Pressing the Advantage

A Regional Growth Strategy for the I-29 Corridor

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Executive Summary

The communities that span the I-29 Corridor in eastern South Dakota from North Sioux City to Watertown and west to Yankton and Madison have joined forces, through a newly created I-29 Corridor Task Force, to craft a plan to identify and act on collaborative opportunities to grow their whole region and to build the capacity to sustain this growth[1]

This report, prepared by Regional Technology Strategies (RTS) of Carrboro, North Carolina under contract to the I-29 Corridor Task Force offers a strategic plan that fuses three overlapping economic development dimensions.

1. The plan seeks to parley existing and emerging private sector strengths into more jobs, more income and more wealth in I-29 Corridor communities.

2. The plan advances a strategy to build and support the research enterprise and educational assets within the region's university and post secondary education and training communities and link them to the private sector as economic development drivers.

3. The plan recommends initiatives and actions to retain and attract higher education and post-secondary graduates and their knowledge and skills as the foundation for the region's future growth and prosperity.

The purpose is to produce more high quality jobs throughout the region, more wealth in the I-29 Corridor communities, and more economic opportunity for all of the region's citizens. The most direct route to these goals are to build and exercise the capacity to engage in higher value (and higher wage and earnings) commerce.

The initial section of the report is the Phase 1 analysis of the I-29 Corridor economy at the regional and sub-regional levels and, based on this analysis a strategic plan, to build and use emerging and existing private sector strengths to generate more higher paying jobs and more wealth in the region's communities. The next section offers the Phase 2 analysis and plan for region's public universities and non-profit research organizations role as a major economic development resource for the overall Phase 1 plan as well as their continued advancement as a economic development driver on their on accord. Finally, a recommendation is offered on a collective regional approach to economic development in the I-29 Corridor.

Phase 1: Economic Analysis of the I-29 Corridor

The economic analysis phase of the report looked at the I-29 corridor through a series of lenses: relationship of the corridor to the rest of South Dakota, demographic changes, leading economic

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[1] For the purposes of this study, the following counties are included in the I-29 corridor: Brookings, Lincoln, Clark, Marshall, Clay, McCook, Codington, Miner, Day, Minnehaha, Deuel, Moody, Grant, Roberts, Hamlin, Turner, Kingsbury, Union, Lake, and Yankton.

clusters, including those with export potential, workforce development capacity, and the region's capacity in innovation and entrepreneurship. One issue that is critical to understand that although there is value in thinking of these counties as one region, there are, in economic terms, sub-regions within the geography defined by such elements as geography, workforce, sectors, infrastructure, natural resources and political boundaries. Whenever possible analysis was performed taking these sub-regions into account.

Phase 1: Key Findings

Region/State

- The I-29 Corridor, led by the Sioux Falls metro area, dominated economic and population growth in South Dakota over the last 10 years.
- The region's economy has grown faster than the state, 9% compared to 6%.
- The Corridor's economy varies substantially from the rest of the state with more finance, services and manufacturing and less agribusiness, government and tourism.

I-29 Demographics

- The region has experienced net in-migration.
- The Corridor is becoming more integrated as more workers commute to work within the region.
- The region's workforce has a large cohort of retiring workers that presents a workforce challenge.

I-29 Lead Clusters

A key component of RTS' analysis of the I-29 Corridor is looking at the region's clusters as an economic unit. A cluster is a geographic concentration of interrelated competitive firms and institutions of sufficient scale to generate external economies making the whole greater than the sum of its parts. They occur where a group of businesses, drawing on similar resources, exist in relationships with other nearby businesses and institutions that contribute to their competitiveness. Examples range from the high tech clusters of microelectronics, semiconductor, and software businesses in Silicon Valley, California to the biotechnology industry in the Research Triangle, North Carolina or the ceramics industry in western New York. A region's clusters tend to be the primary wealth generators in its economy.

In terms of the I-29 Corridor, some key findings are:

- The major clusters in the region all grew from 2004-2009 with the exception of agribusiness.

- Both the financial and the energy clusters are forecast to grow significantly from 2009-2014 but they are affected by recent legislative changes at the Federal level.

- The clusters with the greatest potential to export their products are: financial services, life sciences, agribusiness, energy, and advanced manufacturing.

- Most of the growing clusters in the region contain significant levels of manufacturing employment.

Workforce Development

- The Corridor's demographics show both good and bad signs for the region with the in-migration offset by out-migration of young people and a large increase in retirees.

- Due to these demographic shifts, the region has experienced workforce shortages.

- The lack of locally available workforce training resources is alarming. Two technical institutes are not sufficient given the geography, economy and population.

Economic Targets

- The targets established by the state and within the Future Sioux Falls effort provide an excellent starting point for looking at targets within the Corridor, in particular the state targets for biotechnology, medical devices, energy and computer/IT along with the Future Sioux Falls targets of medical services and research, corporate and data services and renewable energy technology provide a strong basic array of targets.

- The super-sector of advanced manufacturing is a key and serves many of the other targets.

- There a number of emerging sectors that relate well to the overall economy and some of the targets identified above.

Innovation in the Economy

- The hard infrastructure for innovation, such as incubators, research parks and fiber optic backbone is well developed.

- The soft infrastructure of technical service providers is adequate but could be improved.

- There are no significant resources available for early stage capital.

- The level of R&D performed in South Dakota industry is very low, even when adjusted to the size of the economy.

- Risk capital sources are substantial relative to the size of the economy.

Phase 1: Recommendations and Action Steps

The recommendations and actions presented below define a regional economic development strategy based on the current and emerging wealth generating sectors and clusters within the I-29 Corridor. As such it focuses on producing and deploying the economic strengths that will govern the region's future economy by (1) improving the economic competitiveness of the lead and emerging economic engines of the Corridor and (2) integrating the economic development assets more fully with the university-based development strategies developed in the Phase 2. The goal remains a constant: generating greater numbers of higher wage jobs and building wealth in the region's communities.

Workforce Development

Recommendation: Develop more widely distributed workforce training that meets the needs of new workers, existing workers and companies.

Actions

- The region and specific interested communities should work with Lake Tech and Southeast Tech to add satellite campuses where needed and funded.
- Where a satellite campus is infeasible, investigate the model used by Yankton at its Regional Technical Education Center.
- Advisory councils should be employed to get companies across the region involved and committed.

Recommendation: Encourage high schools students to take STEM related courses even if they are not planning on matriculating to a four-year university.

Actions

- Continue/expand the development of articulation agreements between the K-12 system and tech schools.
- Continue/expand the development of articulation agreements between the tech schools and state universities.

Recommendation: Help technical school students understand the occupational opportunities within the regional economy.

Action

- Include technical school students within the Dakota Seeds program.

Private Sector-Led Networks

Recommendation: The I-29 Task Force should facilitate the creation of region-wide business associations.

<u>Actions</u>

- The Task Force should begin by convening an Advanced Manufacturing Association within the Corridor.
- The Task Force should examine opportunities for other sectoral-based associations.

Recommendation: Sub-regional economic development professionals should facilitate the development of workforce skill networks.

<u>Action</u>

- Use corporate roundtables to build and serve sub-regional skill councils.

Entrepreneurship

Recommendation: The I-29 Task Force should work within the region to build a better entrepreneurial environment.

<u>Actions</u>

- Develop under-35 entrepreneurship networks that encourage and excite emerging talent.
- The I-29 Task Force should investigate the development of a region-wide entrepreneurship council.
- Investigate avenues to create local or sub-regional organizations to own entrepreneurship.
- Encourage the addition of an effective entrepreneurship program within the technical schools.

Recommendation: Address the earliest stage funding gaps through proof-of-concept and pre-seed funds for the region's universities and technology companies.

<u>Action</u>

- The I-29 Corridor Region Task Force should form a sub-committee to plan and lead an initiative to address the earliest stage risk capital gaps. It is suggested that the sub-committee be comprised of technology company entrepreneurs and representatives from the risk capital community, technical assistance professionals from technology-based economic development intermediaries (incubators, et al), university and non-profit technology transfer offices. (Also see Proof of Concept fund recommendation under University – Community Linkages.)

Creative Economy

There are opportunities within I-29 corridor to use creativity as an economic development engine.

Recommendation: The I-29 Task Force should investigate and encourage initiatives within the region based on the creative economy.

Actions

- Encourage sub-regional efforts that build on cultural and nature resource assets.
- Encourage the development of local food systems as cultural assets.

Phase 2: The University and Research Sector

The second phase of the report addresses the role of the area's universities and non-profit research organizations within the I-29 Corridor Region's new economic growth strategy to generate more higher-paying jobs and wealth in communities. In particular we focused on South Dakota State University, the University of South Dakota, Dakota State University, Avera Research Institute and Sanford Health.

Phase 2: Key Findings

The following key findings from this university and linked non-profit research institution analysis summarize the basis for the recommended actions that conclude the Phase 2 section of this report.

- South Dakota's colleges and universities (particularly in the I-29 corridor) turn out significant numbers of science and technology-oriented degrees at the baccalaureate level and compare favorably to other states. However, this is not the case at the graduate level where science and engineering degree production lags behind other states.
- The South Dakota economy, compared to other states, employs relatively fewer degreed individuals, at every level and particularly in the sciences and engineering. In addition, South Dakota, compared to other states, seems to export relatively more of its talented young people.
- Private sector R&D support is one of the strongest indicators of innovation capacity. There is a low level of private research support within the region's universities.

- The lack of emphasis on research and graduate programs within the state's universities during the 80's and 90's has constrained the region's capacity to produce and support knowledge-intensive, higher value commerce jobs and companies.

- The universities have lost much ground to their peers in a very competitive environment. They will need to be very strategic about support for graduate education and research if these activities are to be funded at a level that will allow them to get back in the game.

- While there is growing across-the-board excellence in R&D, the most nationally competitive area of knowledge development lies in the life sciences – widely defined. This includes the historical and proven strength in plant and animal bioscience as well as emerging strengths in biomedical and medical engineering. The broad technology platform associated with light activated materials and whose applications cut across campuses, research institutes, companies and targeted within a 2010 Center should be noted. Electrical engineering should also be acknowledged as a strength area.

- The three universities have distinctly different missions, profiles and economic development engagement strengths that can lead to very different roles in regional development.

- There is a good bit of effective outreach activity to employers activities associated with SDSU College of Engineering and Dakota State information technology and computer information systems but it is not scalable or routinely structured to systematically respond to the needs of the region's manufacturing community – especially the very strong advanced manufacturing presence in the Sioux Falls, Brookings, Watertown and Yankton communities.

- The presence of the national industrial extension system, the MEP, is very limited in South Dakota and the I-29 region when compared to other states. In fact, it is the only state without a physical MEP center location.

- Relative to institutions in other states, South Dakota is playing a twenty-year game of catch-up, as most of their peer institutions established technology transfer functions by the mid 1990s. Because of both startup and catch-up demands, the level of staffing across the state of technology transfer functions and offices is limited and stressed given the task at hand.

- On many university campuses, entrepreneurship centers or programs provide ancillary services to the established technology transfer offices, however in South Dakota these programs are themselves in early stages of development and mostly confined to instructional activities and student-focused programs.

- The university cultures and related policies and practices for entrepreneurial behavior and economic development engagement are in early formation stages.

- The public and non-profit capacity to support university-associated science and technology-based economic development is well ahead of the universities' research enterprises and entrepreneurial cultures capacity to generate opportunities. For the size of this regional market, the shared university-community innovation infrastructure is very advanced. The constellation of existing and planned research parks and campuses and incubators throughout region – all with existing and potential university connections should as a group function as a formidable economic development asset.

Phase 2: Recommendations and Action Steps

The recommendations and actions presented below define a regional economic development strategy based on the current and emerging capacities within the higher education institutions and non-profit research organizations within the I-29 Corridor. Within the main report, in a number cases the recommendations and actions also include additional implementation notes. The strategy focuses on producing and deploying the talent and knowledge that will govern the region's future economy by (1) building capacity across all campuses to produce economic development outcomes and (2) fusing with the previously presented private sector economic development strategy to support and leverage that strategy's specific objectives and outcomes. The goal remains a constant: generating greater numbers of higher wage jobs and building wealth in the region's communities.

Institutional Roles

The three universities and two research institutions have distinctly different missions, profiles and economic development engagement strengths that suggest different roles in regional development strategy based on what they do best. Because of the limited resources that are available and the need for strategic focus it is recommended that each institution be viewed as the lead actor in the domains where it is in position to lead but not that activities and participation be limited to that domain. A role for the capacity associated with the Sioux Falls University Center (UC) and its GEAR Center facility should also be factored into this strategy. On behalf of all South Dakota's public university, the UC functions as an attendance center for non-traditional undergraduate students and for selected graduate degrees. The GEAR center offers lab space for lease for university researchers with grant funded projects that benefit from being in Sioux Falls rather than their main campuses as well as incubation space for emerging laboratory-based companies. The facilities together represent a substantive hard innovation infrastructure asset that can link to and leverage resources within the Sioux Falls region and accommodate collaborative research efforts that focus on commercializeable outcomes.

South Dakota State University

For the purposes of this plan, it is recommended that SDSU function in the lead position in forging and advancing the region's university-private sector nexus based on the existing scope and volume of its activities in this area. SDSU has a long and successful history in agricultural extension and agricultural biotechnology development (including private sector outreach and licensing), the state's college of engineering (which has strong private sector connections), and the region's only full time university technology office and director with experience in industry and academic administration. SDSU working with its Foundation should accelerate the recruitment of endowment funding for a comprehensive center for innovation and entrepreneurship that is aligned with the Entrepreneurial Studies academic program, is cross-cutting and leads both in-reach within the university and outreach in the region. SDSU should also house a newly created South Dakota MEP for the eastern half of the state. The existing technology and know-how base associated with USD's activities – especially biomedical engineering in Sioux Falls and DSU's information systems and assurance technological prowess and connections into industry also need to be explicitly supported and advanced as part of this regional effort to build out the university-private sector linkage network.

Dakota State University

Capacity to create and deploy information technology and IT know-how is a ubiquitous and essential regional competitiveness asset. The good news here is that one of the distinguishing features of the I-29 corridor as an economic region is that it has a strong university with a singular dedicated IT mission. The bad news is that, to an extent, DSU's value as an economic development asset is one of the region's best-kept secrets. It is recommended that DSU function as the lead economic development-related resource in IT matters related to information systems, information assurance, and digital arts and design.

University of South Dakota

As the state's liberal arts university with a strong on-campus research profile in several science domains (neuroscience, behavioral sciences, et al) as well as an emerging but already strong position in several biomedical engineering areas within its smaller Sioux Falls campus, the basic research enterprise at USD needs continued and greater support. This plan contemplates leadership from USD in two specific areas. First, USD's Sanford School of Medicine is a critical asset in the region's bioscience future by virtue of its research portfolio and its connection to the Sanford Research's Sioux Falls campus. The constellation of medical/biomedical assets in Sioux Falls represented by the School of Medicine, the USD Graduate School's Biomedical Engineering Program, the Center for Research and Development of Light-activated Materials, Avera Research Institute, and the Sanford Health Research facilities offer a major development opportunity. Leadership is required from both the public and private sides of this development path. USD is the natural entity to lead on the public side.

Second, creative endeavors associated with arts and design not only add value to products and services, in a broader sense they define a community and a region's amenities and cultural identity. Their presence, or lack thereof, is part of the economic development fabric. Through its College of Fine Arts USD is the region's most important asset in this area and should be viewed as a leader and critical resource in developing and implementing strategies to build the region's arts, design and cultural amenity profile.

Avera Research Institute and Sanford Research

As private, non-profit research organizations, Avera Research Institute and Sanford Research are not educational institutions but tightly focused mission driven organizations. Their ability to participate in the development and implementation of this regional strategy should be viewed through that lens. Although there is a considerable difference in scale between the two organizations, both are enthusiastic participants and entrepreneurial with substantive, focused research agendas. They should be supported in their plans AND also factored into regional endeavors and collaboration research initiatives where appropriate including innovation infrastructure networks.

Talent Development & Deployment

Recommendation: Launch and support an initiative to retain higher education graduates, especially those in science and engineering fields and recapture talented graduates that have left the state.

<u>Actions</u>

- Establish internship programs either modeled on the statewide Dakota Seeds program or functioning as adjuncts to the program.
- Work with respective alumni organizations to identify and "claw back" talented graduates that reside outside the region.

Knowledge Development

Recommendation: Lead a major effort to boost focused university research activities oriented toward producing economic development outcomes.

<u>Actions</u>

- Create a South Dakota Research Alliance (SDRA) - a statewide public – private partnership with an economic development mission - to accelerate the growth of the state's economy by enhancing university research that can lead to commercializable outcomes, developing and attracting scientific talent with an entrepreneurial orientation, and encouraging technology commercialization.

Knowledge Deployment

Recommendation: Establish the South Dakota Industrial Extension Service

<u>Action</u>

- The I-29 Corridor Task Force should create a Committee to lead an initiative to establish the South Dakota Industrial Extension Service.

Recommendation: Form a committee to explore ways to establish and market a creative economies initiative at the regional level.

Action

- Work with USD as the university lead but use the considerable assets of DSU and SDSU.

Technology Transfer

Recommendation: The economic development community should work with the region's universities and non-profit research organizations when appropriate to bolster, connect, focus and support their technology transfer efforts as it has a vested interest in their success.

Actions:

- Support the establishment of the South Dakota Research Alliance.
- Support efforts to make South Dakota companies, startups and jobs the top Technology Transfer Office priority for publicly funded universities as opposed to maximizing licensing revenues.
- Seek funding support outside the general university budget.
- Seek to enable the Technology Transfer Offices but don't centralize them.
- Connect technology transfer personnel to the local and regional economic development community's awareness of new and established technology and knowledge intensive firms.
- Support the formation of an I-29 Corridor Technology Transfer Alliance.
- The economic development professionals in the three university communities should support on-campus efforts to build a fully realized technology transfer and commercialization network that connects to the local and regional innovation infrastructure and to the private sector.

Entrepreneurial Culture

Recommendation: Actively encourage the creation of an Entrepreneurship Center at South Dakota State University.

University-Community Linkages

Recommendation: The economic development professionals in the four communities with university research operations should support efforts to build more comprehensive and robust entrepreneurship, commercialization, talent deployment and outreach activities on campus and

help organize efforts on their innovation infrastructure side to connect to the on-campus networks.

Actions

- The economic development community should specifically support efforts to build strong university-connected entrepreneurship support systems.
- The economic development community should help the universities establish and expand on campus internship programs that place undergraduate and graduate students in the region's companies (including startups) and research institutions.
- The economic development community should form a formal regional innovation infrastructure network.
- Establish a Proof of Concept Fund to validate promising university-based technological opportunities and to bridge the gap between research grant funding and early stage private investment funding. A proposed plan for such a fund has been developed by South Dakota Innovation Partners and the South Dakota State University Technology Transfer Office.

The Region Works

There remains a powerful argument and strong need to organize and function at the regional level. The I-29 region is a corridor connected through common infrastructure and its communities are networked in employment and trading patterns, one way or another, to its Sioux Falls hub. The need for some joint action at the regional level has never been more acute. The region's companies, economic development organizations, and education and training service providers function in an intensely competitive environment in which even multinational corporations form networks to extend resources and reach. Broad partnerships are required among those parties with common interests to bring the region's full range of economic development assets in to play, to extend and leverage local resources and to create new regional competitive advantage.

Recommendation: A regional SD29 Alliance should be established to market the I-29 Corridor and support economic development initiatives that benefit the entire region.

Actions

- The natural starting point for this effort is for the I-29 Task Force to explore ways of transforming itself into this type of organization. The Task Force membership already includes the region's major economic development actors and could be expanded as warranted.
- At the outset, the Alliance should come together as a way of marketing the region, leveraging the assets of the economic development, business and academic communities. Opportunities will arise from this joint marketing that will, in time, strengthen the relationships between the various organizations and lead to new economic activity and growth.

Main Report

Foreword

The communities that span the I-29 Corridor in eastern South Dakota from North Sioux City to Watertown and west to Yankton and Madison have joined forces, through a newly created I-29 Corridor Task Force, to craft a plan to identify and act on collaborative opportunities to grow their whole region and to build the capacity to sustain this growth. This document is a first step in this effort. This is a strategic plan in a most literal sense. The most conventional definition of *strategy* is "a carefully devised plan of action to achieve a goal." However, for this initiative, another definition may be even more apropos. In evolutionary theory, *strategy* is a "behavior, structure, or other adaptation that improves viability" – or in this case, economic viability.

Dynamic and volatile markets shape an economic environment in which the comprehensive capacity to effectively adapt to rapidly changing circumstances is a fundamental competitive advantage. In this case, the word "comprehensive" is not used lightly. The intent here is to cover the economic development waterfront. If the idea is to generate or capture more and better jobs then a region must be adroit in adapting the resources used to support its companies, in the way it markets its communities, in the way its universities and workforce development institutions educate and train, in the ways and means its universities use their research enterprise to engage with the business community – even in the way it organizes and delivers economic development services.

While many of the recommendations and action steps suggested in this plan address current and pressing issues and opportunities, the core of the plan emphasizes building and protecting fundamental, sustainable capacity to compete in value-oriented markets – the kind of capacity that equips the region to adapt and prosper in a very dynamic economic environment.

The strategies, tactics and actions offered in this document are just the entry ticket. The real test is in the implementation. Success here will require a group of talented and committed professionals and volunteers in the private and public spheres, a business culture that values trust based on an understanding of mutual self interest and an expectation of reciprocity, and an organizational and operating scheme to get it done.

Purpose

This report, prepared by Regional Technology Strategies (RTS) of Carrboro, North Carolina under contract to the I-29 Corridor Task Force offers a strategic plan that fuses three overlapping economic development dimensions.

1. The plan seeks to parley existing and emerging private sector strengths into more jobs, more income and more wealth in I-29 Corridor communities.

2. The plan advances a strategy to build and support the research enterprise and educational assets within the region's university and post secondary education and training communities and link them to the private sector as economic development drivers.

3. The plan recommends initiatives and actions to retain and attract higher education and post-secondary graduates and their knowledge and skills as the foundation for the region's future growth and prosperity.

Success in dimensions one and two is dependent upon success in dimension three.

The overall approach outlined in the original Request for Proposal for this initiative is both unusual and savvy. It requires the blending of two dependent strategic plans. It calls for an action agenda for a coordinated regional effort to identify and grow existing and emerging clusters and sectors. In a second phase, it then calls for a strategic plan to organize and guide university resources as an economic growth engine to directly support the regional development strategy while continuing their own development as academic and research intuitions.

While the economic development process addressed within this plan can at times be complicated the purpose of the plan is not. The purpose is to produce more high quality jobs throughout the region, more wealth in the I-29 Corridor communities, and more economic opportunity for all of the region's citizens. The most direct route to these goals are to build and exercise the capacity to engage in higher value (and higher wage and earnings) commerce.

Report Structure

This report is comprised of four sections in addition to this introduction. The initial section of the report is the Phase 1 analysis of the I-29 Corridor economy at the regional and sub-regional levels and, based on this analysis a strategic plan, to build and use emerging and existing private sector strengths to generate more higher paying jobs and more wealth in the region's communities. The next section offers the Phase 2 analysis and plan for region's public universities and non-profit research organizations role as a major economic development resource for the overall Phase 1 plan as well as their continued advancement as a economic development driver on their on accord. The third section of the report presents a separate recommendation for organizing at the regional level along with actions that could be effectively pursued on a regional basis. The final section contains two appendices; Appendix A elaborates on the university entrepreneurial culture analysis and findings in the Phase 2 report narrative. Appendix B presents full versions of the four benchmark case studies of university engagement in economic development. The findings from these case studies are also featured and used in the Phase 2 report narrative.

