelopment.org	State Entity
Montana	None		
Nebraska	Nebraska Department of Economic Development	http://www.neded.org/	State Entity
Nevada	Nevada Commission on Economic Development	http://www.expand2nevada.com/technology/resources/	State Entity
New Hampshire	Economic Development Division	http://www.nheconomy.com/nheconomy/dredweb/main/index.php	State Entity
New Jersey	New Jersey Commission on Science and Technology	http://www.state.nj.us/scitech/	State Entity
New Mexico	Office of Science and Technology	http://www.edd.state.nm.us	State Entity within Economic Development Department
New York	New York Science and Technology Foundation	http://www.nystar.state.ny.us/	State Entity
North Carolina	North Carolina Board of Science and Technology	http://www.ncscienceandtechnology.com/	State Entity
North Dakota	None		
Ohio	Ohio Department of Development	http://www.odod.state.oh.us/Industry_and_Technology.htm	State Entity
Oklahoma	Oklahoma Center for the Advancement of Science and Technology	http://www.ocast.state.ok.us/	State Entity

State	Lead S&T Entity	Web Site	Form
Oregon	Oregon Inc.	http://www.oregoninc.org/index.htm	State Entity
Pennsylvania	Ben Franklin Technology Partners	http://www.benfranklin.org/	State Entity
Rhode Island	Rhode Island Economic Development Corporation	http://www.riedc.com/r/index.html	State Entity
South Carolina	South Carolina Technology Alliance	http://www.sctech.org/	Private Nonprofit
South Dakota	None		
Tennessee	Department of Economic and Community Development	http://www.state.tn.us/ecd/techdev.htm	State Entity
Texas	Texas Department of Economic Development	http://www.governor.state.tx.us/divisions/ecodev	State Entity
Utah	Governor's Office of Economic Development	http://goed.utah.gov/business_development/index.html	State Entity
Vermont	Vermont Department of Economic Development	http://www.thinkvermont.com/technology/index.cfm	State Entity
Virginia	Center for Innovative Technology	http://www.cit.org/	Private Nonprofit
Washington	Washington Technology Center	http://www.watechcenter.org/	State Entity
West Virginia	West Virginia Development Office	http://www.wvdo.org/business/index.html	State Entity
Wisconsin	Wisconsin Technology Council	http://www.wisconsintechnologycouncil.com/	Private Nonprofit
Wyoming	none		