Phase 1: Economic Analysis of the I-29 Corridor

The first phase of the project analyses the economic structure and opportunities within the I-29 Corridor Region in order to develop economic development strategies that generate higher-paying jobs and wealth in the region, sub-regions and communities along the corridor. It is divided into three sections. The first section begins with a look at the key design specifications that the analysis and recommendations should honor. The second section forms the backbone of Phase 1 as it examines demographic trends and future expectations, develops an in-depth quantitative analysis of the I-29 region economy and its sectors and clusters, an examination of those basic factors that support sustainable economic development such as workforce, innovation capacity, and entrepreneurship and finally an examination of regional and sub-regional competitiveness from the standpoint of the economic development professional. The third Phase 1 section presents a body of basic recommendations, specific actions and implementation notes that define the overall regional economic development strategy. The purpose and intent of this phase is:

- Support the continuing development of emerging, growing and mature economic clusters that drive income and wealth generation across the Corridor;

- Encourage and mobilize opportunities for regional and sub-regional efforts to build and support target economic clusters;

- Encourage and mobilize opportunities for Corridor and state collaborative efforts to build and support target economic clusters; and

- To craft a strategic plan that builds on public and private sector assets and points of economic advantage and competitiveness to produce desired private sector economic development outcomes.

Seven Key Design Specifications

Based on its collective experience over the last 25 years in designing and implementing strategic regional economic development initiatives that build on regional assets including workforce, existing and emerging strengths in sectors and clusters, infrastructure, economic competitiveness and quality of life the research team crafted seven key design recommendations for the private economic sector contribution to the I-29 Corridor region growth strategy.

Private sector led. While government, education, workforce development and other institutions need to create an environment in which economic growth is nurtured, only the private sector and private actors generate industries, jobs and income.

Importance of Workforce. Increasingly the quality of workforce is the determining factor in economic success particularly in retention, expansion and recruitment of companies. The workforce development infrastructure must deal with both static and dynamic needs.

Companies must have the necessary supply of skilled workers today but they also need to know that there are systems to deliver new skills (lifelong learning) and an adequate pipeline of highly skilled workers for the future.

Support of cluster networks. Clusters transcend Phase 1 and 2 efforts and in fact are a key tool to build synergy between academic/research/technology and the private sector economic development.

Role of entrepreneurship. As economies need a stream of new, skilled workers, they also need the constructive/destructive chaos of new innovative companies built by entrepreneurs. Innovative entrepreneurial firms are the perfect complement to established mature firms.

Rational and defensible economic development (ED) tools. The economic development is becoming more savvy, technical and competitive. Convincing firms that a region is the best place to be is a complicated mix of quantitative and qualitative factors. Sensible, practical and cost-effective ED tools reflect this reality.

Importance of regional and sub-regional collaboration. The I-29 Corridor forms an attractive glue for the region but no area effectively economically integrated with all other areas of the corridor. I-29 is made of overlapping sub-regions that vary depending on the sector, relationships, educational institutions and other factors. The sub-regions need to understand that the overlapping sub-regions can be more economically effective if they work together.

Focus on income and wealth for lowest rungs. A strong and resilient economy provides opportunities for economic success at all levels of the economic ladder. This requires strategies that provide pathways to economic success for those who choose to end their education at the high school, technical skill and technology college degree level, as well as those choose to continue on to receive 4-year and advanced university degrees. The reality is that the majority of jobs today and into the foreseeable future do not require 4-year and advanced degrees. These jobs do, though, require a strong educational foundation, quality skills, and the means to improve and add skills throughout a person's work career.

Setting the Stage

The ongoing global economic meltdown has changed all the rules. Projections of economic growth, jobs, and occupational needs made just two or three years ago must be viewed with trepidation. Assumptions about baby-boomer retirement plans, family assets, housing values and personal spending patterns must be reexamined by both the individuals and families affected and those trying to think strategically about growing their regional economies. We have no magic crystal ball and must make do with thoughtful and rigorous analysis all the while watching for the next shoe to drop on the economy.

From the outside the story of the I-29 and South Dakota economies appears to reflect the fable of the tortoise and the hare. Headlines like "Reports of the Phoenix real estate market's demise have been greatly exaggerated" from a real estate website in April 2007 seem fanciful in hindsight but at the time nearly all of the "experts" continued to suggest that the hare was unstoppable.

During the last decade in which housing values and housing starts were increasing at double-digit rates in hotspots like Phoenix, Las Vegas, and South Florida, South Dakota saw steady if unspectacular growth. The steady but unremarkable growth in population, employment and economic output across South Dakota rarely made headlines in the national press. Nevertheless, South Dakota's unemployment rate was lower than the national average in every year of last 10 years and gross state product increased steadily. The tortoise was doing quite well.

The last two years have left the hares – California, Florida, Arizona – gasping for breath while the tortoise that is South Dakota, while affected by the global crisis, continues its steady progress. Today South Dakota boasts an unemployment rate of 4.8% up from 3.0% in 2008 that is less than half of the national average and trails only the oil and gas boom affected North Dakota. The tortoise has clearly won the latest economic battle.

As an analyst coming in from the outside we see our job as helping the tortoise to continue and accelerate its steady economic rise while enhancing economic and technological innovation and building a sustainable economy that leads to better and more higher paying jobs.

Analysis of the Economy of the I-29 Corridor

This major section will examine demographics, a quantitative analysis of the economy including a brief state-wide picture, an analysis of emerging, growing, established and mature/declining sectors and clusters within the region, followed by evaluation of key factors supporting economic growth and a competitive analysis from the standpoint of the economic development professional.

For the purposes of the following analysis we use the 20 counties that surrounding I-29 as it makes its way along the eastern edge of South Dakota. The counties included are:

Brookings	Lincoln
Clark	Marshall
Clay	McCook
Codington	Miner
Day	Minnehaha
Deuel	Moody
Grant	Roberts
Hamlin	Turner
Kingsbury	Union
Lake	Yankton

Demographics

Population Change

The past decade (2000 to 2009) can be called the Decade of Sioux Falls from the standpoint of South Dakota. Table 1 below tells the story. During that time the Sioux Falls metro area (which includes Minnehaha and Lincoln counties) saw its population increase by 29% from 174,000 to 224,000. During that same time the State grew by 7.5% (compared to US growth of 9.1%) and the 20-county region grew by 14.2%.

But if we remove the Sioux Falls metro from the equation we find the startling result that the population in the rest of the state and the I-29 region barely grew. Sioux Falls increased by 50,620, the rest of the state by 6,069 and rest of the region by 377!

Looking more closely we find that two things were happening in the region. First, the least populated and most rural counties nearly all saw declines, many steep, over the decade. Second, we find a continuance line of five counties starting from Union to the south to Brookings further north with consistent population growth forming a core of increasing population and, as we will see later, a nexus of economic growth. Slower growth extends north of Brookings into Hamlin and Codington counties. The three counties hosting the universities all gained population though Clay, the location of the University of South Dakota, grew quite slowly.

Over 50% of the region's overall growth was the result of net in-migration. The region saw positive net in-migration in every year with the last five years the strongest. Only five counties, Minnehaha, Lincoln, Union, Brookings and Lake experienced net in-migration with the first three accounting for the bulk of the increase. Internal Revenue Service tax return data suggest that the region is experiencing net out-migration in the 25-20 age group but that the region is getting some of this population back as they return in their 30's with families.

The dramatically uneven population growth suggests that the growing Sioux Falls-Brookings corridor will need to be utilized as a platform for an urban-rural strategy to broaden success within the region.

A simple look at population growth gives us part but not the entire picture. Another aspect is the age structure of the population within a community, county or region. The age structure has implications in many areas: school enrollment, workforce and health care just to name three.

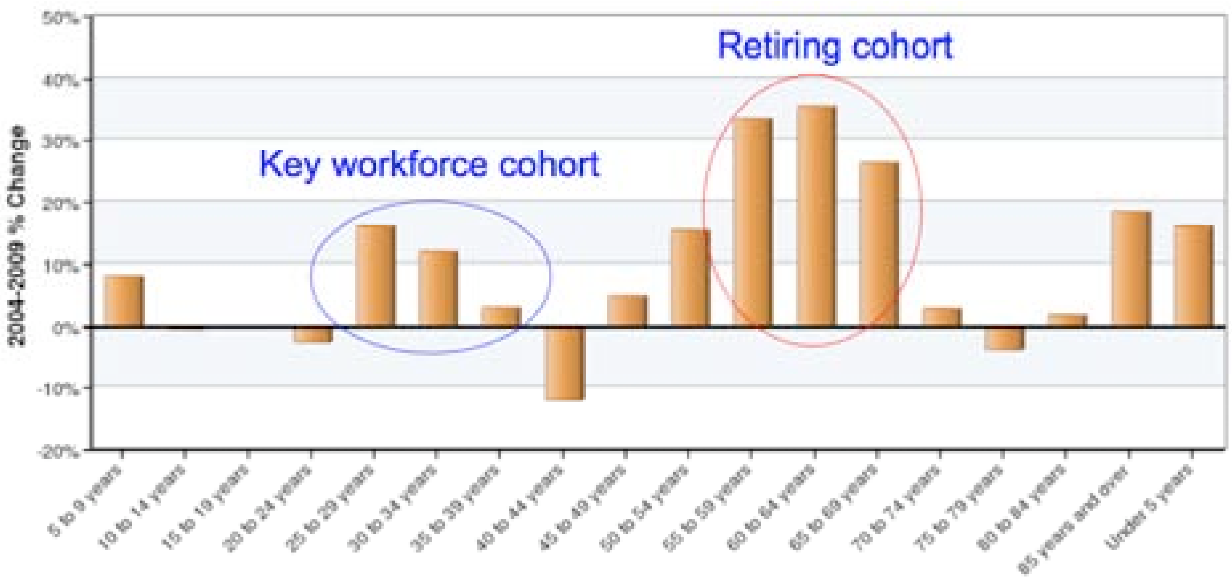
Table 1. Population 2000 and 2009

County/Region	2000	2009	Percent Change
Lincoln	24,529	41,218	68.0%
Minnehaha	149,117	183,048	22.8%
Union	12,589	14,589	15.9%
Lake	11,245	11,994	6.7%
Brookings	28,295	30,056	6.2%
Hamlin	5,549	5,754	3.7%
Yankton	21,606	21,986	1.8%
Codington	25,899	26,168	1.0%
Clay	13,498	13,490	-0.1%
Roberts	10,002	9,933	-0.7%
Moody	6,580	6,375	-3.1%
McCook	5,849	5,619	-3.9%
Deuel	4,493	4,203	-6.5%
Turner	8,849	8,237	-6.9%
Kingsbury	5,810	5,308	-8.6%
Marshall	4,581	4,160	-9.2%
Grant	7,832	7,068	-9.8%
Day	6,243	5,509	-11.8%
Miner	2,882	2,420	-16.0%
Clark	4,121	3,431	-16.7%
I-29 Region	**359,569**	**410,566**	**14.2%**
Sioux Falls metro	**173,646**	**224,266**	**29.2%**
Rest of I-29 Region	**185,923**	**186,300**	**0.2%**
South Dakota	**755,694**	**812,383**	**7.5%**

Source: Census Bureau

Figure 1 shows how the age structure within the region has changed over the past five years of available data, 2004-2009. Two important cohorts stand out. The key workforce cohort of 25-39 year olds has grown significantly during this period. An increase in younger workers is a very good economic sign for the region. This is particularly true given that there is a substantial population in their 50's and 60's nearing retirement age. Without the growth in the younger cohort the regional economy could experience difficulties filling positions vacated by retirees. In fact our research team was told by the region's economic development professionals that, before the recent economic crisis, shortages of workers had been an acute problem. Brookings, for example, had periods in which there were significant numbers of unfilled positions due to the lack of skilled and available workers.

Figure 1. I-29 Region Population Change by Age Cohort, 2004-2009



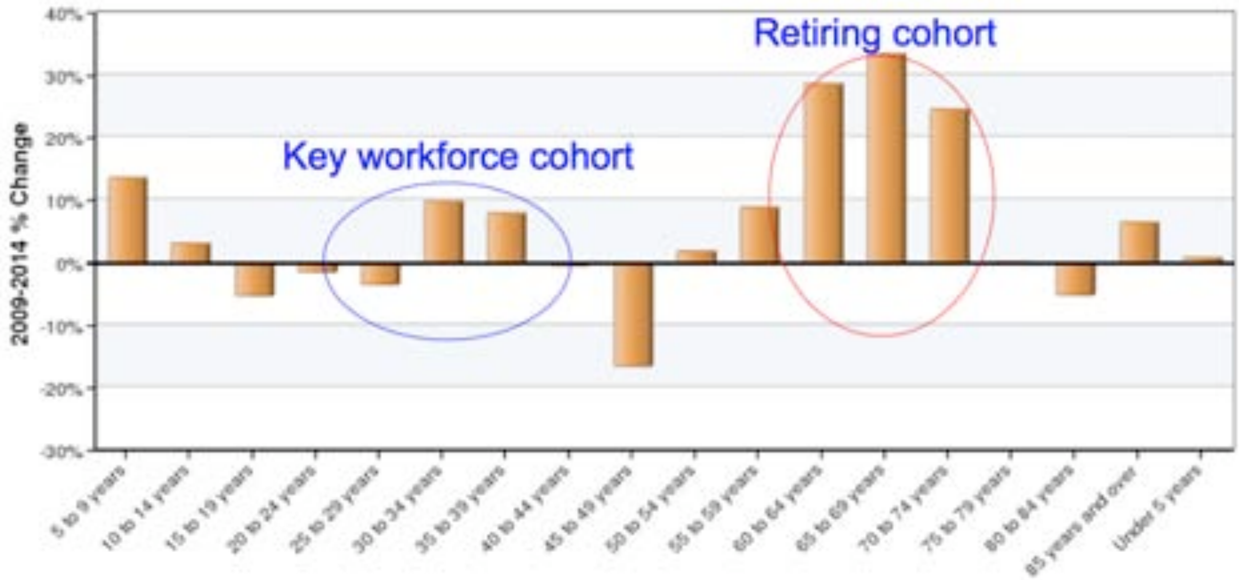
Source: EMSI, 2010

Projections of population growth over the 2009-2014 period suggest a slowing of the population growth rate. The regional population is expected to grow to 427,000, a 4.4% increase. Most of the increase is expected to be the Sioux Falls metro area with the least populated and rural counties continuing to lose population. The Sioux Falls metro area is expected to have a total population of 243,000 by 2014. The percentage of the I-29 living in the five growth counties mentioned above in the Union to Brookings corridor will continue to grow.

The change in age cohorts will continue to be an important factor within the region particularly with regard to workforce. As Figure 2 shows, older workers and retirees are projected to grow significantly. Some of these jobs will be filled by the growing 30-39 cohort but the population of middle age workers, 45-49, is expected to decline. It is likely that training resources will be needed to assure transition into the many replacement positions opened by retirement.

Looking longer term, from 2009-2019 shows this trend continuing. Figure 3 compares the cohort populations in 2009 to the projections for 2019. The increase in the retiring baby boomers compared to the decline in middle age workers is striking and will present a challenge over the next decade. This suggests a policy effort to keep and attract the working age population.

Figure 2. I-29 Region Population Change by Age Cohort, 2009-2014



Source: EMSI, 2010

Figure 3. I-29 Region Population Age Cohort Comparison, 2009-2019

Commuting Patterns

As the region's population has become more concentrated in the Sioux Falls metro area and in the other more urban counties, there has been significant change in the commuting patterns of workers within the region. These changes in commuting reflect a growing integration of the economies within the Corridor.

What we have seen is that more workers are commuting out of their county of residence to work and employers are relying more and more on a broader geographic labor pool. Effectively areas like Sioux Falls and Brookings are becoming more reliant on workers from surrounding counties to meet their labor needs. The more rural counties with fewer new work opportunities within their home counties are more and more driving in to the regional economic engines.

Perhaps more surprising is that workers in the more prosperous and growing areas are also commuting more than five years ago. This may be due to the increasing number of families with both spouses working and the lack of availability of compatible job opportunities for both spouses within their county of residence. Our research team was often told that, for example, spouses of professors at USD and SDSU commuted into Sioux Falls in order to continue their careers. Table 2 shows the change over the 2002-2008 period for selected counties in the region of the percent of workers who both live and work in the same county. For example, the percent of workers living in Clark County who also work there declined from 50% to 41%. Even Minnehaha County shows a significant decline. It should be noted that there is significant commuting across borders particularly Union County where 22% of workers travel from South Dakota to Iowa to work.

Table 2. Population 2000 and 2009

	Percent working within their county of residence		
County	**2002**	**2008**	**Change**
Brookings	78%	73%	5.8%
Clark	50%	41%	8.5%
Clay	65%	53%	12.6%
Codington	83%	74%	9.5%
Lake	70%	58%	12.6%
Minnehaha	89%	83%	5.9%
Union	51%	43%	7.8%

Source: US Census Bureau, http://lehdmap4.did.census.gov/themap4/

Key Findings: I-29 Demographics

- While the population within the state and region increased over the last ten years most of the growth occurred within the two-county Sioux Falls metro area. Sioux Falls grew by 29% and outside of that growth the overall I-29 population was stagnant.

- The growth in Sioux Falls was part of a broader growth region that spanned five counties from Brookings south to Union. This sub-region is expected to continue to lead population growth and increase its share of I-29 population.

- The region experienced consistent overall net in-migration over the last 10 years and this trend is expected to continue. Some data indicate that loss of the 20-29 age group to out-migration was balanced by in-migration in the 30-40 age group.

- Most of the more rural counties lost population, with Miner and Clark losing more 15% of their population.

- The region is expected to continue to grow over the next five to years but at a slower pace. The more urban counties, led by the Sioux Falls metro area, will continue to see increasing populations while the rural areas are likely to remain stagnant.

- The age cohorts for the region show both positive and negative signs. A key age cohort, 25-39 has grown significantly over the last five years and this cohort is expected to continue to grow overall. The long term increase in population about to or already retired presents a workforce challenge.

- Commuting patterns show that the region is becoming more integrated. More people, from both rural and urban counties, are commuting out-of-county to work. This suggests two key findings. First, the more urban areas such as Sioux Falls and Brookings are relying more on commuting workers from the surrounding rural counties. Second, as rural economies continue to struggle, residents in these counties are forced to commute due to lack of economic opportunity.

The Key Sectors and Clusters of the I-29 Corridor

We turn now to an in-depth analysis of the I-29 economy. We will start with a look back over the last five years and then examine some projections on future changes. This analysis will focus on the entire region though the more urban counties dominate the data. In some cases we will look at some sub-regional points of interest that suggest possible regional actions.

A Quick Look at the I-29 Corridor compared to the rest of South Dakota

To add perspective we start with a look at how the rest of the South Dakota economy performed over the last five years in comparison to the I-29. We'll also briefly address differences between the rest of the state and regional economic structure looking at broad economic categories.

Job growth within South Dakota over the 2004-2009 period grew from 514,000 to 552,000, a growth rate of 8%. The strongest growth occurred in finance, professional and business services, education and health services, and construction. Agriculture and manufacturing were stagnant.

A more interesting comparison is between the Corridor and the rest of the state. Table 3 summarizes relative performance from 2004-2009.

Table 3. I-29 Corridor compared to the Rest of the State, 2004-2009 Employment

	2009 Jobs		Growth Rate		
Description	**I-29**	**Rest of**	**I-29**	**Rest of**	**Relative**
Agriculture, natural resources, mining	14,561	23,874	1%	3%	54%
Construction	17,925	16,950	13%	10%	94%
Education and health services	41,524	32,778	15%	8%	113%
Financial activities	34,779	20,047	20%	22%	154%
Government	33,090	47,268	7%	0%	62%
Information	4,676	3,360	7%	3%	124%
Leisure and hospitality	24,171	26,522	8%	5%	81%
Manufacturing	28,557	11,790	1%	-2%	215%
Other services	12,908	12,043	0%	5%	95%
Professional and business services	24,525	16,629	14%	11%	131%
Trade, transportation, and utilities	55,819	48,573	7%	5%	102%
Totals	292,536	259,832	9%	6%	

Source: EMSI, 2010

The Corridor accounts for 53% of employment within the state. As can be seen, the Corridor grew significantly faster than the rest of the state in overall employment, 9% compared to 6%. Finance and professional and business services grew well in both regions.

More interesting is the column of Table 3 labeled ***Relative Concentration***. This compares how concentrated employment is within the various sectors between the Corridor and the rest of the state. So, for example, the agriculture, natural resources, and mining sector is about half as important in the Corridor compared to the rest of the state in terms of employment. About 5% of workers in the Corridor are employed within the agriculture, natural resources, and mining sector but over 9% in the rest of the state.

The table demonstrates some other dramatic differences. In particular, manufacturing is vastly more important to the Corridor. Finance, professional and business services and information technology are also significantly more important to the Corridor. Besides agriculture, government is relative less important to the Corridor.

The I-29 Corridor economy

We now turn to a detailed examination of the Corridor economy. We will look at employment and wages and dig down to find the key sectors and clusters of the region. Just as importantly we will examine some emerging economic activity that presents future opportunities and also see how the key sectors and clusters are expected to perform. First though we briefly describe economic clusters and their value.

RTS and its research team typically examine regional economies from two approaches. The first is the traditional analysis of *sectors*. For example we can look at agricultural machinery equipment manufacturing. But we also look at the economy using the *cluster* as our economic unit. A cluster is a geographic concentration of interrelated competitive firms and institutions of sufficient scale to generate external economies making the whole greater than the sum of its parts. They occur where a group of businesses, drawing on similar resources, exist in relationships with other nearby businesses and institutions that contribute to their competitiveness. Examples range from the high tech clusters of microelectronics, semiconductor, and software businesses in Silicon Valley, California to the biotechnology industry in the Research Triangle, North Carolina or the ceramics industry in western New York. Any concentration of similar businesses that draw on a common pool of suppliers, services, educational institutions, workforce skills, natural resources, or other assets that can be found in a region may be a cluster.

A region's clusters tend to be the *primary wealth generators* in its economy. Clusters can be the basis for intelligent and cost-effective public strategies. Cluster initiatives are interventions by private, public and semi-public actors and organizations such as companies, economic developers, workforce boards, and non-profit entities to improve a region's economic situation by influencing how member companies use public resources, work together, or do business. Cluster-based strategies or strategies to gain access to certain kinds of economic and business benefits associated with clustering behavior can work. They are always more successful when employers' real needs are driving the process of strategy formulation. So, for example, we will look at agricultural machinery equipment manufacturing within the advanced manufacturing cluster that shares common processes, workforce, suppliers, etc. that serve a broader range of economic sectors.

Within our analysis we will focus on the wealth generators, also known as the *export* or *base* industries, within the economy. We generally exclude *support* industries such as restaurants, grocery stores, retail stores and other sectors that are traded only within the local or regional economy and do not bring in money and wealth from outside the region. We also do not include government.

Clusters in the Corridor

Examining the economy from the standpoint of clusters provides a good starting point. Table 4 and Figure 4 show the region's leading clusters by employment size. Average earnings (including benefits) are also shown.

As noted above the employment figures in Table 4 include not only the final output sector, for example machinery equipment, but also those sectors that support it.

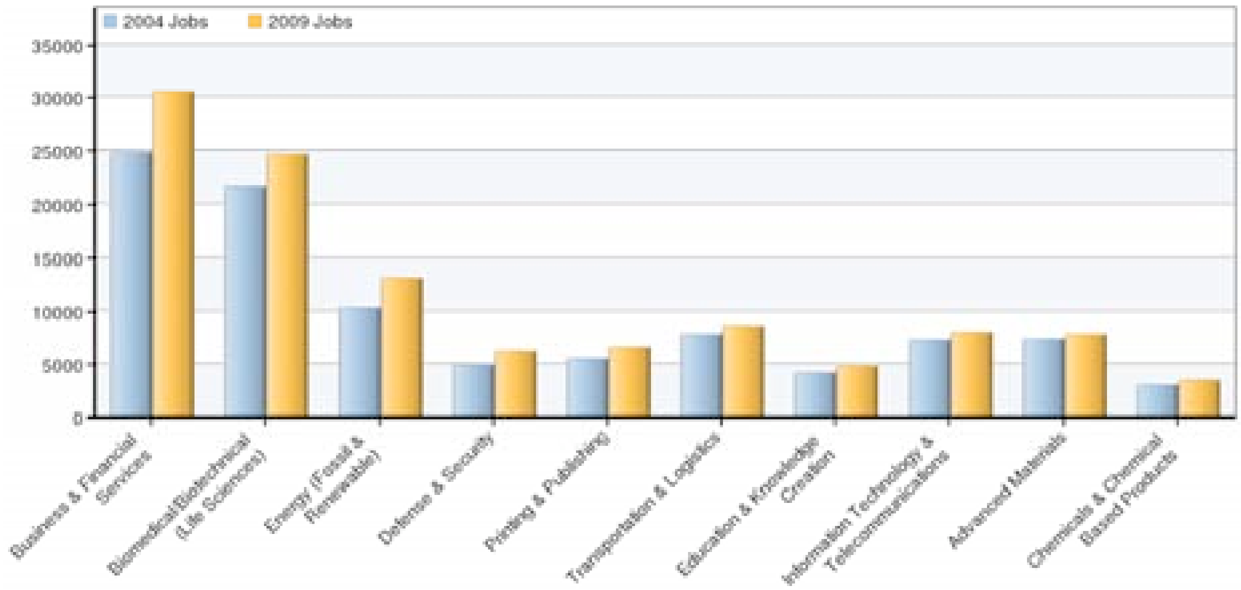
The largest clusters are not surprising. Growth clusters include financial services and life sciences that, while large and established, continue steady growth. Financial services has been a key driver for the economy, is the largest cluster and added the most jobs within the last five years. Life sciences, which includes hospitals, medical research, and medical device manufacturing has also been a dynamic part of the economy. Agribusiness, a historically important cluster, is in a mature stage and while large is in a slow decline. Economic conditions, especially surrounding a leading food processing employer, suggest that this cluster's importance may decline more rapidly in the next five years. The emerging energy cluster contains ethanol production, various manufacturing sectors and significant employment levels in engineering services, laboratories and research. It should be noted that most clusters include significant levels of manufacturing employment with finance being a notable exception. We provide more detail on the role of growth-stage manufacturing clusters in a later section.

Table 4. I-29 Corridor Clusters, 2004-2009

Cluster Name	**2004**	**2009**	**Employment**	**Earnings**
Business & Financial Services	24,824	30,500	5,676	$43,316
Biomedical/Biotechnical (Life Sciences)	21,636	24,656	3,020	$45,223
Agribusiness, Food Processing & Technology	22,829	22,622	(207)	$46,497
Energy (Fossil & Renewable)	10,352	13,151	2,799	$49,088
Arts, Entertainment, Recreation	8,840	9,022	182	$19,407
Transportation & Logistics	7,801	8,545	744	$52,981
Information Technology & Telecommunications	7,270	7,944	674	$54,573
Advanced Materials	7,341	7,776	435	$54,661
Printing & Publishing	5,487	6,529	1,042	$40,635
Defense & Security	4,875	6,252	1,377	$53,962
Forest & Wood Products	5,561	5,209	(352)	$42,303
Machinery Manufacturing	3,706	3,918	212	$49,987

Source: EMSI, 2010

Figure 4. I-29 Corridor Clusters, 2004-2009



Over the 2009-2014 period, projections suggest significant growth in several of the clusters. Table 5 and Figure 5 display these expected changes. We have included some of the smaller manufacturing clusters that are expected to grow to demonstrate the continuing role that manufacturing is expected to play within the region. Note that recent and expected changes in Federal law that are not factored into the projections could significantly affect several of the clusters. In particular, business & financial services are unlikely to grow at the projected rate due to the recent legislation on credit cards and student loans. The size of the impact is difficult to gauge at this point.

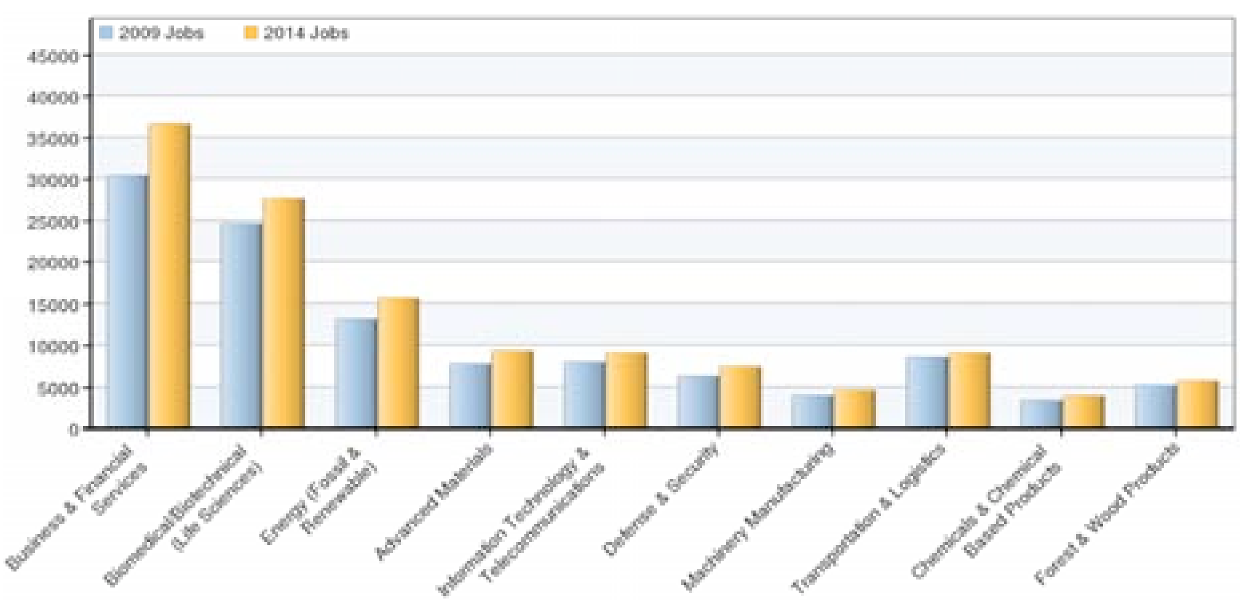
On the other hand the energy cluster and the manufacturing clusters that support it should be positively affected by the increased Federal focus on alternative energy sources. Particularly relevant for the Corridor are opportunities in ethanol and other biomass energy and wind. The net affect of these Federal changes could very well have an overall positive impact on the region.

Table 5. I-29 Corridor Clusters, 2009-2014

Cluster Name	2009	2014	Employment Change	Earnings
Business & Financial Services	30,500	36,659	6,159	$43,316
Biomedical/Biotechnical (Life Sciences)	24,656	27,633	2,977	$45,223
Agribusiness, Food Processing & Technology	22,622	21,368	(1,254)	$46,497
Energy (Fossil & Renewable)	13,151	15,677	2,526	$49,088
Transportation & Logistics	8,545	9,128	583	$19,407
Information Technology & Telecommunications	7,944	9,131	1,187	$52,981
Advanced Materials	7,776	9,282	1,506	$54,573
Printing & Publishing	6,529	7,408	879	$54,661
Defense & Security	6,252	7,429	1,177	$40,635
Forest & Wood Products	5,209	5,715	506	$53,962
Machinery Manufacturing	3,918	4,660	742	$42,303
Chemicals & Chemical Based Products	3,387	3,945	558	$23,287
Fabricated Metal Product Manufacturing	2,537	3,038	501	$49,987
Transportation Equipment Manufacturing	1,493	1,881	388	$58,162

Source: EMSI, 2010

Figure 5. I-29 Corridor Clusters, 2009-2014



Lead Export Sectors in the Corridor

The discussion of clusters needs to be supplemented with an analysis of the lead sectors to see what is driving the clusters within the Corridor. The focus will be on those sectors within the cluster that have high concentrations of employment measured by the *location quotient*. The location quotient compares the regional employment in a sector as percent of the total regional employment to the national employment in the sector as a percent of total national employment. A location quotient (or LQ) that is above 1 indicates that the sector has a higher concentration in the region than in the national economy. Economists generally consider a LQ above 1.5 to be a strong indicator that the sector exports its goods or services outside of the region and therefore brings in income and wealth into the region.

The LQ is calculated as follows:

$$LQ = \frac{\dfrac{\text{Region's employment in a specific NAICS}^{2}\text{ code}}{\text{Region's total employment}}}{\dfrac{\text{Nation's employment in a specific NAICS code}}{\text{Nation's total employment}}}$$

Export Financial Cluster Sectors

The financial cluster is clearly an export driver. Figure 6 shows the 2004 and 2009 employment levels in export sectors of the financial cluster. Three of the sectors dominate in employment levels but three other sectors, while relatively small, also contribute to the wealth generating capacity of the cluster. The importance of smaller export sectors should not be minimized.

Table 6 shows the data reflected in the figure above and demonstrates this importance. While *Other depository credit intermediation* has only 253 jobs, the LQ (concentration) within the sector is 8.5 times as great as the national figure. The overall LQ for these export sectors is nearly 5.

[2] The North American Industry Classification System (NAICS) groups industries into different sectors.

Figure 6. Employment Levels in Export Financial Cluster Sectors, 2004-2009

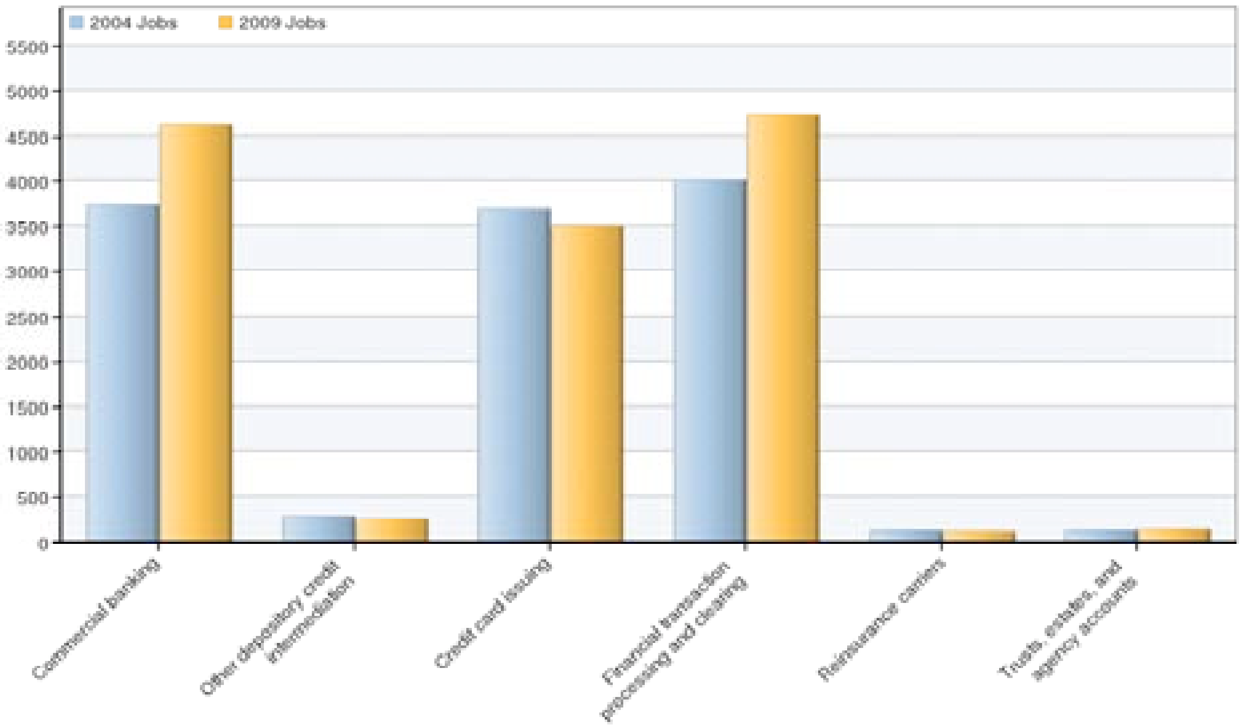


Table 6. Lead Export Sectors in the Financial Cluster, 2004-2009

Financial Cluster Sector	2004 Jobs	2009 Jobs	2009 LQ
Financial transaction processing & clearing	4,013	4,738	18.7
Commercial banking	3,729	4,621	2.0
Credit card issuing	3,694	3,496	18.2
Other depository credit intermediation	289	253	8.5
Trusts, estates, and agency accounts	131	134	1.9
Reinsurance carriers	123	121	2.5
Total	11,979	13,362	4.7

Source: EMSI, 2010

Table 7 displays the expected changes in the export sectors within the financial cluster. As we note above in the discussion of the overall cluster, these projections, made before the recent Federal changes, are likely to overestimate 2014 jobs somewhat. Also note that the *All other financial investment activities* sector is expected to grow and increase its LQ to 1.5 by 2014 and is added to the table. This is a demonstration of the potential impact of cluster development as parts of the cluster supply chain grow to support the overall cluster.

Table 7. Lead Export Sectors in the Financial Cluster, 2009-2014

Financial Cluster Sector	2009 Jobs	2014 Jobs	2014 LQ
Financial transaction processing & clearing	4,738	6,603	19.9
Commercial banking	4,621	5,516	2.3
Credit card issuing	3,496	3,121	19.1
All other financial investment activities	475	709	1.5
Other nondepository credit intermediation	336	312	11.1
Trusts, estates, and agency accounts	134	195	2.1
Reinsurance carriers	121	190	4.2
Total	13,921	16,646	3.2

The increase in the financial cluster has also had some dramatic impacts on supply chain sectors that remain fairly small and have low LQs. Of particular interest has been the increase over the 2004-2009 period of the computer programming and design sectors that are vital to financial operations. During this period these sectors grew 71% and now account for over 1,500 jobs. This was more than triple the national rate of growth. During 2009-2014 the increases are expected to continue adding another 500 jobs to the total. Even with this growth, the Corridor will still have a relatively low concentration, with a LQ below 1. This presents a prime growth opportunity for the region.

Export Life Sciences Cluster Sectors

Unlike manufacturing much of the Life Sciences cluster is local instead of export oriented – effectively providing local goods and services that we need in our day-to-day lives such as basic medical services and prescriptions from the pharmacy. But within the I-29 Corridor, particularly in the Sioux Falls metro area, there are several sectors that fall into the export base category as they bring in dollars from outside the region. Here we'll look at some of those sectors to see where the cluster is a wealth generator.

Table 8 lists cluster sectors that export at least some of their goods and services. Clearly the region is drawing in patients from outside of the region as demonstrated by the LQ. Two of the sectors are in manufacturing. The potential for additional manufacturing developments in advanced materials and medical devices is strong given the strength within the Corridor in advanced manufacturing.

The lead sectors are projected to continue to grow which is expected given the national increase in the health care economy. Table 9 and Figure 7 detail the changes from 2009 to 2014.

Table 8. Lead Export Sectors in the Life Sciences Cluster, 2004-2009

Life Sciences Export Sectors	2004 Jobs	2009 Jobs	2009 LQ	Earnings
General medical and surgical hospitals	9,613	11,641	1.6	$54,171
Nursing care facilities	4,645	4,198	1.5	$26,902
Surgical appliance and supplies manufacturing	1,063	1,163	7.8	$79,954
Homes for the elderly	978	951	1.6	$19,088
Other hospitals	687	868	2.7	$48,236
Outpatient mental health centers	474	596	2.0	$32,469
Other residential care facilities	213	528	1.8	$24,540
Residential mental and substance abuse care	453	411	1.3	$32,069
All other health and personal care stores	187	195	1.3	$53,421
Electromedical & electrotherapeutic apparatus mfg	138	121	1.2	$39,013

Source: EMSI, 2010

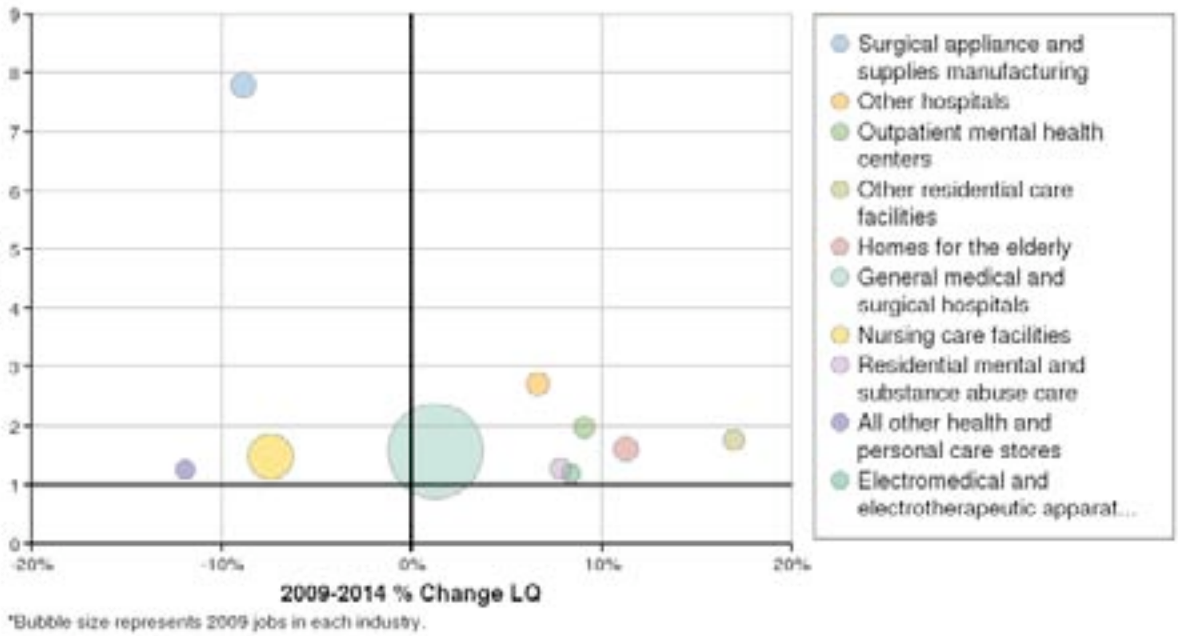
Table 9. Lead Export Sectors in the Life Sciences Cluster, 2009-2014

Life Sciences Export Sectors	2009 Jobs	2014 Jobs	2014 LQ	Earnings
General medical and surgical hospitals	11,641	13,009	1.6	$54,171
Nursing care facilities	4,198	4,205	1.4	$26,902
Homes for the elderly	951	1,272	1.8	$19,088
Surgical appliance and supplies manufacturing	1,163	1,109	7.1	$79,954
Other hospitals	868	1,099	2.9	$48,236
Outpatient mental health centers	596	742	2.2	$32,469
Other residential care facilities	528	694	2.1	$24,540
Residential mental and substance abuse care	411	530	1.4	$32,069
Electromedical and electrotherapeutic apparatus mfg	121	150	1.3	$39,013

Source: EMSI, 2010

Figure 7 graphically depicts the expected changes over the five years. The bubbles to the right of the bold line are increasing their relative concentrations, i.e. the LQ is increasing. Increasing LQs demonstrate that the Corridor has a competitive advantage in that sector.

Figure 7. Life Sciences Export Sectors Location Quotients and Employment Growth, 2009-2014



Export Agriculture and Agribusiness Cluster Sectors

Agriculture and agribusiness remain a strong but mature and declining part of the Corridor economy. The main export sectors within the cluster include crop and animal production and crop and animal manufacturing. Production is a lead economic driver in the more rural counties, particularly counties in the northern half of the Corridor. Manufacturing is spread out within the region with the John Morrell & Company hog processing facility in Sioux Falls by far the largest employer with about 3,000 employees. Employment fell by 3% from 2004-2009 though the LQ concentration remains at 3 times the national average. High agribusiness LQs are expected in more rural states.

The declines are expected to accelerate over the 2009-2014 period as shown in Table 11. The Corridor is projected to lose 8% of employment in these sectors over double the rate projected for the nation. These declines may ultimately be much worse as there are indications that the Sioux Falls Morrell facility, like the Morrell facility in Sioux City, Iowa, might close as its parent company consolidates operations.

Table 10. Lead Export Sectors in the Agribusiness Cluster, 2004-2009

Agribusiness Export Sectors	2004 Jobs	2009 Jobs	2009 LQ	Earnings
Crop and animal production	12,743	12,512	2.8	$44,092
Animal, except poultry, slaughtering	3,291	3,169	12.5	$46,478
Cheese manufacturing	299	561	8.4	$47,409
Cookie and cracker manufacturing	428	510	8.9	$46,729
Frozen specialty food manufacturing	310	251	2.6	$47,223
Meat processed from carcasses	199	204	1.1	$90,583
Dog and cat food manufacturing	172	141	4.2	$49,218
Fluid milk manufacturing	156	122	1.3	$72,209
Other animal food manufacturing	138	112	2.0	$68,156
Dry, condensed, and evaporated dairy products	282	74	3.0	$61,247
Poultry processing	293	71	0.2	$38,199
Soybean processing	49	57	2.9	$80,709
Total	18,360	17,785	3.1	$45,826

Source: EMSI, 2010

Table 11. Lead Export Sectors in the Agribusiness Cluster, 2009-2014

Agribusiness Export Sectors	2009 Jobs	2014 Jobs	2014 LQ	Earnings
Crop and animal production	12,512	11,196	2.7	$44,092
Animal, except poultry, slaughtering	3,169	3,038	11.6	$46,478
Cheese manufacturing	561	633	8.9	$47,409
Cookie and cracker manufacturing	510	609	11.3	$46,729
Frozen specialty food manufacturing	251	310	3.0	$47,223
Meat processed from carcasses	204	218	1.1	$90,583
Dog and cat food manufacturing	141	132	3.9	$49,218
Fluid milk manufacturing	122	77	0.8	$72,209
Poultry processing	71	63	0.2	$38,199
Other animal food manufacturing	112	62	1.1	$68,156
Soybean processing	57	43	2.2	$80,709
Dry, condensed, and evaporated dairy products	74	35	1.4	$61,247
Total	17,785	16,418	2.9	$45,826

Source: EMSI, 2010

Export Energy Cluster Sectors

The energy cluster in the Corridor can be an emerging cluster that is still developing. The ethanol sector within the Corridor is already a major player in the national market. Alternative energy, particularly wind has grown rapidly and has potential for substantial future growth.

As an emerging cluster, we do not expect to necessarily find high concentrations. More important are growth rates. The sectors, as shown in table 12, grew 58% over the 2004-2009 period compared to the national growth rate of 17%. Growth over the 2009-2014 is projected to continue at a slower pace, 29%, but still much faster than the nation (Table 13). The continuing growth presents to build a stronger cluster through strengthening the supply chain for the industry.

The growth projection for the 2009-2014 period does not take into account two recent events. The increasing emphasis, funding and tax credits available for alternative and renewable energy should lead to a significant uptick in new energy developments. The proposed development of a refinery near Elk Point in Union County by Hyperion Energy Center has the potential to generate approximately 4,500 construction jobs and 1,800 permanent jobs. In addition, the location in Sioux Falls of the headquarters of POET Energy, the world's largest ethanol producer, provides a unique opportunity for further developments within this growing industry.

Table 12. Lead Export Sectors in the Energy Cluster, 2004-2009

Energy Lead Sectors	**2004 Jobs**	**2009 Jobs**	**2009 LQ**	**Earnings**
Engineering services	751	1,089	0.6	$64,202
Ethyl alcohol manufacturing	183	492	31.2	$76,347
Other technical consulting services	222	445	0.9	$59,073
Electric power distribution	607	425	1.7	$70,830
Power boiler & heat exchanger manufacturing	212	412	11.1	$50,729
Physical, engineering and biological research	135	311	0.3	$56,122
Electric power and specialty transformer mfg.	250	225	5.1	$56,597
Testing laboratories	164	207	0.8	$40,566
Geophysical surveying and mapping services	16	162	4.3	$81,507
Electric bulk power transmission and control	17	129	2.7	$87,581
Hydroelectric power generation	0	108	0.0	$110,792
Turbine and turbine generator set units mfg.	0	97	0.0	$39,638
Environmental consulting services	72	54	0.2	$37,377
Total	2,628	4,157	1.0	$63,931

Source: EMSI, 2010

Table 13. Lead Export Sectors in the Energy Cluster, 2009-2014

Energy Lead Sectors	2009 Jobs	2014 Jobs	2014 LQ	Earnings
Hydroelectric power generation	108	129	2.7	$110,792
Electric bulk power transmission and control	129	186	3.7	$87,581
Electric power distribution	425	354	1.3	$70,830
Ethyl alcohol manufacturing	492	850	40.5	$76,347
Power boiler and heat exchanger mfg	412	601	15.1	$50,729
Turbine and turbine generator set units mfg.	97	148	3.4	$39,638
Electric power and specialty transformer mfg.	225	114	2.7	$56,597
Engineering services	1,089	1,366	0.7	$64,202
Geophysical surveying and mapping services	162	291	6.4	$81,507
Testing laboratories	207	246	0.9	$40,566
Environmental consulting services	54	54	0.2	$37,377
Other technical consulting services	445	623	0.9	$59,073
Physical, engineering and biological research	311	409	0.4	$56,122
Total	4,157	5,371	1.1	$63,931

Source: EMSI, 2010

Export Manufacturing Sectors

Most of the major export clusters within the Corridor, with the exception of finance, including significant manufacturing components. Some of the manufacturing sectors within the region serve more than one cluster. The crosscutting nature of manufacturing in the Corridor suggests that a separate appraisal of manufacturing is worthwhile. Below we put the sector into perspective and demonstrate its fundamental role in the present and future of the Corridor.

Manufacturing is virtually always viewed, correctly, as an export sector. As a result the economic development community sees an importance in manufacturing beyond its direct levels of employment. Manufacturing through its economic multiplier effects drives other jobs within the regional economy. Within the Corridor manufacturing employment directly accounts for 10.5% of total jobs, less than retail trade. But an analysis of the economic base of the Corridor, through the use of an economic input-output model, shows that the ultimate impact of the broad manufacturing sector is much larger. The 28,557 regional jobs in manufacturing ultimately generate over 56,000 total jobs – effectively doubling its direct impact. Including the multiplier effects it accounts for 19% of regional jobs and 21% of earnings, making it a dominant super-sector in the Corridor.

Table 10 displays data for some of the key sectors within Corridor manufacturing. Several points deserve noting. First, these sectors have extremely high LQs that suggest strong competitiveness. Secondly, average earnings within most of the sectors are competitive compared to other sectors.

What is most remarkable is that manufacturing in the Corridor held its own during a time of enormous upheaval within the industry. Corridor manufacturing employment over the 2004-2009 grew slightly from 28,145 to 28,557 while the industry nationally declined by 14% within the same time frame. As we will discuss below, much of this relative success is based on the structure of manufacturing in the region which relies more heavily on advanced manufacturing sectors that require higher levels of capital equipment and higher skilled workers. These factors make the region more globally competitive in manufacturing.

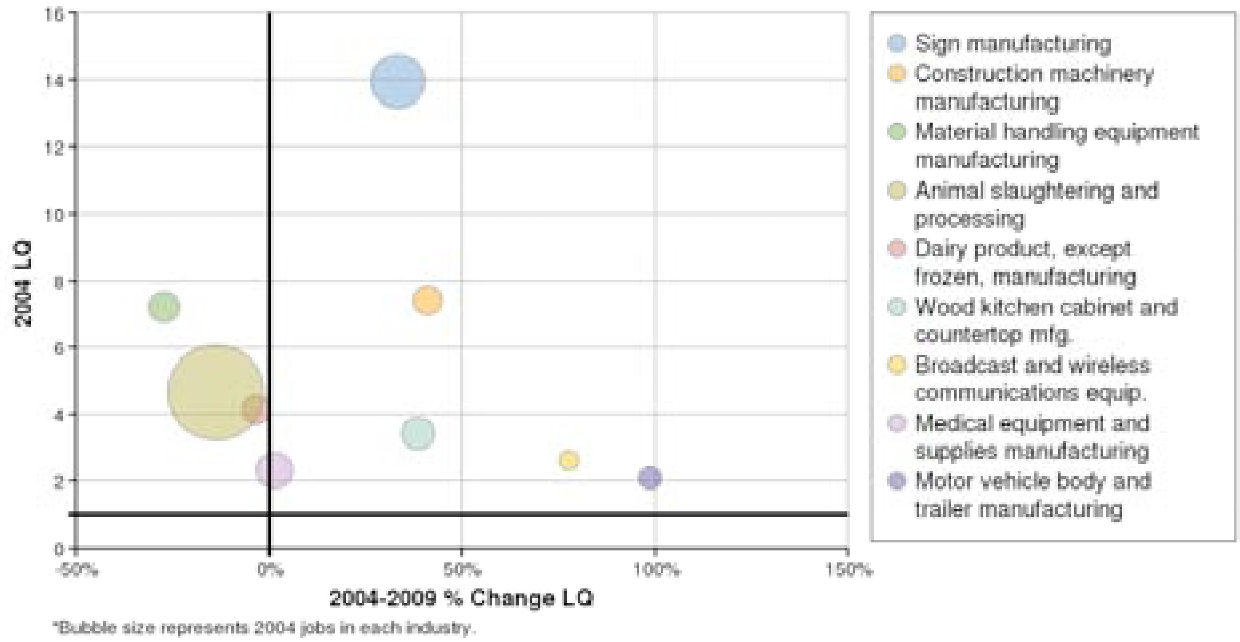
Table 10. Key Sectors in Manufacturing, 2004-2009

Manufacturing Sector	2004 Jobs	2009 Jobs	2009 LQ	Earnings
Animal slaughtering and processing	3,801	3,444	4.0	$48,922
Sign manufacturing	1,918	3,132	18.6	$43,601
Construction machinery manufacturing	760	1,278	10.5	$50,656
Medical equipment and supplies manufacturing	1,140	1,233	2.4	$78,183
Wood kitchen cabinet and countertop mfg.	947	1,019	4.7	$35,902
Motor vehicle body and trailer manufacturing	550	803	4.1	$55,889
Dairy product, except frozen, manufacturing	737	757	4.0	$52,764
Material handling equipment manufacturing	882	635	5.3	$56,007
Broadcast and wireless communications equip.	321	610	4.7	$54,753
Total	11,056	12,910	5.1	$50,852

Source: EMSI, 2010

Figure 8 demonstrates the competitive nature of these sectors. The size of the bubble represents the LQ or concentration as listed in Table 10. Those bubbles to the right of the dark vertical line experienced an increase in the LQ from 2004 to 2009 meaning that they grew relatively faster than the sector did nationally, another indication of the competitive nature of these industries.

Figure 8. Growth and Concentration in Key Manufacturing Sectors, 2004-2009



Source: EMSI, 2010

Looking forward, manufacturing in most sectors is projected to continue to do well over the next five years. Table 11 describes some of the expected key sectors in 2014, all with a LQ of 2.1 or higher. Overall manufacturing is expected to grow by over 3,000 jobs reaching 31,700 by 2014. During the same time frame US manufacturing is projected to continue to decline.

Table 11. Key Sectors in Manufacturing, 2009-2014

Manufacturing Sector	**2009 Jobs**	**2014 Jobs**	**2014 LQ**	**Earnings**
Sign manufacturing	3,132	3,824	18.5	$43,601
Animal slaughtering and processing	3,444	3,319	3.7	$48,922
Construction machinery manufacturing	1,278	1,690	13.2	$50,656
Medical equipment and supplies manufacturing	1,233	1,179	2.1	$78,183
Wood kitchen cabinet and countertop mfg.	1,019	1,134	4.6	$35,902
Motor vehicle body and trailer manufacturing	803	1,071	5.2	$55,889
Broadcast and wireless communications equip.	610	1,011	7.5	$54,753
Other household and institutional furniture	753	910	4.6	$37,600
Other basic organic chemical manufacturing	497	852	10.4	$77,411
Dairy product, except frozen, manufacturing	757	746	3.8	$52,764

Source: EMSI, 2010

The Special Role of Advanced Manufacturing within the Corridor

The discussion above on manufacturing looked at the broad range of leading sectors within the industry. As the research team interviewed economic development specialists and leading manufacturing firms in the Corridor, it became apparent that there was a group of manufacturing sectors that were using advanced manufacturing techniques that shared similar needs for technology, capital investment and highly skilled workers. By using these techniques the companies have been able to remain successful in a manufacturing environment where low cost international competitors had put much of US manufacturing out of business. It became clear to us that a focus on these companies and sectors could be the basis for strong strategic action plan for sector and cluster networks, workforce skills panels, supply chain connections, workforce training initiatives and industry-university collaboration. Advanced manufacturing can be considered a *super-sector* as it includes a range of sectors that share certain characteristics.

The advanced manufacturing super-sector includes some of the lead sectors described above but the analysis here will present the depth and breadth of the advanced manufacturing sectors. Table 12 lists the 22 sectors that share some or all the requirements of an advanced manufacturing imperative and shows how they have grown over the 2004-2009 period. All but two have LQs above 1. As of 2009 nearly 15,000 Corridor workers were employed in advanced manufacturing.

Table 13 and Figure 9 compare employment within each sector in 2009 and projected for 2014. Nearly all sectors are projected to grow. Overall advanced manufacturing is expected to increase from 14,806 in 2009 to 17,604 in 2014, a 19% increase. During the same time frame these sectors are expected to grow nationally by only 3%, reflecting the competitiveness of these sectors within the I-29 Corridor.

Table 12. Lead Advanced Manufacturing Sectors, 2004-2009

Advanced Manufacturing Sectors	**2004 Jobs**	**2009 Jobs**	**2009 LQ**	**Earnings**
Sign manufacturing	1,918	3,132	18.6	$43,601
Construction machinery manufacturing	760	1,278	10.5	$50,656
Medical equipment and supplies manufacturing	1,140	1,233	2.4	$78,183
Wood kitchen cabinet and countertop mfg.	947	1,019	4.7	$35,902
Motor vehicle body and trailer manufacturing	550	803	4.1	$55,889
Other household and institutional furniture	690	753	3.2	$37,600
Commercial machinery repair and maintenance	532	734	1.7	$50,364
Material handling equipment manufacturing	882	635	5.3	$56,007
Broadcast and wireless communications equip.	321	610	4.7	$54,753
Machine shops	494	541	1.3	$43,291
Agricultural implement manufacturing	621	500	4.0	$47,131
Other plastics product manufacturing	441	476	1.0	$43,587
Power boiler and heat exchanger manufacturing	212	412	11.1	$50,729
Plastics packaging materials, film and sheet	392	409	3.0	$46,119
Plate work and fabricated structural products	438	393	1.4	$56,448
Other motor vehicle parts manufacturing	515	387	1.9	$44,190
HVAC and commercial refrigeration equipment	277	384	1.6	$41,969
Ornamental and architectural metal products	556	306	0.9	$41,706
Metal valve manufacturing	289	211	1.5	$45,588
Turbine & power transmission equipment mfg.	168	206	1.3	$54,342
Metalworking machinery manufacturing	210	196	0.7	$48,972
Heavy duty truck manufacturing	85	189	4.5	$53,656
Total	12,438	14,806	2.9	$49,275

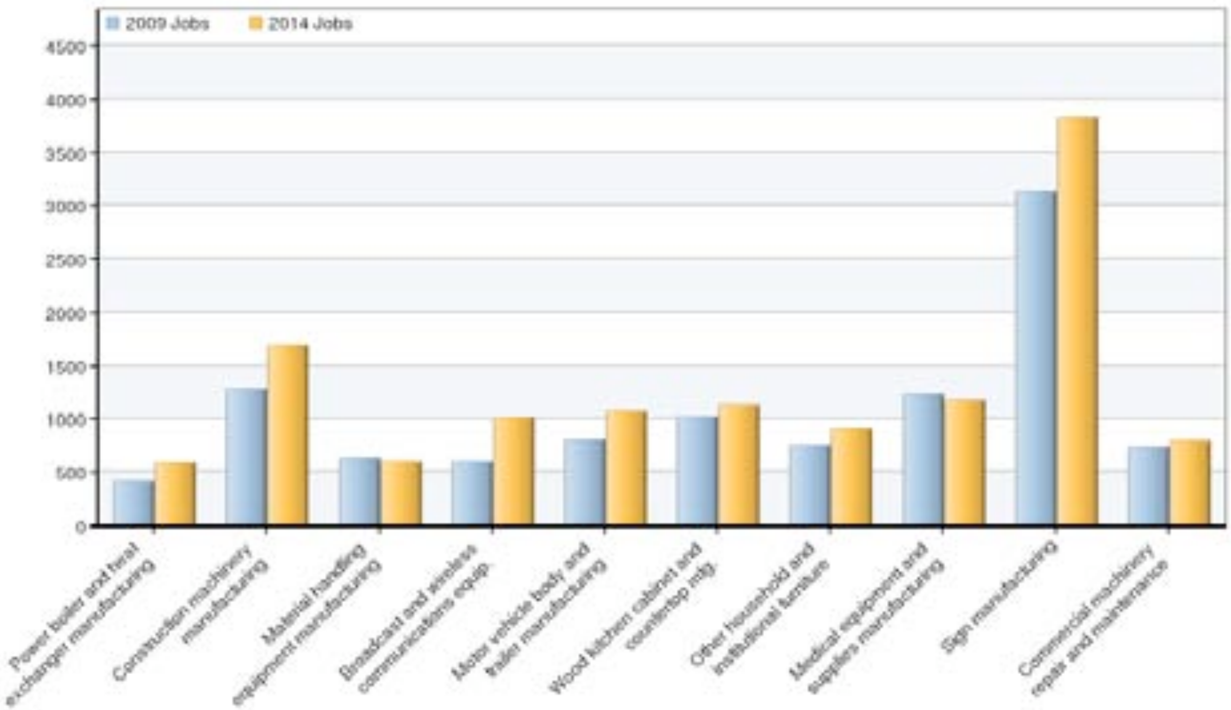
Source: EMSI, 2010 and RTS, Inc.

Table 13. Lead Advanced Manufacturing Sectors, 2009-2014

Advanced Manufacturing Sectors	**2009 Jobs**	**2014 Jobs**	**2014 LQ**	**Earnings**
Plastics packaging materials, film and sheet	409	488	3.2	$46,119
Other plastics product manufacturing	476	545	1.1	$43,587
Plate work and fabricated structural products	393	445	1.3	$56,448
Ornamental and architectural metal products	306	326	0.9	$41,706
Power boiler and heat exchanger manufacturing	412	601	15.1	$50,729
Machine shops	541	575	1.3	$43,291
Metal valve manufacturing	211	252	1.8	$45,588
Agricultural implement manufacturing	500	531	4.5	$47,131
Construction machinery manufacturing	1,278	1,690	13.1	$50,656
HVAC and commercial refrigeration equipment	384	476	2.0	$41,969
Metalworking machinery manufacturing	196	259	1.0	$48,972
Turbine & power transmission equipment mfg.	206	267	1.7	$54,342
Material handling equipment manufacturing	635	602	5.0	$56,007
Broadcast and wireless communications equip.	610	1,011	7.5	$54,753
Heavy duty truck manufacturing	189	239	6.7	$53,656
Motor vehicle body and trailer manufacturing	803	1,071	5.2	$55,889
Other motor vehicle parts manufacturing	387	385	1.8	$44,190
Wood kitchen cabinet and countertop mfg.	1,019	1,134	4.6	$35,902
Other household and institutional furniture	753	910	4.6	$37,600
Medical equipment and supplies manufacturing	1,233	1,179	2.1	$78,183
Sign manufacturing	3,132	3,824	18.5	$43,601
Commercial machinery repair and maintenance	734	794	1.7	$50,364
Total	14,806	17,604	3.4	$49,275

Source: EMSI, 2010 and RTS, Inc.

Figure 9. Employment in Key Advanced Manufacturing Sectors, 2009 and 2014



Advanced Manufacturing Workforce Needs

As the research team examined the advanced manufacturing sector we were struck by the potential future workforce needs of the super-sector. First, we examined the demographic data presented above and saw the large cohorts of workers, many of them in manufacturing, that are nearing retirement. While some of the demographic data show strength in some younger age cohorts, the decline in middle age workers over the next 10 years was alarming.

Second we noted that while unemployment is up, the levels remain relatively low. Historical analysis shows that economic recovery is likely to bring unemployment down to levels where replacement workers are not always available. We were told in particular that until the last two years there were significant shortages of workers, in Brookings especially, that were available and qualified for the open jobs within advanced manufacturing.

Third, as outsiders, we found the lack of technical training resources to be alarming. Fortunately the quality of the training at the two Corridor technical schools, Lake Technical Institute in Watertown and Southeast Technical Institute in Sioux Falls, is quite high and they offer a wide range of innovative programs. Technical schools, particularly those serving a manufacturing base, need to be able to respond to local needs of manufacturers. Their workers may need training but driving to remote sites when they work full-time restricts their ability to access training resources. Often specialized equipment is needed and on-site training is preferred. The technical schools appear to do a wonderful job but they serve too large a geographic area.

To put this in perspective examine Table 14 that compares enrollment in 2-year and 4-year colleges across states in the region. With one exception, Montana, South Dakota has the lowest percentage of enrollment in 2-year colleges, 15%. The comparison is not perfect, as South Dakota does not typically allow student credits to transfer from technical schools to state universities as is done in many other states. Still the imbalance between these numbers seems to ignore the reality of present and future workforce needs. According to the latest US Bureau of Labor Statistics report shows that less than a quarter of jobs in 2018 will require a 4-year degree or higher. These data also show that the jobs requiring an Associate's Degree or certification will be the fastest growing segment of need.

Table 14. Enrollments in Two and Four Year Colleges, 2007

State	**4 year college**	**2 year college**	**4 year %**	**2 year %**
South Dakota	32,943	5,710	85%	15%
North Dakota	35,747	10,070	78%	22%
Iowa	70,325	100,736	41%	59%
Minnesota	116,146	121,710	49%	51%
Nebraska	48,606	43,277	53%	47%
Montana	29,337	2,468	92%	8%
Wyoming	12,496	22,967	35%	65%

We do not wish to devalue the Bachelor's degree or higher levels of education. The knowledge economy needs high skilled workers and areas with higher percentage of college graduates tend to have higher incomes. Those with college degrees make more money and are less likely to be unemployed. Nevertheless the prospects for those with an Associate's degree or post high school training in an in-demand field are quite good while those with a high school degree or less are poor.

Within the Corridor's advanced manufacturing super-sector strong basic skills, a good work ethic, and specific skill training provide good opportunities for those who do not wish to get a college degree. The advanced manufacturing super-sector will require a projected 4,512 new and replacement jobs. Without adequate training resources the Corridor may not be able to match those needs. The industry may have to look elsewhere without an adequate workforce and without training resources available to keep workers current with the latest equipment and skill needs.

Sub-regional Concentrations in Key Sectors

Our focus so far has been on the region as a whole. A key next step is look at the geographic distribution of the key sectors. This is important for two reasons. First, the geographic distribution allows us to better understand the sub-regional relationships within the Corridor, for example where sub-regions share a skilled workforce or where parts of a sector supply chain are co-located within a sub-region. Second, an understanding of sub-regions provides a key tool in developing strategies to build the Corridor economy. It provides a rationale for creating formal or informal relationships or networks involving private companies and the public and not-for-profit sectors.

The earlier discussion of commuting patterns and the increasing interconnected nature of the labor markets in the I-29 creates a number of opportunities for sub-regional workforce initiatives. These initiatives could be sector-based or more broadly based on training and educational assets. For example, the latter could involve efforts to develop methods to provide technical training beyond the limited geography of the two technology colleges.

It is important to understand that these sub-regions can be quite dynamic. For example a county may be in an economic sub-region with counties to its north in some sectors but in a different sub-region with southern neighbors in another sector. We start with sector- or cluster-based sub-regions and then follow with efforts based on geography.

Financial sector

The financial sector is one of the most concentrated within the Corridor. Of the 8,370 jobs all but 2,061 are in Minnehaha County. Several other counties have significant financial operations that serve a national market including Yankton, Union and Codington counties but there seems to be limited integration between the communities. To some extent Union, Yankton, Minnehaha, Lincoln and Clay (due to USD) share a workforce, forming a limited southern financial sub-region. The concentration of financial services is widespread with 15 of the 20 counties having LQ of 1.5 or above.

There are some emerging opportunities between Madison and Sioux Falls due to the IT and security expertise at Dakota State University. As noted above, IT presents a key supply chain opportunity for the region within the financial industry.

Life Sciences

The sub-regional opportunities within the life sciences cluster are stronger. The relationship between Sioux Falls and Vermillion due to the medical school creates a bond, as does the exchange of workforce between the counties. Yankton is farther west but the strong hospital sector including an Avera facility links Yankton to Sioux Falls and other communities for both services and workforce. Brookings and SDSU bring biotech expertise and emerging companies creating a natural relationship between these areas. There appear to be opportunities for collaboration with regard to workforce, supply chains, biotechnology and research within the overlapping sub-regions.

The IT and data security expertise at Dakota State University also presents opportunities for IT related work involving medical records. The national move to electronic medical records provides an emerging opportunity of sub-regional collaboration.

Agribusiness

Unsurprisingly the highest LQs in agribusiness are in the rural counties, mostly in the northern half of the I-29 Corridor. Across the country many rural and urban areas have been working together to build strong local food systems. These collaborations can lead to higher incomes for farmers, more fresh, local foods available to rural and urban residents and improved health outcomes.

South Dakota's agriculture sector is not especially well suited to this practice because of the agricultural products typically produced – corn for grain, soybeans, wheat and sunflower. There is limited production of fresh vegetables but there may be opportunities for beans, meats, poultry, dairy and cheeses. Many school systems and hospitals have started programs to use more locally grown foods. Farmer's markets and restaurants focusing on and marketing local foods (including meats and cheeses) are other markets. A local foods focus could lead to a new market that entices more farmers to plant seasonal vegetable, melon and potato production as a value-added sideline. SDSU Cooperative Extension could play a role in bringing together the communities, schools, restaurants, hospitals and farmers.

Advanced Manufacturing

The extensive supply chain relationships and shared workforce needs between companies in advanced manufacturing super-sector offer the strongest sub-regional connections. In particular Watertown and Brookings, which along with Yankton, have the highest concentrations of manufacturers, have significant opportunities for cooperative efforts. Given the location of Lake Technical Institute in Watertown and the firm supply relationships between companies in both towns. In addition, Lake County and Madison, which has lost much of its manufacturing base, could be a viable partner both as a source of labor as well as the location of smaller manufacturers that support the supply chain for the larger manufacturers in Watertown and Brookings. They are focused on smaller entrepreneurial companies in advanced materials, medical devices and, with the strength at Dakota State University, on IT focused on data security.

The Sioux Falls metro area does not have a high concentration of advanced manufacturing but because of the size of the metro economy it does have significant numbers of firms and employment. For example Daktronics, the largest advanced manufacturing firm, based in Brookings, also has a substantial facility in Sioux Falls. The combined resources of Lake Tech and Sioux Falls Tech form strong north-south bookends for a broader region to support the workforce of advanced manufacturers. Sioux Falls has strong focus in financial services, IT and health care but it also has extensive programs in engineering, electronics and industrial technology. These latter programs, along with its IT emphasis, provide a complement to Lake Tech. A sub-region extending from Watertown to Sioux Falls and including the more rural surrounding counties is a natural for major advanced manufacturing initiatives.

Future Sioux Falls

Sub-regional efforts do not need to be sector or cluster focused. Several communities in the Corridor have examined ways to develop broader economic strategies based on a common geography instead of common sector/cluster needs. The prominent recent example is the on-going *Future Sioux Falls* metro effort. The recently released strategy plan focuses on workforce, innovation and entrepreneurship, quality of life, and marketing. Implementation of a five-year effort is underway. This broad effort supported with substantial local corporate and individual funding provides an excellent template for sub-regional efforts. These types of sub-regional efforts are consistent with broader regional I-29 efforts and can work synergistically to build both the sub-region and region. They should be seen as complimentary not competitive.

Yankton-Vermillion

Yankton has an historic regional hub presence with the more rural counties to its west for manufacturing and health care, two dominant sectors of their economy. During the past decade the community faced the closure of several major manufacturing facilities and lost its satellite campus of Sioux Falls Tech. Partially in response, Yankton became interested in becoming more fully integrated towards the economically dynamic I-29 Corridor to its east. As a result they have created a local effort to develop the innovative and largely locally funded and supported Regional Technical Education Center (RTEC) that replaces to some extent the Sioux Falls Tech satellite campus. The community has also developed a strong focus on networks of young entrepreneurs. The community sees opportunities to work more closely with Vermillion and Clay County to its east, viewing Yankton's manufacturing, tourism and health sectors as complimentary to USD, its faculty and the Vermillion workforce and economy.

Examples of possible sub-regional efforts between the two communities include developing shared infrastructure, a regional entrepreneurial network, and education and workforce training initiatives. Interesting opportunities exist between the two communities in building a stronger creative economy based on the shared tourism potential of the Missouri National Recreational River. USD's College of Fine Arts and Beacom Business School could play a major role in helping the communities improve their economies, community vibrancy and quality of life.

The Lakes of Madison/Lake County

Increasingly urban residents of the Sioux Falls metro and, to a lesser extent Brookings, find year-round or weekend homes on the lakes of Madison/Lake County as quality compliments to the urban experience. The lakes, Madison, Brant, and Round, are near enough to the urban areas for easy commutes while providing a different life experience. At this point the lakes have limited amenities, stores, restaurants, and a creative economy (arts, music) that are expected by urban residents. This limits the economic impact to Lake County and reduces the quality of the experience for visitors and residents. Efforts to build these amenities would improve the economic impact in rural Lake while providing a strong quality-of-life amenity for recruiting and keeping highly skilled and mobile urban workers, producing a win-win for the communities.

Sub-Regional Summary

The examples are not comprehensive and some that are suggested here by our outsider team may not appear relevant or workable to those with local knowledge. They are listed to provide an array of possibilities and not a set list of recommended actions. A regional organization can provide a venue for communities and sub-regions to find ways to work together that are not envisioned without a platform for creative communication and collaboration.

Targets for the Corridor and Emerging Sectors

The above analysis provides a basis for developing a list of economic targets for internal development, supply chain integration and recruitment, retention and expansion.

To start we want to emphasize several key points.

First, any list of target sectors needs to dynamic. Economic leaders, public and private, need to be diligent to see where opportunities have closed and others have opened. Sticking to past targets just because they have the stamp of approval is a fool's game in the more global economy we live. For example, the global economic crisis has thrown a monkey wrench into many regional plans across the country and world. Vigilance and a willingness to change are hallmarks of effective modern economic strategies.

Second and more reassuring, the targets that have been adopted by the state and recently by Future Sioux Falls provide a good starting point for looking at the I-29 Corridor. The targets are:

State

- Biotechnology
- Medical devices
- Energy – wind, biofuels, ethanol
- Firearms
- Computer/IT

Future Sioux Falls

- Medical services and research science
- Corporate and data services
- Renewable energy technology
- Warehousing and distribution

Of the targets, firearms manufacturing is focused more on the western half of the state. Our team did not focus on warehousing and distribution, as it appears to offer fewer region-wide opportunities. This is not to say that these sectors should not be considered for the Corridor, only that they may be second-tier opportunities.

Our analyses suggest the addition of an additional broad target and the clarification of another. As is clear above, our team sees the advanced manufacturing super-sector as a way to look at manufacturing targets. While biotechnology, medical devices, and energy have large manufacturing implications, the opportunities seem much broader. Advanced manufacturing can be an unwieldy and sometimes overly broad focus. Nevertheless, it is clear that the success of the region's manufacturing sector during a period of global turmoil was the result of a shared use of capital, technology, skilled workers and a large, vibrant, and committed array of locally created and owned companies.

It is highly unusual to find a manufacturing community like this. Daktronics, Raven, Larson, Angus, Electronic Systems, Counterpart, Falcon Plastics and others have grown up within the Corridor. Daktronics and Falcon have expanded into other I-29 communities, Sioux Falls for Daktronics and Madison for Falcon. Others that are not locally owned such as 3M, Terex, and Angus have long histories and commitments to their communities. 3M for example has expanded at least eight times since building its first facility in Brookings in 1969.

The combination of globally competitive production methods and local ownership/commitment are powerful advantages. This suggests that the Corridor make a special effort to honor, support and build on this legacy. Effective strategies to respond to the workforce, supply chain, educational, research and infrastructure needs of advanced manufacturing should be a commitment of any regional effort.

For clarification we see an inherent connection between the state's Computer/IT focus and the Corporate and Data Services focus of Future Sioux Falls. In particular these two focuses dovetail perfectly with the financial and medical sectors of the I-29 economy. An integration of these targets seems advisable.

Emerging Targets

The targeted industries and clusters discussed above provide a broad-brush picture. This broad-brush allows for targeted marketing and policy decisions. Within some of these sectors and clusters there are specific narrow industries that might present entrepreneurial, recruitment or expansion possibilities for the Corridor. Typically these sectors reflect opportunity and have a limited representation within the Corridor at this point.

The research team used two methods to identify these emerging targets: 1) competitiveness of the emerging sector and 2) supply chain gaps found in the regional targets.

First we looked at a measure of competitiveness called the shift-share analysis along with an examination of concentration, the LQ. Shift share is a traditional analysis method for determining how much of regional job growth is attributable to national trends versus local trends. Shift share helps answer the question: "Why is industry X growing (or declining) in our region?" Overall national growth accounts for part of the change. Overall industry growth accounts for another part of the change. After accounting for these two factors, we are left with the change accounted for by the unique characteristics of the industry within the region, the **competitiveness factor**. A positive competitiveness number indicates that the region is doing something right.

We looked for sectors that had three characteristics over the 2004-2009 period and the projected 2009-2014 periods. First we determined those sectors that demonstrated a particularly strong competitiveness factor – it grew faster than expected based on national and sector comparisons. Second we filtered for those sectors that were under-represented within the region according to concentration. We made some judgment calls based on our discussions with people in the I-29 corridor and our understanding of the markets. Third, we analyzed which of the broad target sectors the narrow sectors might serve. Some are relevant to a single target while others are parts of the supply chain in several target areas.

The team used a second method that focused on unmet needs within the target clusters. This analysis looked for **supply chain gaps** where firms located within the region are unable to find the good or services they need within the region. These gaps, technically calculated using an input-output model of the region's clusters, gave us a second set of potential sectors for targeting. Again judgment was necessary in the choices as some gaps are unlikely or impossible to be filled within the region.

Table 14 displays our findings. These should be seen as relevant to the region as a whole and not to specific communities or sub-regions. The sectors fall generally into four categories:

- Sectors that could enhanced energy development
- Manufacturing sectors that fit within life sciences, advanced manufacturing and energy
- IT services needed within all the targets
- Scientific and professional services needed within all targets

Table 14. Potential Sector Targets for the I-29 Region

Naics	Description	IT	FN	LS	AM	EN
221122	Electric power distribution					
237130	Power and communication system construction					
325211	Plastics material and resin manufacturing					
326113	Nonpackaging plastics film and sheet mfg.					
326199	All other plastics product manufacturing					
332312	Fabricated structural metal manufacturing					
332410	Power boiler and heat exchanger manufacturing					
332510	Hardware manufacturing					
333120	Construction machinery manufacturing					
333412	Industrial and commercial fan and blower mfg.					
333611	Turbine and turbine generator set units mfg.					
333912	Air and gas compressor manufacturing					
333922	Conveyor and conveying equipment mfg.					
333999	Miscellaneous general purpose machinery mfg.					
334220	Broadcast and wireless communications equip.					
334290	Other communications equipment manufacturing					
334419	Other electronic component manufacturing					
334515	Electricity and signal testing instruments					
336120	Heavy duty truck manufacturing					
336211	Motor vehicle body manufacturing					
336212	Truck trailer manufacturing					
339112	Surgical and medical instrument manufacturing					
339113	Surgical appliance and supplies manufacturing					
339113	Surgical appliance and supplies manufacturing					
518210	Data processing and related services					
541511	Custom computer programming services					
541512	Computer systems design services					
541513	Computer facilities management services					
541519	Other computer related services					
541620	Environmental consulting services					
541690	Other technical consulting services					
541710	Physical, engineering and biological research					
541990	All other professional and technical services					

IT -- Information technology and computer services
FN -- Finance and corporate services
LS -- Life sciences
AM -- Advanced manufacturing
EN -- Energy

Source: EMSI, 2010 and RTS, Inc.

Key Findings: The I-29 Corridor Economy

The Corridor and the State economy

- The Corridor grew significantly more rapidly that the rest of the state over the 2004-2009 period, 9% versus 6%. In particular education and health services, business services, construction and leisure and hospitality grew faster.

- There are significant differences between the structure of the Corridor economy and the rest of the state. The region has much stronger concentrations in finance, IT, professional and business services and especially manufacturing.

- The rest of the state relies more on agribusiness, government and tourism.

Clusters in the Corridor

- A region's clusters tend to be the *primary wealth generators* in its economy, particularly those that are oriented to selling outside of the region. The lead clusters within the Corridor are unsurprising to those familiar with the economy. Business and financial services has grown rapidly and directly employs the largest number with 30,500, growing over 5,000 from 2004. The cluster is projected to continue to grow by another 6,000 employees over the next 5 years.

- The recent Federal changes on financial surrounding credit cards and the student loan program will undoubtedly negatively impact the growth rate. It is too early to tell what the overall impact will be.

- Life sciences which includes traditional health care but also research, medical devices and other health related products is the second largest cluster. It is expected to grow about 10% over the 2009-2014 period reaching nearly 28,000 workers.

- The mature agribusiness cluster remains a major but declining force within the economy. While the Corridor economy grew by 9%, agribusiness declined slightly but remains the third largest cluster. Through 2014 the cluster is projected to lose an additional 1,200 workers.

- The potential closure of the Morell hog processing plant that employs 3,000 would dramatically increase the decline.

- The emerging energy cluster, both traditional and renewable, grew substantially from 2004-2009 and now employs 13,000. The growth is projected to accelerate.

- Two factors may increase this growth substantially. Recent Federal energy policy changes are likely to spur more wind, biomass and ethanol development. Of even greater potential impact is the proposed Hyperion refinery in Union County that would add nearly 2,000 permanent jobs.

- Manufacturing is included within most of the region's clusters with business and financial services an exception. In addition four of the lead clusters, advanced materials, printing and publishing, forest and wood products and machinery are based on manufacturing products.

Lead export sectors in the Corridor

- Sectors that sell outside the region are considered export sectors. These sectors bring income from outside the region and generate wealth and jobs in the regional economy. We determine export sectors by looking at a measure of concentration known as the location quotient.

- Parts of the financial services cluster are major export sectors in the Corridor. These sectors transaction processing, credit card issuing and credit intermediation have concentration levels above 8, making them highly concentrated. The concentration of finance may be affected by the factors noted above though it will remain a very large presence.

- Life sciences in many cases is not an export cluster as it serves a local market. Within the Corridor there are substantial sectors that are export oriented including some health services, medical devices and other manufactured products. Continued growth is expected. The growing presence of the medical school, the Sanford Institute and Avera and increasing manufacturing and research opportunities suggests the growth could accelerate.

- Agribusiness contains a large export component but will continue to decline in importance over time.

- Energy is led by the relatively large ethanol sector. Opportunities in wind, biomass, and ethanol clearly make this a growth area. The Hyperion refinery if built would dramatically change the whole energy sector.

- Manufacturing is led by a super-sector of advanced manufacturing industries that share common workforce skill needs, capital requirements, supply chains and technology. Advanced manufacturing is quite diversified and includes an exceptional collection of locally owned and headquartered firms. Growth is expected to continue, defying the decline in manufacturing nationwide.

- The continuing well-being and growth of the advanced manufacturing super-sector may be hampered by the inability to fulfill their needs for highly skilled trained workers because of limitations within the technical school system. The quality of the two technical institutes is high but they have limited ability to serve the local needs outside of their area. The growth in employment in the sector will be dominated by workers who are highly skilled but do not necessarily require a college degree.

Sub-regions in the Corridor

- The I-29 corridor is a large region that contains a number of effective or potentially effective sub-regions. The sub-regions might share workforce needs, supply chains, educational institution relationships or other characteristics that suggest sub-regional strategies could be effective tools to grow the Corridor economy.

- Some sub-regions are the result of the dispersion of a specific sector such as financial services, life sciences or advanced manufacturing. These sub-regions may find workforce initiatives, company networks, supply chain relationships and other strategies that generate additional economic activity across the sub-region.

- Other sub-regions are specifically geographic, not sector based. The Future Sioux Falls project is the most prominent example. These types of initiatives are entirely consistent with a Corridor initiative.

- The opportunities for sub-regional efforts are substantial. For example, communities and counties working together could develop effective entrepreneurship networks, build creative economies that improve the quality and increase tourism, and create connections between rural and urban areas.

Targets for the Corridor and Emerging Sectors

- The targets established by the state and within the Future Sioux Falls effort provide an excellent starting point for looking at targets within the Corridor. While not all the targets appear to be appropriate within the Corridor, they do provide a consistent focus and allow for marketing and branding of the Corridor in collaboration with the State and the Sioux Falls metro. In particular the state targets for biotechnology, medical devices, energy and computer/IT along with the Future Sioux Fall targets of medical services and research, corporate and data services and renewable energy technology provide a strong basic array of targets.

- Our team sees strong opportunities within a broader target of advanced manufacturing. Workforce, supply chain, company-university collaboration and entrepreneurial development are all possible avenues to use advanced manufacturing as economic engine. The remarkable array of locally created and owned manufacturers is an unusual and economic meaningful feature of the region.

- We also feel a combined focus of the states computer/IT target and the Sioux Falls corporate and data services target. These targets fit perfectly with an emphasis on the financial and medical sectors of the Corridor economy.

- A series of emerging sectors were identified that build on competitive advantage and supply chain needs in growing clusters. Within some of these sectors and clusters there are specific narrow industries that might present entrepreneurial, recruitment or expansion possibilities for the Corridor.

- The list of emerging targets includes sectors that serve IT, finance, life sciences, advanced manufacturing and energy. Many would serve more than one of the lead clusters of the region.

Critical Competitiveness Factors

The economic base of a region is supported by a number of critical factors upon which competitiveness is gained or lost. Here we will look at some of the key factors including entrepreneurship, workforce, and quality of life. Appendix C contains a summary of some of the financial and other incentives available within the state and the Corridor.

Entrepreneurial Energy

A strong entrepreneurial environment provides a basis for a dynamic and resilient economy. Here we present data on the net creation of jobs from new companies (births) and those that close (deaths).

Establishment data include the number of establishment births and deaths by NAICS sector for the counties in the Corridor. Establishment births are, according to the US Census, defined as those establishments that have zero employment in the first quarter of the initial year and positive employment in the first quarter of the subsequent year. Deaths are those establishments that have positive employment in the first quarter of the initial year and zero employment in the first quarter of the subsequent year. [3]

Measuring entrepreneurial energy in a region is not straightforward. Using establishment births and deaths data we provide a measure of entrepreneurial energy looking at two 12-month time periods. We also provide detail for two important sectors, manufacturing and finance, which have performed well by this measure.

The rate at which the new businesses start in the nation occurs at 11.5% of existing establishments in a year. In South Dakota the birth rate of new businesses is roughly 9% with births outnumbering deaths in the state. The experience in the Corridor is similar to the state. The data indicate that Codington, Lincoln and Union counties have had the strongest performance. Even during a recessionary period the three counties had more new business

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[3] This analysis uses the ecological method put forth by the Small Business Administration (Plummer and Headd, 2008). The ecological method measures the rate at which a region sees births (deaths) of businesses over a 12-month period.

formation than business deaths. For the rest of the Corridor the two time periods show differing results.

Between 2002 and 2003 the region saw new business formation at rates between 7-9%, in line with the state but less than the national establishments birth rate. Two counties in the region stand out during this 12-month timeframe – Codington and Deuel. Codington, which has the second greatest number of establishments behind Minnehaha (Sioux Falls is located in this county), spawned 20 more business births than deaths. Deuel, on the smaller side in terms of economic activity in the area has a much higher birth rate (10.6%) than the state signaling some sort of new business energy in the county. Unfortunately, for every business started in Deuel in the region another business died. From this data, there is no way in knowing how employment was affected and what the net job loss or gain was during this period.

What is striking about the 2005-2006 timeframe is the increase in business creation within the Corridor. Nearly half the region created a higher percentage of businesses than the state as a whole and a couple of counties surpassed the national establishments birth rate. Minnehaha and Lincoln, which make up the Sioux Falls metro area, were the leaders in net births.

Table 15. Establishments Birth Rates, All Sectors

Geography	**Birth Rate, 2002-2003**	**Net Births, 2002-2003**	**Establish-ments 2002**	**Birth Rate, 2005-2006**	**Net Births, 2005-2006**	**Establish-ments, 2005**
Nation	11.5%	68,166	6,386,609	12.4%	122,720	6,639,118
South Dakota	8.7%	39	24,439	9.8%	216	25,205
Brookings	7.4%	-2	789	10.4%	11	800
Clark	7.6%	-5	119	10.3%	0	117
Clay	9.2%	-6	306	9.0%	-6	300
Codington	9.2%	20	1,021	8.3%	3	1,044
Day	6.5%	-9	199	8.6%	-4	197
Deuel	10.6%	0	141	11.9%	-1	143
Grant	6.5%	-6	277	10.9%	17	284
Hamlin	7.8%	-3	153	10.9%	0	165
Kingsbury	9.5%	-1	210	9.5%	-7	190
Lake	7.9%	-2	355	8.2%	2	354
Lincoln	9.4%	6	711	17.6%	64	876
McCook	8.7%	2	183	6.4%	-7	187
Marshall	7.7%	-3	143	8.6%	-1	152
Miner	8.2%	0	73	8.6%	-2	70
Minnehaha	9.0%	-7	5,299	9.2%	68	5,426
Moody	6.1%	-4	147	7.6%	-2	144
Roberts	6.5%	-2	248	13.2%	13	250
Turner	8.4%	-11	273	8.0%	-13	262
Union	10.6%	10	424	11.3%	13	435
Yankton	7.4%	-18	721	7.5%	-9	719

Source: U.S. Census Bureau | Statistics of U.S. Businesses & County Business Patterns

Note: Birth rate is the number of new businesses divided by the total number of businesses. Net births are the number of births minus the number of establishment deaths.

We turn now to analysis within two of the leading sectors within the Corridor, manufacturing and finance.

The manufacturing sector as we have seen above is a strong presence in the Corridor with high concentrations in Brookings, Codington and Yankton and significant levels of establishments and jobs in Sioux Falls. The data in Table 16 reflect this strength as the lead counties show significantly higher birth rates than both the state and the nation. (Many of the counties in the region have such a small number of manufacturing establishments that the birth rates are unreliable to use as a measure of entrepreneurial energy.) Overall, the region saw higher birth rates in the manufacturing sector in the 2005-2006 time-period than in 2002-2003.

Table 16. Establishments Birth Rates, Manufacturing (NAICS 31-33)

County	Birth Rate, 2002-2003	Net Births, 2002-2003	Establish-ments, 2002	Birth Rate, 2005-2006	Net Births, 2005-2006	Establish-ments, 2005
Nation	7.0%	-6,756	322,113	7.4%	-2,469	312,132
South Dakota	7.4%	10	897	10.9%	47	964
Brookings	0.0%	-1	32	21.9%	6	32
Clark	0.0%	-1	5	33.3%	3	9
Clay	0.0%	0	12	0.0%	-1	10
Codington	0.0%	-6	66	7.5%	0	67
Day	12.5%	0	8	10.0%	1	10
Deuel	100.0%	1	2	0.0%	0	5
Grant	28.6%	2	7	10.0%	1	10
Hamlin	0.0%	0	8	0.0%	0	8
Kingsbury	10.0%	1	10	3.4%	0	29
Lake	8.3%	-2	24	11.5%	3	26
Lincoln	3.0%	0	33	14.3%	4	49
McCook	12.5%	0	8	0.0%	-2	7
Marshall	0.0%	0	6	10.0%	0	10
Miner	0.0%	0	11	0.0%	0	3
Minnehaha	6.4%	4	157	7.6%	8	172
Moody	25.0%	1	4	25.0%	1	4
Roberts	5.9%	0	17	27.3%	2	11
Turner	9.1%	-1	11	22.2%	1	9
Union	3.8%	0	26	12.0%	1	25
Yankton	3.3%	-3	30	6.9%	-1	29

Source: U.S. Census Bureau | Statistics of U.S. Businesses & County Business Patterns

South Dakota and the Corridor saw substantial business closings in the finance and insurance sector in 2002-2003. Between 2005 and 2006 the region saw more business births overall led by Lincoln, which experienced significant new business formation. Birth rates are above the national and state levels in several of the lead counties within the financial industry.

Table 17. Establishments Birth Rates, Finance and Insurance (NAICS 52)

County	Birth Rate, 2002-2003	Net Births, 2002-2003	Establish-ments, 2002	Birth Rate, 2005-2006	Net Births, 2005-2006	Establish-ments, 2005
Nation	12.7%	10,947	413,194	13.9%	16,034	437,333
South Dakota	9.1%	-28	1,892	8.3%	25	1,843
Brookings	9.4%	1	53	11.9%	1	59
Clark	0.0%	0	9	0.0%	0	9
Clay	5.6%	1	18	0.0%	-1	18
Codington	7.7%	-3	78	4.5%	-2	67
Day	0.0%	-4	19	5.9%	0	17
Deuel	12.5%	-2	8	0.0%	0	7
Grant	6.5%	-7	31	15.8%	1	19
Hamlin	8.3%	1	12	21.4%	3	14
Kingsbury	6.3%	-2	16	0.0%	0	3
Lake	3.7%	-2	27	4.0%	-1	25
Lincoln	4.8%	-4	62	25.0%	15	84
McCook	0.0%	0	15	0.0%	-2	17
Marshall	7.1%	-2	14	8.3%	1	12
Miner	0.0%	-1	4	0.0%	-1	5
Minnehaha	9.7%	-24	527	8.9%	2	463
Moody	0.0%	0	9	0.0%	-1	7
Roberts	50.0%	-1	2	5.0%	1	20
Turner	0.0%	-1	23	0.0%	-2	21
Union	21.9%	5	32	12.1%	1	33
Yankton	10.2%	-3	59	7.3%	1	55

Source: U.S. Census Bureau | Statistics of U.S. Businesses & County Business Patterns

It is important to note that data on births and deaths of businesses is only collected for establishments with paid employees and excludes non-employers and other businesses without paid employees. Thus, the overall entrepreneurial energy (or business startups) in a region may be understated in the above analysis.

As with all data, sometimes the definition may not exactly fit the application. Establishment births in this report are used to provide some indication of where entrepreneurial activity is occurring. However there is a difference between growth oriented entrepreneurship and traditional business startups. While both create wealth in a region they do so at vastly different rates and often with varying degrees of innovation. However, the start of any business suggests a condition and risk-taking that fosters an environment of economic growth in a region.

The data suggest that the region has a reasonably strong environment for new business with particularly strong results within two key sectors. Data limitations restrict the ability to take county level analyses any further. There are some measures of state level entrepreneurial activity and policy environments. The measures of entrepreneurial activity, using more detailed data than available on a county level, tend to put South Dakota in a middle ranking. The *2009 Kaufmann Index of Entrepreneurial Activity by State* places the state 28th, behind Wyoming, Montana, Nebraska and Minnesota and ahead of Iowa and North Dakota. The *2008 State New Economy Index* produced by the Information Technology & Innovation Foundation ranks South Dakota 31st on its measure of *Economic Dynamism*. On the other hand the Small Business & Entrepreneurship Council, which is based on the state's policies instead of its performance, ranks the state first in the nation. The lack of a state income tax is a key element in this high rating.

Workforce

A high quality workforce is fundamental requirement of a vibrant economy. Here we will briefly examine the occupational composition of the region and then look at workforce needs over the next 5 years. Additional details on workforce needs are shown in Appendix D.

The occupational composition of the Corridor is very similar to that of the nation as a whole. Most of the workforce can be found in office and administrative occupations or sales-related occupations. Where the Corridor differs from the nation is in the production occupational category as shown in Table 18 below. The Corridor has a higher percentage of the regional employment in this occupational category, which is not surprising given the strength in advanced manufacturing that depends heavily on production type occupations such as team assemblers, machinists, and welders.

As shown in the table the regional economy has close to 300,000 jobs in 2009. By 2014 the jobs in the Corridor are projected to add upwards of 22,000 new jobs – a 10% growth in employment. Adding new jobs to the economy is a sign of economic vitality; however, the picture of total labor demand is incomplete. *Replacement jobs* often get lost in the discussion of the true demand for labor. Replacement jobs are those jobs expected to need filling as a result of turnover (e.g., employees changing occupations, retiring). Overall, the replacement needs of the region far outweigh the demand for new jobs. The forecasted number of replacement jobs needed by the end of 2014 is forecasted to be around 33,940. The total demand for labor, new and replacement jobs, between 2009 and 2014 is projected to be nearly 63,926.

Table 18. Workforce Occupational Composition, 2009

Occupational Category	**I-29 Corridor**	**Nation**
Management occupations	8.13%	7.4%
Business and financial operations occupations	4.62%	5.1%
Computer and mathematical science occupations	1.63%	2.1%
Architecture and engineering occupations	0.87%	1.5%
Life, physical, and social science occupations	0.84%	1.0%
Community and social services occupations	1.29%	1.5%
Legal occupations	0.46%	0.8%
Education, training, and library occupations	4.62%	5.6%
Arts, design, entertainment, sports, and media occupations	2.38%	2.8%
Healthcare practitioners and technical occupations	5.32%	4.6%
Healthcare support occupations	2.08%	2.5%
Protective service occupations	1.07%	1.9%
Food preparation and serving related occupations	7.00%	6.7%
Building & grounds cleaning & maintenance occupations	3.33%	4.0%
Personal care and service occupations	3.81%	3.6%
Sales and related occupations	13.43%	13.0%
Office and administrative support occupations	15.21%	14.2%
Farming, fishing, and forestry occupations	0.82%	0.7%
Construction and extraction occupations	5.35%	4.9%
Installation, maintenance, and repair occupations	3.33%	3.5%
Production occupations	7.04%	5.5%
Transportation and material moving occupations	6.47%	5.9%
Military Occupations	0.91%	1.2%
Total	**292,536**	**173,451,657**

EMSI, 2010

The most recent projections available on the educational needs of workers indicate that about one-third of workers will need a 4-year college degree by 2018 with about another third requiring some college education or an Associate's degree.[4] Table 19 shows the educational attainment levels for the more populous counties within the Corridor to give some idea of the ability of the region to meet its future needs. The data indicates that the region is doing a good job of fulfilling the needs for four-year degrees. Based on the Georgetown report the region is likely to fall short in providing enough workers needs with Associate's and advanced degrees.

[4] *Help Wanted: Projections of Jobs and Education Requirements through 2018.* Georgetown University Center on Education and the Workforce, June 2010.

Table 19. Educational Attainment in the Workforce, 2008

County	Less than High School	High School Only	Some College	Associate Degree	Four Year College Degree	Graduate Degrees
Brookings	582 4.97%	3,161 26.98%	2,926 24.97%	865 7.38%	2,678 22.86%	1,504 12.84%
Clay	245 4.59%	1,139 21.34%	1,275 23.89%	320 6.00%	1,334 25.00%	1,024 19.19%
Codington	1,110 8.73%	4,907 38.59%	2,837 22.31%	1,218 9.58%	1,995 15.69%	648 5.10%
Lake	456 8.98%	1,732 34.09%	1,239 24.39%	1,239 24.39%	961 18.92%	338 6.65%
Lincoln	743 5.89%	3,786 30.03%	3,102 24.61%	1,420 11.26%	2,708 21.48%	847 6.72%
Minnehaha	6,554 8.50%	22,472 29.14%	19,251 24.96%	6,786 8.80%	16,521 21.42%	5,536 7.18%
Union	430 6.56%	2,113 32.22%	1,505 22.95%	516 7.87%	1,328 20.25%	667 10.17%
Yankton	998 9.06%	3,719 33.78%	2,523 22.92%	881 8.00%	2,016 18.31%	873 7.93%

Source: US Census

Quality of Life

Many factors describe a favorable quality of life within South Dakota and the Corridor. Economic conditions are, as we note above, quite favorable with the second lowest unemployment rate in the country. High employment numbers combined with low taxes, a low cost of living (92.4 where the US overall is 100), reasonable housing costs, and relatively low cost health care contribute to a quality living environment. The region also boasts a low crime rate and good educational achievement levels up to four-year degrees. In our interviews and discussions within the Corridor we heard concern that a lack of cultural, recreational and other community amenities was a barrier to keeping and attracting high-skilled workers, particularly younger workers.

Innovation Capacity

This portion of the analysis offers a "quick" qualitative assessment of the I-29 Corridor's capacity to support innovation. It is divided into three segments that address innovation infrastructure, risk capital and industry R&D levels.

A Note About Innovation

For the purposes of this analysis, innovation is defined as something newly put to use, whether an idea, practice, or artifact and/or the act of using something new. The innovation process consists of the steps through which something used moves from concept to utilization. To take this one step further, much of the Phase 1 University-oriented economic development strategy focused, ultimately on capacities and activities that enable and impel technological innovation. For the purposes of this analysis, technological innovation is defined as "The development and commercialization of new technologies and the products, processes, and services in which they are embodied."

Innovation is the lifeblood of vibrant market economies. A regional economy's capacity to innovate and create new value is the key to sustaining the wealth-generating process. Over the long run, this capacity is what distinguishes thriving communities from those that struggle just to stay in place.

Innovation Infrastructure

This segment examines the innovation infrastructure that is already in place throughout the I-29 Corridor. More specifically, it applies the traditional definition of infrastructure to the innovation capacity. For the purposes of this analysis, innovation infrastructure is defined as "the public and non-profit systems, services and facilities of a region the directly enable innovation."

As a general rule, private assets are regarded as outside the purview of the innovation infrastructure because infrastructure elements are fundamentally public goods or in the case of non-profit organizations and public-private partnerships have a very significant public good dimension. Furthermore, in order to craft a strategy that employs these innovation infrastructure assets, their boundaries need to be identified and understand in a way that allows for specific investment and specific roles. However, there may be some circumstances in which private for-profit entities should logically be included because their commercial activities embody a strong public good dimension.

This analysis will split the innovation infrastructure universe into two types – hard infrastructure and soft infrastructure with additional classifications under each type according to role. There will be overlap in some instances as there will be cases were services included in soft infrastructure are associated with their hard infrastructure home – for example, an incubator. Nonetheless, the services are distinct from the facility.

In fact, differentiating and understanding the roles of the various elements is critical from an "actionable recommendation" standpoint. For instance, an incubator located in a research park will most likely include at least three different elements. The real estate function of the research park is distinct from the actual design, mission, management, plant and equipment associated with the facility that is in turn distinct from the incubation services offered within the facility. In the latter case there may be a broad scope of services bouncing from simply joint access to the copier and conference room to technical assistance for accounting problems, marketing issues, supplier/vendor management or even product or process design. Any strategic action to support or grow one of these infrastructure assets should address each element on its own terms. They may be linked but they are not all rolled up into one amorphous bundle.

Innovation Infrastructure Inventory

Is the region in a position to effectively support the movement of new ideas and technologies into products, processes and services and then into markets? The inventory tallies up the assets but does not offer any judgments on internal operations. Its purpose is to offer a calibration of the level of innovation infrastructure investment in play in the I-29 Corridor.

An I-29 Hard Innovation Infrastructure Inventory

As the name implies, this category includes tangible assets including facilities such as incubators, accelerators, non-profit R&D labs, et al, research parks, and fiber optic backbone.

Incubator Facilities

- South Dakota State University Innovation Campus Incubator (Brookings)
- Brookings Bioscience Incubator
- City of Brookings Research and Technology Center
- Sioux Falls Technology Business Center
- Graduate Education and Applied Research Center in Sioux Falls (lab space)
- Heartland Technology Center (Madison)
- The Three Rivers Business Resource Center (Vermillion)

Research Parks

- South Dakota State University Innovation Campus Research Park (Brookings) - 125 acres under development
- Hueners Technology Park (Madison) - 5 acres under development, 80 under option
- Sanford Research Park (Sioux Falls) – 185 acres under development

Fiber Optics

- The state contains approximately 7,000 miles of fiber optics with a strong presence in the corridor from Watertown to Sioux Falls and then over to Yankton. The Corridor is also well connected to Mitchell and Aberdeen to its west. All fiber access is at least to the DS3 level (equivalent to 28 T1 lines) (South Dakota, GOED, 2009)

- Numerous POPs (Point of Presence) are located throughout the region maintained by the a multiple telecommunications companies including AT&T, MCI, Midcontinent Communications, Knology, Qwest, SDN Communications and Sprint

- Fiber-to-the-Premise in Brookings: Brookings Municipal Utilities and Swiftel Communications together provide fiber optic cable to every house and business within the city limits.

An I-29 Soft Infrastructure Inventory

This portion of the infrastructure includes financial resources such as public or non-profit grant or early stage funds, service and technical assistance organization with explicit innovation missions , and networks like associations, alliances, task forces and so on that allow for flow of information and enable transactions.

Direct Innovation Support Organizations

- The service and technical assistance functions within the region's six small business incubators:
    - South Dakota State University Innovation Campus Incubator (Brookings)
    - Brookings Bioscience Incubator
    - City of Brookings Research and Technology Center
    - Sioux Falls Technology Business Center
    - Heartland Technology Center (Madison)
    - The Three Rivers Business Resource Center (Vermillion)
- Enterprise Institute (Brookings)
- Brookings Area Entrepreneur Network
- Lake Area Improvement Corporation – DSU Center for TechnoEntrepreneurism -- currently funded for operation but seeking a director (Madison)

Innovation Targeted Public or Non-Profit Financial Resources

- Small Business Innovation Research/Small Business Technology Transfer Programs - headquartered at the South Dakota Small Business Development Center in Sioux Falls (see SBIR program description under the Risk Capital discussion below)

- South Dakota Innovation Partners LLC*

* South Dakota Innovation Partners' operations feature a strong public good dimension. While committed to generating an acceptable return to its limited partners, South Dakota Innovation Partners' mission also focuses on producing technology-based economic development outcomes. The company invests very early in the innovation process and also provides technical assistance to early- stage opportunities.

Industry R&D Levels

In much of the literature examining industrial performance, the terms *Innovation* and *R&D* are used interchangeably. While these two terms are clearly connected, they are not synonymous. *Innovation* is a concept, while R&D is a measurable, observable activity. Not all firms or industries engaging in R&D are innovative. It's certain, however, that any firm or industry that is successfully reaping the benefits of innovation is investing in research and development.

Because it is directly tied to productivity growth and competitive advantage, industrial R&D is one of the best indicators of a region's capacity to innovate. Industry performs over 75% of <u>all</u> R&D in the U.S. and funds 65% of <u>all</u> R&D. The private sector also funds 85% of industrial R&D. {*The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators* (Office of Technology Policy, Technology Administration, U.S. Department of Commerce, 2000)}

County level industrial R&D expenditure data are not available for the entire U.S. so it is not possible to aggregate county industrial R&D expenditures into a regional I-29 Corridor total and compare on a normalized basis to any other region. These data are available from the National Science Foundation at the state level through 2006. For 2006, South Dakota ranked 49th in the U.S. in R&D expenditures by industry at $95 million. A more insightful measure adjusts for the relative size of the economies still points to a low level of industrial R&D. Using gross domestic product (GDP) at the state level and the national level to normalize this measure produces the following result. *For 2006, there was $2.79 million dollars of industrial R&D performed in South Dakota for every billion dollars of GDP generated by the state's economy. For the U.S. total, there was $17.63 million dollars of industrial R&D performed for every billion dollars of U.S. GDP.*

Risk Capital

This portion of the analysis is intended to define the types of risk capital assets most needed to support the regional innovation process and then to offer a snapshot of the risk capital assets in the I-29 Corridor that may be available to serve this purpose.

Why the Emphasis on Risk Capital as Opposed to all Types of Capital?

High-impact companies generate better paying jobs at faster rates than other companies. They are often the wealth generating engines within regional economies and are responsible for a disproportionate share of income and employment growth.

High-impact companies typically represent only a very small portion of the firms within a regional economy and often require very specialized financing to launch and to grow. For periods they often are required to spend money faster than they are making it in order to fuel their own growth. They can't afford to hire people, build facilities, order parts and equipment, etc. after orders are placed. In many cases, they will not have the assets (especially startups and young companies) to serve as collateral to secure loans. Add to this scenario that, at least at the startup stage, many more high growth potential companies fail than succeed. Under these circumstances, a bank would be crazy to loan them money. This is where an alternative source for capital comes in to play – venture capital. Venture capital generally is offered in the form of equity financing; that is, the capital provider participates in profits and proceeds as an owner or stockholder. There are many variations of venture capital "products" that are designed for business endeavors and risk levels. When viewed together, debt and equity capital products (and all the variations in between) define the financing spectrum available to businesses.

Perhaps the easiest way to understand the financing spectrum for businesses is to forget about "debt versus equity" distinctions and instead think in terms of "low risk versus every other kind of risk" and "low return versus every other kind of return." Low risk financing is provided by banks and other credit-oriented institutions in the form of secured loans (for simplicity' sake, let's include the SBA guaranteed loan programs in the upper end of this low risk category). Venture financing has, in effect, come to mean everything else. That is, financings that are not low risk and are not adequately secured by conventional lending standards.

While in popular media and discussion venture capital is often depicted as single, homogeneous kind of financial product; it is far from that. There is a whole range of types of venture financing generally defined by the stage, risk level, size, characteristics and objectives of the investment.

Why the Emphasis on Very Early Stage Risk Capital as Opposed to all Types of Venture Capital?

Routine access to venture financing is difficult to manage for most communities and regions. It has been consistently documented over the last two decades (most recently by Chen, Gompers, Kovner and Lerner) that the venture capital industry remains concentrated on the west coast and east coast and still displays a marked tendency to invest close to home.

> "More than half of the 1,000 venture capital offices listed in Pratt's Guide to Private Equity and Venture Capital Sources are located in just three metropolitan areas – San Francisco, Boston and

> New York. More than 49% of the U.S.-based companies financed by venture capital firms are located in these same three cities."[5]

To complicate matters, while there is some mobility (meaning money will travel outside of it's management's location to find good deals) for larger deals, there is little or none for smaller financings—especially early stage deals. Which means, as a general rule, if you want access to early stage capital you better "do it yourself." This recognition has given rise to a host of early stage capital fund inducement efforts at the state and municipal levels throughout the country. Locally owned and managed early stage venture funds are important to regional economies for at least four reasons.

1. The kinds of companies that need and attract these funds are high value-added, high growth companies capable of raising the standard of living in our communities. They generally pay higher wages; they require higher knowledge and skills levels of their employees; they operate on higher gross profit margins; and they retain and reinvest more earnings than do other companies. Also, they often return more money to owners and investors, leading to reason number two.

2. When venture funds are locally owned and managed, a greater portion of their returns to investors is added to the wealth of the community in which the funds are located.

3. Reason number three is less tangible but just as important. These early stage, locally owned and managed funds make a powerful public contribution by their mere existence. By fueling the birth rates and improving the likelihood of success for high value-added firms, the venture capitalists infuse their communities with a sense that all things are possible and an appreciation for risk-taking, knowledge and skill. They foster and shape a culture of innovation

4. Well managed, local early stage funds can serve as a gateway or link to larger venture firms that can provide subsequent rounds of risk financing as the company enters the market and begins to grow.

Circumstances in recent years have rendered the development of smaller local funds even more problematic. Within the industry, more capital has been concentrated in fewer hands. Many institutional investors that invest in venture capital funds want to invest at least $10 million in a fund and represent no more than 10% of the fund's capital, thereby limiting their focus to funds of $100 million or more. Smaller institutions also perceive safety in investing in large funds. When a fund has $100 million under management, they need to invest $2 million to $5 million in a company over time. This leads them to favor the later stage deals. Seed and start-up companies are more people-intensive than capital-intensive. The early stage companies need smaller amounts of capital to hit the early milestones, and they require the active involvement of the investor to help fill the gaps in the founding management team. *Therefore, although they are*

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[5] Henry Chen, Paul Gompers, Anna Kovner, and Josh Lerner, "Buy Local? The Geography of Successful and Unsuccessful Venture Capital Expansion," *National Bureau of Economic Research Working Paper No. w15102*, June 2009.

a critical development asset, early stage funds often don't make sense as a strictly private, rate of return-maximizing investment. Larger funds and larger deals offer a better alternative because the investment is more "efficient" and there is much less risk while still realizing an acceptable rate of return.

Finally, it is important to note that this brief discussion of capital availability focuses exclusively on high growth potential, high value-added, and/or technology intensive ventures. That is, the kind of startups and firms whose growth rates, gross margins, market size, and competitive advantages would qualify them under traditional early stage venture capital investment criteria regardless of whether they would chose to seek institutional risk capital. These kinds of startups and expansions generally represent only a small subset of the total number of businesses started in a given economy over a specific period of time. They tend to have much larger initial capital requirements than the "average" startup and, as previously mentioned, additional large amounts of cash are most often required to fuel their growth.

An I-29 Corridor Risk Capital Inventory

This part of the innovation capacity assessment is intended to identify the region's risk capital assets that may be available to support the innovation process.

Prairie Gold Venture Partners

Sioux Falls

Early Stage focus with preference in life sciences and alternative energy

Review of portfolio 9 companies listed on web shows no South Dakota-based investments.

Bluestem Capital Company

Sioux Falls

Avoids startup and early stage and only invests in opportunities that feature principals with a track record

Preferred investment areas are: hospitality, restaurant, utilities, technology, manufacturing and energy.

Listed portfolio companies have a strong South Dakota presence.

McGowan Capital Group

Sioux Falls

Focus on mid-stage companies in $500,000 – $20,000,000 revenue range

List portfolio companies show a strong SD investment presence in the I-29 Corridor. Geographic preference is no more than a day's drive from Sioux Falls.

South Dakota Innovation Partners, LLC

Brookings and Sioux Falls

Focus on startup and early stage companies in the I-29 Corridor region

Industry investment area preferences include energy, agriculture, technology, and animal and human health.

SDSU Brookings Angel Fund, LLC - Regional Angel Investors Network (RAIN) member

Brookings

Focus startup companies within South Dakota and bordering states

Industry investment areas include: value-added agriculture and agricultural support enterprises, science and medicine, and alternative energy.

Prairie Winds Capital, LLC - Regional Angel Investors Network (RAIN) member

Sioux Falls

Focus on the startup companies within the Sioux Empire Region

Industry investment area preferences include: value-added agriculture and agricultural support enterprises, science and medicine, alternative energy, transportation and information technology.

Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Programs

SBIR is a competitive federal grants program that helps small business develop technologies and the products, processes and services in which they are embodied and bring them to the marketplace. The program is targeted to startup and early stage companies and is limited to U.S. owned and operated for-profit firms with under 500 employees. The firm must employ the principal researcher. The SBIR program is comprised of three phase and the participating federal agencies award funds based on technical merit, degree of innovation and market potential. Phase 1 awards are up to $100,000 and focus on technical merit or feasibility of an idea or technology. Phase 2 awards are up to $750,000 and are designed to extend the work of Phase 1 by helping to complete R&D work and developing commercialization strategies. Phase 3 represent the point where the product, process or service moves into the marketplace. No funds are awarded for Phase 3. The STTR program The STTR has similar qualifications but requires non-profit research facility participation. Ten agencies give SBIR grants and five STTR.

The SBIR program has been highly regarded by small technology companies and scientific entrepreneurs throughout the U.S. At the federal level, the SBIR proposal evaluation and award process is highly competitive, rigorous and based on technical and commercial merit.

As a result, at least nine states have established programs that match SBIR Phase 1 funding. The program's efficacy was recently affirmed as a national policy instrument by the National Research Council in its publication, *An Assessment of the SBIR Program* (National Academies Press, 2008). This comprehensive assessment concluded: "The core finding of the study is that the SBIR program is sound in concept and effective in practice."

Of particular interest to the second phase of this analysis that focusing on the universities' role in the I-29 Corridor's economic development future, the National Research Council study also found that:

- More than two-thirds of the companies that were awarded SBIR grants had at least one founder that was previously an academic,
- About one-third of the founders of these SBIR award companies were most recently employed as academic prior to starting the company, and
- Over a quarter of the companies employed university faculty as contractors.

The SBIR programs function as a significant pre-seed and seed capital provider in a number of states. According to the South Dakota SBIR/STTR State Program Office within the South Dakota Small Business Development Center, for 2009 the state received $2,017,597 of SBIR awards distributed among 5 Phase 1 winners and two Phase 2 winners. While the number of annual SBIR awards to South Dakota companies, at first blush, seems modest it is a solid showing in view of the low levels of private sector R&D and science and engineering intensive companies.

Findings: Innovation Capacity

Infrastructure

- The I-29 Corridor Region has a highly developed hard innovation infrastructure level, especially relative to the size of the regional economy, with its six incubators, advanced fiber optic backbone and its three research parks that together have access to roughly 400 acres for future development.

- The I-29 Corridor Region has a strong concentration of technical service providers that support the innovation process.

- The I-29 Corridor Region has no development finance resources dedicated to funding the earliest stages of the innovation process in university and private sectors settings such as proof of concept or pre-seed funds that are most often delivered through pubic or non-profit entities. However, as referenced in Phase 2 of this report in the University - Community Linkages discussion, it should be noted that proposed plans do exist to form a public-private partnership led by the South Dakota State University Technology Transfer Office and South Dakota Innovation Partners to administer and manage a proof of concept center.

Industry R& D

- The level of R&D performed in South Dakota is very low, even when adjusted to the size of the economy. For every billion dollars of GDP generated by South Dakota's economy, there is $2.79 million of private industry R&D performed in the state. For all country as whole, for every billion dollars of GDP generated by the national economy, there is $17.63 million of industry R&D performed. While these are statewide figures, they are also consistent with the relatively low levels of high tech employment specific to the I-29 Corridor Region cited earlier in this analysis. It is also worth noting South Dakota is one of the relatively few states without tax credits for company-financed research. cite low high tech concentration?

Risk Capital

- Relative to the size of its economy, the region has surprising number of risk capital sources – four venture capital companies and two active angel groups.

- Interviews with representatives of the region's venture capital community expressed concerns about "quality deal flow" in their preferred industry target areas. Though several of funds had multiple investment in South Dakota-based companies, the majority of the portfolio companies for the group are out of state.

- With the exception of the federal SBIR program, there are no funds dedicated to the earliest proof-of-concept or technical feasibility stages of the innovation process. These funds are most often managed by public or non-profit entities because the combination of risk and return levels and the overhead burden per deal render often don't make business sense to for-profit risk capital providers.

Summary Finding

- The region's innovation infrastructure; that is "the public and non-profit systems, services and facilities of a region the directly enable innovation" is highly developed. It is well positioned to "enable" innovation but it needs more throughputs. It needs more early stage opportunities to act upon. The relatively low levels of university R&D (documented in Phase 2 of this report) and low concentrations of high technology employment highlight this circumstance. These very early stage funds will need to be an integral part of strategy to ratchet up production of early stage innovation opportunities generating by the private sector and by universities.

A Sector- and Cluster-Based Economic Development Strategy for the I-29 Corridor

The recommendations and actions presented below define a regional economic development strategy based on the current and emerging wealth generating sectors and clusters within the I-29 Corridor. As such it focuses on producing and deploying the economic strengths that will govern the region's future economy by (1) improving the economic competitiveness of the lead and emerging economic engines of the Corridor and (2) integrating the economic development assets more fully with the university-based development strategies developed in the Phase 2. The goal remains a constant: generating greater numbers of higher wage jobs and building wealth in the region's communities.

Workforce Development

As all economic development professionals know, workforce is a make or break element in the decision of firms to start, expand, stay or relocate. Companies look not only at the workforce of today but also what they can expect in the future. Part of that calculation looks at the ability of the system to produce highly skilled, ready-to-work individuals. Part involves the ability to easily access additional training for existing employees so that companies know that their workers can re-skill throughout their careers.

The Corridor has a comparatively strong workforce built on quality K-12, tech and four-year university. Where the Corridor and South Dakota in general falls short is access to technical school programs that are convenient in terms of class times and locations. As a result one sees mostly young people on the tech campuses and comparatively few workers coming back for skill upgrades.

Recommendation: The region should collaborate to develop more widely distributed workforce training that meets the needs of new workers, existing workers and companies.

By statute the state is limited to the present four technical institutes. Technical schools serve inherent local needs especially in situations where full time workers are returning for skill upgrades or training needs to happen using specific equipment. The present system does not serve this purpose.

Action 1: The region and specific interested communities should work with Lake Tech and Southeast Tech to add satellite campuses where needed and funded.

There is precedent for development of satellite campuses. For example, Yankton had a satellite campus of Southeast Tech from 2002 to 2004 until it closed because of slowing training activity. Lake Tech has conducted on-site welding training in Madison. The Corridor needs a committed effort to broaden the geographic availability of training. Communities and counties might share costs in order to spread the cost burden.

Action 2: The region should insure that companies across the region are fully involved and committed to the technical school programs. Advisory councils can help insure that programs are responsive to needs of area companies as well as the students.

Technical schools rely on local employers to build programs that are responsive to local economic needs. With two schools serving the needs of the entire I-29 region it is imperative that employers across the region have input into offerings and programs through advisory councils. The local nature of the schools should not exclude region-wide input.

Action 3: Where a full satellite campus is infeasible, investigate the model used by Yankton at its Regional Technical Education Center that is not part of the technical school system.

The community in Yankton has created a technical center using locally raised funds and grants. Such a program is unlikely to be able to match the infrastructure and services of a state/local funded tech school but can use innovative collaborative arrangements and remote technology to provide services.

Recommendation: Encourage high schools students to take STEM related courses even if they are not planning on matriculating to a four-year university.

Programs that show non-university bound high school students a path to a viable long-term career can increase interest in a rigorous education. Companies, particularly the manufacturing sector, desire STEM skills for more than just their management staff.

Action 1: Continue/expand the development of articulation agreements between the K-12 system and tech schools.

Lake Tech presently has articulation agreements with Lake area high schools within certain programs such as advanced machine tool training. There are also agreements within health care programs that transfer to Lake Tech and Southeast Tech. These programs encourage students to think beyond their high schools experience and plan for rewarding careers within growing economic sectors.

Action 2: Continue/expand the development of articulation agreements between the tech schools and state universities.

Students who had no prior interest in a university often change their minds as they discover their capabilities. Articulation agreements can help those who find they want a four-year degree after all. Lake Tech presently has program-to-program articulation agreements with SDSU. They are narrow and specific and credits transfer as a block from specific programs at Lake Tech to specific degree programs at SDSU. More flexible agreements would be more effective but that would require significant policy changes within the systems. In the long-term the technical school and university systems should look at more flexible programs that respond to the reality that young people are often unready or unable to decide on a final career path.

Recommendation: Help technical school students understand the occupational opportunities within the regional economy.

Action: Include technical school students within the Dakota Seeds program.

Dakota Seeds is a proven success within the undergraduate and graduate school programs at the state's universities. The same kind of program can encourage technical students to see opportunities within their region. Technical school students are not typically as likely to leave their communities but technical school grads in the most in-demand skill areas have employment opportunities across state-lines in Minnesota, Iowa, Nebraska and the strong economy in North Dakota.

Develop Private Sector-Led Networks

Private sector networks can play a number of roles. They are typically most effective when they serve an effective economic region that shares workforce, supply chains, etc. In most cases we recommend that the networks not be shoehorned into a full I-29 region but are developed with an eye to serving the economic sub-region. Region-wide associations are an exception.

Recommendation: The I-29 Task Force should facilitate the creation of region-wide business associations.

Business associations can play a key role in helping communities, regions and states understand the challenges and opportunities they face. They are particularly adept with assisting in drawing attention to needed legislative change or infrastructure and educational needs.

Action 1: The Task Force should begin by convening an Advanced Manufacturing Association within the Corridor

The economic strength and vibrancy of the advanced manufacturing super-sector in combination with the strong local ownership that is committed to the region creates a natural environment for an association. As the geographical center of the super-sector, we suggest the convening of an initial meeting in Brookings to kick off such an effort.

Action 2: The Task Force should examine opportunities for other sectoral-based associations

Once the advanced manufacturing association is created and running the Task Force should use the resulting publicity and energy to engage other major wealth creating economic engines such as finance and life sciences to gauge interest in additional associations.

Recommendation: Sub-regional economic development professionals should facilitate the development of workforce skill networks.

Skill networks are a proven tool to build regional economies. These networks are able to help the educational system, from K-12 through university, understand the existing and emerging skill needs they face.

The most obvious and pressing opportunity is a Brookings and Watertown skills council for advanced manufacturing. Such a council could help with the pressing workforce needs of this vibrant economic engine and also facilitate broader economic cooperation between two communities with much to gain from cooperative action.

Action 1: Use corporate roundtables to build and serve sub-regional skill councils

Some communities, for example Watertown, are developing corporate roundtables to assist them in understanding the needs of their companies. Corporate roundtables consist of the broad range of businesses from manufacturing to service to finance. Skill councils need to be built around a specific industry. The roundtables can bring together the needed businesses to meet and recommend education and training programs.

Entrepreneurship

Throughout our work across the country we find the most resilient economies have a strong environment for entrepreneurship. Entrepreneurship builds on local and regional assets and helps diversify the economy whether in urban or rural areas. The ability to innovate never occurs in vacuum and entrepreneurs inherently respond to the opportunities around them. The I-29 Corridor demonstrates a history of entrepreneurial activity from building advanced manufacturing firms from regional engineering capabilities to responding to the influx of new financial firms by developing innovative IT services to creating a leading ethanol industrial that responds to the existing agricultural base.

Note that we include other entrepreneurial recommendations within the Phase 2 University analysis.

Recommendation: The I-29 Task Force should work within the region to build a better entrepreneurial environment.

Action 1: Develop under-35 entrepreneurship networks that encourage and excite emerging talent

Some communities within the region have seen the creation of networks of young energetic people who are interested in building their economies and improving their communities. Yankton has a thriving network that has been part of the development of the RETC and the creation of a small data center. Other communities should follow the lead. The Task Force and local economic development entities can support these efforts but the young entrepreneurs must own the effort.

The Task Force can assist by recognizing, publicizing and marketing these efforts both with the Corridor and as part of an overall marketing strategy. A key strategy is to find avenues to connect the local networks so that they can learn from the successes and challenges of their peers. Opportunities include the development of business idea competitions with small grants to winners and annual region-wide events to celebrate entrepreneurial success.

Action 2: The I-29 Task Force should investigate the development of a region-wide entrepreneurship council.

A key problem for supporting entrepreneurs is the lack of an organization that *owns* the entrepreneurial space. There are innovative examples of regional entrepreneurship organizations, typically organized as non-profits that have had dramatic impacts on entrepreneurial activity. One of the oldest and most celebrated is the Council for Entrepreneurial Development (CED) in the Research Triangle of North Carolina. Local business leaders established CED in 1984 and today it is seen as the leading arm for developing entrepreneurship. Services include mentoring, networking, connecting companies to investors, holding conferences and developing leadership. The council also serves a key conduit between the universities, their business schools and centers of technology innovation and the entrepreneurial community.

The Task Force role should be to champion the council but not to manage or own it. Business leadership is a key to success. In addition, the development of the council should be mindful of existing entrepreneurial initiatives such as those within the Sioux Falls Development Foundation and university-connected efforts. The council should support and not supplant these efforts. Opportunities for synergy will be apparent.

Action 3: Investigate avenues to create local or sub-regional organizations to own entrepreneurship

Local economic development professionals and Small Business Development Centers (SBDC) rarely have the time or resources to fully support entrepreneurship. Several ED professionals in I-29 voiced frustration that, while they strongly support entrepreneurship as a fundamental part of an effective economic development portfolio, their plates are already full. The SBDCs typically are tasked to assist entrepreneurs with business planning and other services but they rarely if ever can provide broad support or be effective champions.

Local resources are limited and it may be more efficient to create multi-county sub-regional organizations perhaps associated with or created as arms of the recommended entrepreneurship council.

Action 4: Encourage the addition of an effective entrepreneurship program within the technical schools.

Entrepreneurship comes in many forms. Some of the most entrepreneurial business people come from the ranks of companies built on technical skills. The technical schools should investigate the addition of a full range of entrepreneurship training within their programs. The REAL Entrepreneurship training program is a perfect model and has been adopted in 43 states.

Recommendation: Address the earliest stage funding gaps through a proof-of-concept and/or pre-seed fund for the region's universities and technology companies.

Action: The I-29 Corridor Region Task Force should form a sub-committee to plan and lead an initiative to create this I-29 pre-seed fund. It is suggested that the sub-committee be comprised of technology company entrepreneurs and representatives from the risk capital community, technical assistance professionals from technology-based economic development intermediaries (incubators, et al), university and non-profit technology transfer offices. (Note a version of this recommendation is reprised in the Phase 2, University – Community Linkages section of this report that focuses specifically on proof of concept funding.)

Implementation Notes

- The fund should be managed by a non-profit or public-private partnership.
- An initial first round funding target of $2 million is suggested.
- An initial investment range of $10,000 - $100,000 should be explored.
- It is suggested these funds be awarded as investments rather than grants with provisions for some form of "benign" return to help replenish the fund over time.
- This funding should be available for universities, non-profit research institutions and technology companies and entrepreneurs. However, different guidelines, criteria and terms will probably be needed to type.

NOTE: Recommendations and actions that relate to the role of the various innovation intermediaries that define the hard and soft innovation infrastructure can play forging stronger and more fluid connections and networks among the universities innovation intermediaries and private sector companies and entrepreneurs are offered in the second phase of the report.

Creative Economy

While we have not discussed the creative economy within this analysis (it is included in the Phase 2 analysis) we feel that there are opportunities within I-29 corridor to use creativity as an economic development engine.

Recommendation: The I-29 Task Force should investigate and encourage initiatives within the region based on the creative economy.

The creative economy can play a key role in the region's economy. A vibrant creative economy and creative assets is a key quality of life feature. Creativity places a key role in competitiveness particularly with regard to design issues. The region has a perfect example of this in the phenomenal success of Daktronics global reach in stadium and arena displays. Creative assets also play a key role in tourism development, presenting an opportunity within both the rural and urban areas of the region.

This section is closely connected to the creative economy recommendations made in Phase 2.

Action 1: Encourage sub-regional efforts that build on cultural and nature resource assets.

The region boasts any number of assets on which to build. A clear example is the Vermillion to Yankton corridor. In this case, a sub-regional effort to market attractions such as the renowned National Music Museum in Vermillion and the Missouri River National Recreational River could be combined with efforts to build further creative assets – arts, crafts, culinary events – to create a critical mass of tourist options. Such an effort should collaborate with the USD School of Fine Arts and the Beacom School of Business as resources for both the creative and business development assistance.

Action 2: Encourage the development of local food systems as cultural assets

As discussed above local food systems present opportunities to combine the strength of the regional agricultural sector with other needs within the community. Local food systems that increase the availability of local and fresh foods also present opportunities to market the uniqueness of an area. Think of the examples of maple syrup in Maine, wine in California, fine cuisine in New Orleans or cheese in Wisconsin. A local food systems initiative in the Vermillion and Yankton example would add another layer to the attraction. Heritage tourists often look to savor all of a areas unique features. Local farmers markets and restaurants that market their use of local ingredients can be a large part of creating a unique local milieu.

Phase 2: The University and Research Sector

This second phase of the report addresses the role of the area's universities and non-profit research organizations within the I-29 Corridor Region's new economic growth strategy to generate more higher-paying jobs and wealth in communities. It is divided into four sections. As was done in Phase 1, the section begins with a look at the key design specifications that the analysis and recommendations should honor. The second section offers an analysis of the strengths the university and research sector bring to the table as economic development actors as well as the challenges they will most likely need to address to play these roles effectively. The third part of this phase presents findings and lessons learned from a series of four benchmark case studies of university economic development engagement within their communities and regions. The fourth and final Phase 2 section presents a body of basic recommendations, specific actions and implementation notes that define the overall university and research sector strategy.

Five Key Design Specifications

Based on its collective experience over the last 25 years in designing and implementing university-based economic development initiatives, in technology transfer, technology-based entrepreneurship and in running statewide and regional technology-based economic development organizations, the research team crafted five key design recommendations for the university and research sector contribution to the I-29 Corridor region growth strategy.

1. **Entrepreneurial Talent:** Universities can cause companies to start but talented people in the private sector grow them. The plan should support entrepreneurial training and education for university students and faculty, encourage a more entrepreneurial culture within universities, and raise awareness of technology entrepreneurship within the general population.

2. **Strategic Investment:** The plan should focus primarily but not exclusively on the universities' most competitive R&D assets and support them at a scale that allows for success but reserve some room for faculty and programs outside the primary investment areas to create intellectual property, participate in technology transfer activities and foster technology-based companies.

3. **Premeditated Technology Transfer:** Simply bolstering the research enterprise won't work unless you have a good mechanism to move the research outcomes into the private sector. Simply moving the research outcomes into the private sector is inadequate if the intent is grow jobs, companies, incomes and wealth within South Dakota. While licensing a technology to a large, out-of-state multi-national corporation is a victory for the university it is not a victory for South Dakota when the jobs and income are captured elsewhere. In short, we must be good at licensing to, starting and supporting the growth of South Dakota companies. When we talk South Dakota technology transfer we should also ask, "To Whom?" This begs the question of developing strategies to increase the

number of potential private sector licensees for startups and existing South Dakota companies.

4. **University Culture Is Critical:** Those universities that have succeeded in commercializing technology tend to look at the world a little differently. They have different assumptions and perspectives on the world, which are expressed and acted upon in business, government, and the non-profit settings. In a word, they have different cultures. A strategy to foster technology development and technology commercialization must address cultural assumptions concerning entrepreneurial venturing and its apparent conflict with established academic norms. The most significant challenge is NOT to attack or demean those established academic norms, but to articulate strategies and tactics that both support the historic priorities of the university while at the same time support the enhancement of technology development and technology commercialization. Some aspects of organizational culture are a hugely important factor in supporting—or inhibiting—the development and commercialization of new technology in the university environment. If not addressed, it is the torpedo that will sink any technology entrepreneurship strategy, and inhibit the work of an otherwise well conceived technology transfer office.

5. **Networks Are A Very Good Thing:** Excellence of university R&D and the astuteness of university technology transfer offices notwithstanding, early stage technology from academia does not commercialize itself. The processes of technological innovation and commercialization involve an interacting set of organizations and individuals, almost all of whom are external to the research university. They may include: law firms with IP expertise, equity investment firms and solo angels, outsourcing specialists, management and human resource experts, product development specialists, manufacturing engineers, plant designers, and many other experts. In order to facilitate the processes of commercializing academic science and technology, these specialty assets need to be relatively dense within a region—and hopefully adjacent to a university—as well as extensively "networked" with each other.

University And Linked Non-Profit Institutions: Strengths And Challenges

Introduction

This section of the Phase 2 offers a “state and status” analysis of how the university and linked non-profit research sectors in South Dakota are positioned to contribute to the further growth of a high wage, value-adding state economy, with a particular focus on the I-29 corridor. At the onset, it should be emphasized that this analysis will not capture all of the strengths of South Dakota’s university and non-profit research community, but primarily those with clearer economic development potential. This is not to gainsay the great contributions that liberal arts education and scholarship make to maintain the general quality of life in a state and in communities, but for sake of brevity, we will not dwell on those in this analysis. Nonetheless, there is a large body of research that points to the importance of those factors in luring and retaining that “creative class” that is so important in leading those commercial endeavors that will grow and transform a state’s economy. While an examination of the role of universities in defining quality of life and cultural amenities is beyond the scope of this analysis, several aspects of this subject that relate directly to economic development will be addressed later in this section

This analysis will focus on five elements that constitute the primary means by which a university can have positive contributions to its state and regional economic context. They are not independent spheres of activity in the day-to-day function of a university, or a non-profit research organization, but for ease of presentation we will treat them as such. The five elements are:

1. Talent Development and Deployment;
2. Knowledge Development;
3. Knowledge Deployment;
4. Entrepreneurial Culture; and
5. University-Community Linkages

In the next few pages we will further articulate these elements and present quantitative and qualitative data on each of these domains, focusing on the following institutions:

- South Dakota State University
- University of South Dakota
- Dakota State University
- Avera Research Institute
- Sanford Health

Talent Development and Deployment

The average person's conception of a university is that of a place where students take classes, get involved in hands-on extensions of class work (labs, studios) and eventually accumulate enough course credits such they can be certified recipients of a degree in a discipline, with perhaps ancillary evidence of their competence in a major, minor, concentration and so on. From the casual observers' perspective, the performance indicators for this activity usually are expressed in degrees awarded, by areas of study and the like.

There are several potential shortcomings with this seemingly straightforward point of view given the focus of this analysis; we need to be more mindful of the human capital component of economic development. Often the disciplinary structure of universities, and corresponding degree programs, get out of touch with changes in the regional and national economies, and the demands for various new hires by business, industry, government and non-profit sectors. This may be a particularly critical problem when there are major international dislocations in economic affairs, such as globalization or long-term declines in various industries.

A related potential problem is that in virtually any field there will be periods in which rapid changes occur in the underlying premises and methods of a field – in the paradigms that define a field[6]. During those periods universities need to scramble in terms of their personnel practices to make sure that they are current with the directions of science and technology. In the history of science and technology, the centers of cutting-edge inquiry change from institution to institution. While this phenomenon goes beyond this project, it does provide important context.

Another related perturbation regarding university talent production is that in any era there are emerging economic clusters that tend to vacuum up relevant talent from everywhere. These clusters tend to be defined by a convergence of dramatic business and industry growth, convergent fields of technology and entrepreneurial activity. The downside for many universities and states not part of these "hot" trends is that they end up exporting a larger fraction of their college graduates and have relatively poor success in attracting graduates from other states. The net result over time is a gradual degradation of a state's human capital along with a growing diaspora of graduates who moved away from local familial ties to pursue their craft. South Dakota graduates participating in the medical device industries around the Twin Cities is an illustration.

A third qualification to the practice of characterizing universities talent development role as primarily degree production is the fact that state institutions are tied to and derive from a system of publicly-supported K-12 education, which can vary widely in quality and quantity of inputs to higher education. To understand the talent development function of higher education a more systematic approach is often useful.

[6] Kuhn, *The Structure of Scientific Revolutions*

Relevant Data

The data in this section come from four sources: (1) National Science Foundation data from *Science and Engineering Indicators 2010*, particularly that which is organized into State Indicators[7] involving interstate comparisons, including various educational outcomes as well as those covering the deployment of technical talent into the private sector; (2) institutional information from universities located in the I-29 corridor on the scope, and curricular emphases of undergraduate and graduate educational programs; (3) NSF *Institutional Profile* data regarding the graduate degree production of USD and SDSU; and (4) data from either institutional sources or the general research literature on post-graduation employment, particularly state retention vs. out-migration.

Though this information is often closely held by universities, campus alumni databases could be a productive source of relevant information should more in depth research be warranted in the future.

The use of State Indicators (above) to understand talent development activities in the I-29 corridor can be criticized on methodological grounds. For one, statewide statistics are not identical to those that might be available (but are not) that might more accurately describe talent development in the Corridor. Second, using statewide statistics as a proxy for I-29 activities may underestimate the progress and performance within the corridor, since out-of-Corridor university R&D activity and technology-based industries tend to be more sparse. Both of these criticisms are valid to a degree that is unknowable based on available data. However, the use of the State Indicators data has other features that make it extremely powerful. For one, it yields very interesting 50-state benchmark comparisons based on a consistent data collection methodology. Second, it covers the "life cycle" of talent development and deployment, from pre-college schooling (inputs) through the utilization of degree holders in the state work force (deployment). Third, it has the methodological credibility of the primary federal agency that has been gathering and analyzing policy-relevant data on science and technology matters for decades.

Since the Avera Research Institute and Sanford Health are not primarily in the business of offering college-level instruction, they will not be part of this section of the analysis.

The Primary Degree-Granting Institutions

Three universities, located in the I-29 corridor, are the primary foci of this analysis. Capsule organizational summaries follow:

[7] The reader is encouraged to view online Chapter 8 of the recently available edition of *Science and Engineering Indicators 2010* that encompasses over 100 tables and figures of interstate comparisons p://www.nsf.gov/statistics/seind10/pdf/c08.pdf

South Dakota State University (SDSU)

SDSU is the largest university in the state with a fall 2009 enrollment of 12,376, including 1,445 graduate students, with the latter representing a one-year increase of 8.3%. The University, recognized by the Carnegie Foundation as a high research activity research university offering PhD degrees in 12 fields of study, is organized into seven colleges (Agriculture and Biological Sciences, Arts and Sciences, Education and Human Sciences, Engineering, General Studies, Nursing, and Pharmacy) plus the Graduate School. Agriculture and Biological Sciences is the largest College (20.2%). As the State's Land Grant institution, SDSU operates the Agricultural Experiment Station and the Cooperative Extension Services in the state in cooperation with the US Department of Agriculture. A large fraction of both instruction and research is focused on biological systems, natural resources and agriculture. Within the last few years there has been a significant effort to grow research activity in terms of sponsored research support and via the establishment or expansion of doctoral programs. Illustratively, the current Strategic Plan from the Office of the President identifies as Goal #1 to "Enhance academic excellence and strengthen scholarship and artistic activities", and as Goal #2 to "Foster economic growth, vibrant communities, and a sustainable environment." Consistent with the latter, SDSU has recently launched an Entrepreneurial Studies Major, Minor and Certificate program under the Department of Economics. The minor and certificate programs are open to any academic major.

University of South Dakota (USD)

As South Dakota's Liberal Arts university, USD is organized into the College of Liberal Arts & Sciences, the Beacom School of Business, the School of Education, the College of Fine Arts, the School of Health Sciences, the School of Law, the Sanford School of Medicine and the Graduate School. The University also boasts the state's only College of Fine Arts. Fall 2009 total enrollment was 9,617, an increase of 3.5% from the previous year, with 2,004 being graduate students. Graduate enrollment was up 9% in a year, as was non-resident enrollment. USD is the oldest university in the state (1862). USD's Sanford School of Medicine has four campuses. The first two years are spent attending classes at the main university campus in Vermillion. The second two years students learn at partner hospitals in Sioux Falls, Rapid City and Yankton. The Sioux Falls campus houses medical school administration and the clinical departments. Sioux Falls is also home to USD's Biomedical Engineering Program located at the Graduate Education and Applied Research (GEAR) Center.

Dakota State University (DSU)

With a small enrollment of approximately 2,500, DSU would otherwise be of limited economic development significance compared to the flagship institutions (above), except for a very unusual and relatively recent mandate. As per South Dakota Codified Law 13-59-2.2: The primary purpose of DSU ….. Is to provide instruction in computer management, computer information systems, electronic data processing and other related undergraduate and graduate programs. ….

Confirmed and extended by the State Board of Regents, Dakota State has developed a curriculum, the bulk of which is organized around computer-related substance and in turn related to job opportunities in business, industry, education and government. While organized along seemingly standard lines into a College of Education, a College of Business & Information Systems and a College of Arts & Sciences, within each area there are degrees that are information systems oriented (e.g., Digital Arts & Design in liberal arts, a Masters in Educational Technology in the College of Education, Network and Systems Administration in the College of Business & Information Systems). There is a modest contingent of graduate students (roughly 300) and a Doctorate program in information systems is now operating. University officials indicate a placement rate above 90 percent for its graduates.

The Analysis

The next several sections will attempt to describe the talent life cycle in South Dakota. This will include:

- A capsule overview of K-12 education in the state, as a key input to higher education
- A more comprehensive overview of higher education outcomes in terms of baccalaureate and graduate degree production, particularly in science & engineering fields, and with an eye toward how South Dakota fares relative to other states
- An overview of the deployment of talent (degree-holders) into the South Dakota technology workforce
- An analysis of the deployment of South Dakota technology talent away from the state

Inputs to Higher Education

Eight State Indicators from the National Science Foundation deal with early school performance, with states assigned to different quartiles, from 1st (highest-best), to 4th. South Dakota reaches the 1st (best) quartile on six of *these (4th Grade Science Performance; 4th Grade Science Proficiency; 8th Grade Math Performance; 8th Grade Match Proficiency; 8th Grade Science Performance; 8th Grade Science Proficiency*). It reaches the 2nd quartile on *4th Grade Math Performance* and *4th Grade Math Proficiency*.

This is a commendable level of performance, and places South Dakota stride for stride along the likes of Massachusetts, on the majority of these metrics.

Unfortunately, two other NSF State Indicators data tables describe inputs to downstream higher education that are manifested in the K-12 environment are financial inputs to *Elementary and Secondary Public School Current Expenditures as a Share of Gross Domestic Product*, and *Current Expenditures Per Pupil for Elementary and Secondary Public School*s, both of which place South Dakota in the lowest expenditure categories. It should be noted, however, that the linkage between school expenditures and student learning outcomes is not as tight as commonly construed. There is a large body of research literature indicating that this relationship is moderately positive at best. Just scanning the NSF State Indicators data, it is relatively clear that a state like South Dakota does more with less than a state such as California.

However, spending levels may have impacts on programs that do have arguable linkages to higher education outcomes. Thus in the State Indicators on the *Share of Students Taking Advance*

Placement Exams in 2008, and the *Share of Public School Seniors Scoring 3 or Higher on at Least one Advanced Placement Exam* in 2008, the State ranked in the 3rd quartile.

Another end-of-schooling metric of relevance are data from *Diplomas Count 2008* (supported by the Bill & Melinda Gates Foundation), on the graduation rate for the class of 2005, which indicated that South Dakota graduated 75.6%, ranking 18th among the states.

Higher Education Outcomes: Baccalaureate and Graduate Degrees

Many of the State Indicators data from NSF refer to university activity in the natural sciences and engineering (NS&E). By their definition NS&E fields include:

> "…. the physical, earth, ocean, atmospheric, biological, agricultural, and computer sciences; mathematics; and engineering."

Moreover, these are fields that are according to NSF, and appropriate for the objectives of the RTS project, that:

> ". . are fundamental to a knowledge-based, technology-driven economy."

In other words, the more individuals that a state has who are educated in these areas and deployed locally, the more likely that it will be able to be a member of the elite circle of states that are leaders in the "knowledge economy". And in fact, if one looks at the State Indicators tables and figures, one will in fact see places like Colorado, Massachusetts, Maryland and Virginia mentioned. In the case of South Dakota, the situation is more complicated.

In terms of undergraduate educational indices South Dakota looks like at first blush like a Massachusetts. Thus, on an index of *Bachelor's Degrees in Natural Sciences and Engineering per 1,000 Individuals 18-24 Years Old* (2007), South Dakota is in the 1st quartile of states, exceeded only by DC, Rhode Island and Vermont.

For the index of *S&E Degrees as Share of Higher Education Degrees Conferred* (2007), South Dakota is again in the 1st quartile, along with most of the tech-intensive heavies such as California, Colorado, DC, Maryland, New Jersey, Utah, Vermont and Washington. This metric includes both undergraduate and graduate degrees, so that states with more research-intensive schools, with more developed PhD programs, tend to dominate. This metric also includes the social sciences and psychology.

A third metric is *Natural Sciences and Engineering Degrees as Share of Higher Education Degrees Conferred* (2007), which involves the more restrictive definition of the field, but also includes graduate degrees. South Dakota again was in the 1st quartile. So far so good, but now the situation gets more complicated when one turns more exclusively to graduate education outcomes.

Four things are important to note at the outset in looking more closely at graduate education outcomes. For one, graduate education in the natural sciences and engineering – particularly at the doctoral level – is virtually impossible to execute in the absence of large amounts of external research funding, typically from federal agencies. Second, during the 1979-2003 period, resource allocation to undergraduate education dominated with reductions of resources to graduate education and research being implemented. A recent policy shift at the state level has now put that mix more in balance such that South Dakota's flagship universities (SDSU and USD) look more like their peers in other states. Third, generally speaking the university's influence on the growth of a commercial technology sector outside its gates is much more sensitive to the volume of research and research-related activities, such as patenting, local licensing, tech-based startups and conducting contract research with companies in the region. Fourth, in order to have impacts on regional economic development, graduate education needs to be aligned to the dynamic changes in a technology-based, knowledge economy.

There are three State Indicator metrics of relevance here, all of which are based on FY 2007 data. The measure of *Science & Engineering (S&E) Graduate Students per 1,000 Individuals 25-34 Years Old* puts South Dakota in the 3rd quartile among the states. The measure of *Advanced S&E Degrees as Share of S&E Degrees Conferred* puts South Dakota in the 4th and the last quartile. The measure of *Advanced Natural Sciences and Engineering Degrees as Share of Natural Science and Engineering Degrees Conferred* places South Dakota in the 4th quartile. These tables and figures tend to simplify a complexity of organizational influences and decisions, but they sum up to a relative neglect of graduate education. In other parts of this analysis of University Strengths and Challenges, these relatively modest levels of graduate education parallel relatively modest levels of sponsored research activities.

Looking at graduate education at an institutional level, via the NSF *Institutional Profiles* database the picture above is reinforced. Thus, South Dakota State ranks 297th nationally in the number of doctoral recipients (FY 2006), with a yield of 14, which is less than in FY 1997. Of these 6 were in agricultural sciences, 3 in biological sciences, 3 in the social sciences and 2 others in chemistry and health respectively. In terms of full-time graduate students (including masters candidates) enrolled, there were 399 in fall of 2006, which ranked 259th and is essentially dead even with the head count in 1996. The largest fraction of graduate students by far was in the agricultural sciences, followed by the social sciences. This disciplinary breakdown was paralleled among the doctoral awards. It should be noted that these NSF data are somewhat stale in that they do not reflect significant program changes over the past three years. Nonetheless, the graduate education activities of the recent past will be most relevant to the current status of the South Dakota knowledge economy.

The picture at University of South Dakota was very similar, with the exception that there is as distinctly different mix of disciplines involved in graduate education.

Thus, with a total of 52 doctorate recipients USD ranked 184th nationally, with 33 of those in education, 16 in the biological sciences and 9 in psychology. Similarly, with 375 graduate students enrolled in fall of 2006, it ranked 267th nationally. Of these, 163 were in health fields, 76 were in the biological sciences, 63 were in psychology and 34 were in the social sciences.

Deployment of Talent I: The South Dakota Technology Workforce

One of the key definers of technology-based economy is the human capital deployed. Usually, that means the extent to which trained, talented individuals are present and prominent in the work force. In other words, if one gets in a three-car fender-bender in Palo Alto or Boston, there is a non-zero chance that it might involve one angel investor, a software engineer and a materials scientist. For the economic future of South Dakota, it would preferable that similar encounters were more frequent (minus the accident).

Several State Indicators metrics that are focused on university degree-holders are instructive. One is Employed Science & Engineering Doctorate Holders as Share of Workforce (2006), in which South Dakota is in the 4th quartile, 48th out of 52, with Arkansas, Florida, Nevada and Puerto Rico lower. Looking at Engineers as Share of Workforce (2008), South Dakota is again in the 4th quartile, with only Arkansas lower. Computer Specialists as Share of Workforce (2008) is a 3rd quartile placement for South Dakota.

One occupational metric, *Life and Physical Scientists as Share of Workforce* (2008) identified South Dakota as in the 1st first quartile. However, the ranking methodology is somewhat unclear given the wide range of occupational codes involved, that includes within life scientist disparate occupations such as medical scientist and foresters, food scientists and biological scientists. This disparity may in fact correspond well to the state's historical strengths in agriculture and food production, as well as its emerging strengths in biomedical innovation. The physical scientist category is somewhat less diverse.

One final metric among the State Indictors to consider is the Individuals in *Science & Engineering occupations as Share of Workforce* (2008). This is a more inclusive term that encompasses the more focused occupational codes discussed above. It is, in effect, a proxy of the extent to which a technology-based economy exists in the state. South Dakota places in the 4th quartile, and only exceeds the performance of the following states: Arkansas, Louisiana, Maine, Mississippi, Nevada, North Dakota (barely), Tennessee, Texas (surprisingly), West Virginia and Puerto Rico.

If then there is a weak employment opportunity structure for such jobs in the state, where does the reasonably robust supply of baccalaureate graduates from South Dakota universities go for work? This is where the out-of-state deployment of talent comes into play.

Deployment of Talent II: The Diaspora

There is a relatively robust field of interstate migration studies and policy analysis. Terms such as "leavers" and "stayers" abound. Thus leavers are those individuals who leave the state of their birth, or where they earned a BS degree, for career opportunities. Stayers are those who get a job where they got their degree, or were born, and may stay a lifetime.

At another level of analysis, states themselves can be described as "magnets" for leavers from others states or as "sticky" in terms of keeping their own graduates. So what do we know about these processes generally and South Dakota specifically?

Regarding the latter, two studies[8] conducted by the Southern Technology Council have been important. Two indices produced by the study, based on a NSF national database of recent

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[8] Tornatzky, L., Gray, D., Tarant, S., Zimmer, C. Who Will Stay and Who Will Leave?, Research Triangle Park, NC: Southern Technology Council, 2001; Tornatzky, L. Gray, D., Tarant, S. and Howe, J. Where Have All the Students

science and engineering graduates, are telling. One, *net migration/most recent degree*, was computed for all 50 states as a composite of the number of students who received a BS level degree in a target state and stayed on in the state, plus those who received a degree elsewhere, but who took a job thereafter in that state. South Dakota scored in the 4th quartile. A parallel index comprised a composite of students who received a high school degree in the target state and then ended up working there post-college, plus students who went to high school elsewhere but ended up working in the target state. South Dakota also scored in the 4th quartile on this measure as well. More recent analysis by the Pew Research Center's Social & Demographic Trends Project[9] characterizes South Dakota as a Low Magnet/Low Sticky. Ranking 30th on the sticky scale, in terms of the state's ability to retain residents and 47th on its success in drawing people from elsewhere. These rankings would suggest that South Dakota has much more room to improve on the magnet index and exploring creative ways to lure former South Dakotans back.

There is a growing understanding of both retention and attraction of the technologically talented component of interstate migration. Thus, the Southern Technology Council analysis indicated that if a person went both to high school and college in a state, their likelihood of staying on in employment would increase 4-fold than if they just went to college there (arguing for targeted incentives for the best-brightest HS students). It was also found that non-US nationals are more likely to stay on after college graduation. Factors that deterred retention after graduation tended to point to credentials such as a higher GPA and a technology-intensive major, which would make a student more attractive in a larger market. Lower population states are at a disadvantage to more populous states, while attending a college in an urban area seems to encourage retention.

Looking at human capital aggregation more generally, a recent Federal Reserve Bank analysis[10] indicted that the amount of research conducted by a university is a much more robust predictor than the volume of degrees produced. Another analysis[11] considered over 303 counties/rural areas in 18 states, including South Dakota, and concluded that "movers" (from other states) are on average more highly educated than the target destination, but are more attracted to the areas that have a population with a higher average educational level. This finding was confirmed and expanded upon in an analysis[12] of another NSF database that included PhD-level migrants, which also pointed out the importance of the educational level of the potential migration destination as well as – for PhD-level individuals – the amenities available there. Foreign

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Gone? Interstate Migration of Recent Science and Engineering Graduates. Research Triangle Park, NC: Southern Technology Council, 1998

[9] Cohn, D. Magnet or Sticky? A State-by-State Typology http://pewsocialtrends.org/pubs/728/magnet-sticky-states-typology

[10] Abel, J. and Dietz, R. Do Colleges and Universities Increase Their Region's Human Capital? Federal Reserve Bank of New York. Staff Report no. 401, October 2009.

[11] Waldorf, B. Is Human capital accumulation a self-propelling process? Comparing educational attainment levels of movers and stayers. Annals of Regional Science (2009) 43: 323-344.

[12] Gottlieb, P. and Joseph, G. College-to-work migration of technology graduates and holders of doctorates within the United States. Journal of Regional Science, Vol. 48, No.4, 2006, pp.627-659.

graduates will also migrate to places to where there are resident pockets of their own nationality.

There is one additional issue that needs to be mentioned and is worthy of additional study. That is, what is the extent and nature of "claw back" or "returnees" in terms of human capital? People do leave South Dakota, and based on population pyramid estimates for 2020, for South Dakota and the nation, those leaving the state seem to be in the 18-24 age range, with commensurate estimated reduction in the under 18 age range. However, we do know that people do come back, and many of those with significant talents acquired and honed elsewhere. These circumstances may well point to a potential strategy for the state and the I-29 corridor in this area.

Findings: Talent Development and Deployment

- The three universities in the I-29 region have distinctly different missions, profiles and economic development engagement strengths that can lead to very different roles in regional development.
- South Dakota, compared to the rest of the nation has a good to excellent K-12 education based on test scores, retention and college-attendance.
- South Dakota's colleges and universities (particularly in the I-29 corridor), turn out significant numbers of science and technology-oriented degrees at the baccalaureate level and compare favorably to other states.
- South Dakota's production of science and technology-oriented degrees at the graduate level has not been on a par with other states, although there has been an accelerated effort in that area in recent years.
- The South Dakota economy, compared to other states, employs relatively fewer degreed individuals, at every level and particularly in the sciences and engineering.
- South Dakota, compared to other states, seems to export relatively more of its talented young people with baccalaureate degrees.
- South Dakota, compared with other states, seems to be a relatively poor "magnet" for talent from elsewhere.

Knowledge Development

For the purposes of this initiative, this analysis focuses on the aspect of knowledge development that, once deployed, can generate new value in the marketplace and increase value added per worker, gross profit margins and salaries and earnings. To this end then, the emphasis is on developing value-generating knowledge that can be embodied in people (see talent development), and in existing and future companies, products, processes and services within the I-29 corridor economies. It is by its very nature, research driven. It is either created through research or imparted because of research.

Looking at the university environment from a regional economic development perspective, the relevant outcome metric addresses the quantity and quality of university-based research and development activity, and in particular R&D which involves external funding from either government, industry or other third party sources such as foundations. These measures and assessments can deliver two important pieces of information. First, they can calibrate the overall capacity of the institution to develop research-driven knowledge. Second, in what is today a very resource constrained environment, it can be used to identify high performing programs and disciplines for strategic investment from an economic development standpoint.

National Sources

To begin this kind of analysis, the first and most obvious starting point are indicators of research output and productivity published and vetted by national sources. These data can shed some light on where the overall research capacity of institutions of higher learning reside relative to their peers as well as spotlight any specific programs, disciplines, or sub-disciplines that have achieved some national ranking status.

In terms of most academic disciplines and in most universities, research that is enabled via a national competition of proposals tends to win more esteem than that which is supported by internal funds. It tends to be an important underlying metric when universities are assigned to various "tiers" of excellence. It should be noted that looking nationally, roughly 80% of US academic research is conducted by the "top 100" universities.

Another indicator of the quality of R&D, which is somewhat more difficult to track is the extent to which resultant publications are influential in a field of study, often indicated by citation indices, and by publication in a top-tier peer reviewed journal. Some of this information is captured by national sources such as Academic Analytics' Faculty Scholarly Productivity Index. While national rankings in scholarly productivity certainly add value to the overall research milieu for institutions and programs, in some instances it is not clear how these indices translate into economic impact.

Other indicators of R&D are arguably more important for economic impact. For example, which federal funding agency is most involved in a body of sponsored work may be indicative. Some federal agencies tend to support work and in fields with dubious commercial potential, such as Department of Energy weapons research conducted during the peak of the Cold War. On the other hand, source of funding is a slippery predictor and one must look closely at the actual R&D being performed. Thus, National Institutes of Health research support can range from work on health systems design to projects focusing on new bioactive materials for use in medical devices, with somewhat different implications for commercialization potential and growing companies and jobs in South Dakota.

There are two other related nationally sourced metrics that need to be commented on since they have implications for economic impacts. For example, in the National Science Foundation data and other data that will be cited below, there are different amounts noted in a given year for "expenditures" versus research "awards" or "obligations." The reality of externally funded university research is that major grants tend to be multi-year in nature, which makes expenditures a lagging indicator. Thus the initial year of a large project may be a ramp-up period in which temporary research staff such as research associates, post-docs or graduate students are brought on board, with subsequent years devoted to full bore activities. One thing to note however is the size of the disparity between expenditures and awards. If there are large and growing increases in grants awarded (many of which will be multi-year) the expenditures associated with executing those projects will necessarily increase as the projects unfold, much of which will involve adding talented people to the local work force (human capital). It may be that new senior administrators have arrived and are creating incentives and a culture of expectations that sponsored research is a key mission priority. It may be that the university is going through a period in which "franchise hires" are being executed, whereby nationally prominent research professors are being lured to campus, and bringing a portfolio of already funded projects with them, along with functioning as a role model for other faculty to emulate.

On-the-Ground Analyses and Self-Assessments

A second and important information source are self-assessments and on-the-ground analyses that can pick up data that are not reported to or typically captured by the national sources but may well be emergent or very high economic development value. This is especially true when dealing with the several hundred universities outside the top research tiers. For instance, one metric of R&D that may often have particular relevance for regional and state economic development is the amount of sponsored research that is funded by industry. Industry-sponsored research is typically more closely tied to current and emerging commercial opportunity and is consistently characterized in academic literature as the single best indicator of local or regional innovation capacity. While some of this may be reported to national sources such as the NSF, the state, status and potential economic value of the work can only be understood through on-the-ground analysis.

Changing the level of R&D productivity at a university is a very difficult task. When it happens, government, industry and the general public should pay attention. Long-term positive impacts for a state or region are possible.

Relevant Data

For the most part the awards and expenditures-related data reported here are drawn from National Science Foundation (NSF) statistics, in particular tables entitled *Academic Institutional Profiles* and *Academic Research and Development Expenditures (2007).* These data were supplemented by online searchable databases from the National Institutes of Health (RePORT) and a recently developed government-wide search engine, USA Spending.gov. Other data were obtained directly from the South Dakota-based organizations and institutions themselves.

Other data sources investigated for measures, assessments and rankings at the institutional, program/discipline and faculty level include *U.S. News & World Report America's Best Colleges 2010*, *The Chronicle of Higher Education* (Academic Analytics) *Faculty Scholarly Productivity Index 2007*, the Carnegie Foundation for the Advancement of Teaching, the Center for Measuring University Performance, *The Top American Research Universities 2008 Annual Report*, and the

National Research Council's (NRC) Reputational Rankings. The NRC source was consulted and discarded as these data have not been updated sine 1995. A report is anticipated later this year.

South Dakota State University

The university reported a FY2006 total of $33.3M in research expenditures in science and engineering (from all sources), with federal agencies accounting for $12.8M, state and local government for a surprising $11.7M, "all other sources" for $5.8M and institutional funds support of $2.5M. Only $560K of FY2006 R&D expenditures was funded by industry, a very small 1.6% of the total, which has implications for industry partnering in the service of regional development. Of the $12.8M in federally sponsored expenditures, approximately half ($6.1M) was in the agricultural sciences, another $2.4M was in the non-medical life sciences and $938K was in the biological sciences. A notable $1.3M was expended in electrical engineering, far and away the sponsored research leader in the College of Engineering, which totaled $1.8M across all engineering areas in FY2006.

These data are somewhat contradicted by looking at the comparative growth of R&D expenditures by source. While the growth of total expenditures over the four years prior to FY2006 was 66.5% the increase in federal sponsorship was a somewhat smaller 40%. Interestingly, the investment of institutional funds more than doubled, while the "other sources" category increased from $1.4M to $5.8M between FY2002 and FY2006.

The 2007 NSF update of SDSU total research expenditures indicated an increase to just over $39M which is a laudatory jump of $5.7M or 17% from FY2006. This total ranked 183rd nationally. It is also notable to look at longer term trends, revealed by the same NSF data. FY 2000 research expenditures at SDSU were $16.8M, reflecting a 132% increase from then to FY2007 totals. This is a particularly notable record given that the expenditure increases were quite modest during the middle of this decade. The FY2007 update data also point to the preponderance of R&D focused on the life sciences, broadly construed ($31.4M out of $39M) and a near doubling of expenditures in engineering (from $1.8M in FY2006 to $3.3M in FY2007).

In terms of federal funding obligations in the FY2006 data (which includes unspent future budgeted amounts) and which totaled $22.9M, the largest fraction came from the Department of Agriculture ($9.3M), followed by the Department of Defense ($6.2M), the Department of Health and Human Services ($2.4M) and $3.3M from NSF. Of particular note, the federal obligations from the Department of Agriculture was not all for R&D support, with $4.1M dedicated to "other" activities, which typically means extension support. State support noted above for the 2006 expenditure data is presumably dedicated to similar activities.

Specific Research Strengths

Based on a combination of interviews with faculty and university officials, self-assessment data and internal publications, previous external analyses, Internet and publications search and examination of information from nationals sources, the research team identified the below listed areas of evident and specific academic research strength. For the most part, applications for these strengths are oriented toward life sciences-related and biomed-related markets with some of the engineering applications being the exception. It should be noted that although Veterinary and Plant Sciences are historical and familiar research strength areas, they continue to represent very strong research capacity for applications in very large national and international markets. As mentioned later in this document's technology transfer discussion, SDSU's ownership position in swine virus vaccine has been a substantive royalty producer.

- Veterinary Sciences including vaccines and animal models
- Plant Sciences including plant/crop breeding, dedicated energy crops
- Electrical Engineering including Photovoltaics
- South Dakota State University (SDSU)/United States Geological Survey Earth Resources Observation and Science (USGS/EROS) Geographic Information Science Center of Excellence
- Materials Science including non-destructive testing
- Pharmaceutical Sciences

University of South Dakota

As per NSF sources, USD reported a FY2006 total of $22.6M in research expenditures in science and engineering (from all funding sources), with federal agencies accounting for $17.3M. The same NSF data set (Institutional Profiles). USD reported zero R&D expenditures from industry for FY2006 and for the previous four years.

The vast majority ($15.3M) of USD's federally supported 2006 expenditures were in the medical sciences, with the closest expenditures being in the biological sciences ($887K) and chemistry ($665K). Research expenditures in 2006 of $2.4M came from state or local government, and as noted there were no industry-sponsored research expenditures. The NSF FY2007 update on total research expenditures indicates essentially no growth between 2006-2007 and in fact a slight decline to $21.5M. This is not unusual for universities with a modest research portfolio, in which the completion of a few major grants may not be accompanied by ramp-up of new awards.

However, this anomaly should be put in context. For example, one additional notable (and positive) metric regarding expenditures data is the long-term growth rate of the USD research enterprise. In FY2000 USD reported $4.7M in R&D expenditures that grew to $21.5M in FY2007. This represents a phenomenal 357% increase over 7 years. It should also be noted that $13.4M of that increase was in the medical sciences.

In terms of federal funding obligations (which includes unspent future budgeted amounts) the FY2006 NSF data indicated a total of $13.9M, virtually all ($13M) of that coming from the Department of Health and Human Services, plus a modest $589K from NASA and $489K from NSF. However, since the NSF data on funding obligations is considerably dated, it is useful to look at more recent local information.

The Office of Research & Sponsored Programs at USD has recently published its own analytic report[13] that expands on these NSF data. The data therein are in terms of proposals and awards

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[13] Office of Research and Sponsored Programs, University of South Dakota. FY2009 Grants and Contracts Report. Annual Report on Externally Sponsored Projects. November 2, 2009.

and reinforce the growth trends described above. For FY2009 there was $28.4M in awards, with the School of Medicine accounted for $13.9M, the College of Arts of Sciences accounting for $8.4M, primarily in Earth Sciences and Physics ($3.5M), Chemistry ($2.3M), Biology ($824K) and Psychology ($801K). Within the School of Medicine awards, Basic Medical Sciences accounted for $4.9M, Center for Disabilities $2.8M and Sanford Research/USD $5.2M.

Specific Research Strengths

Based on a combination of interviews with faculty and university officials, self-assessment data and internal publications, previous external analyses, Internet and publications search and examination of information from nationals sources, the research team identified the below listed areas of evident and specific academic research strength. As was the case with SDSU, for the most part, applications for these strengths are oriented toward life sciences-related and biomed-related markets with some of the engineering and materials applications associated with light-activated materials and biomedical engineering being the exceptions. In addition, Fine Arts is a special case and requires further explanation as offered below.

- Neuroscience
- Behavioral Sciences including Clinical Psychology
- Biomedical Engineering
- Light Activated Materials (including Photovoltaics)
- Fine Arts*

*Though not in the science or engineering domains, as will be discussed later in this section, there are some circumstances where strength in arts and design can represent a significant economic development asset.

Dakota State University

With its tightly focused mission, Dakota State University emphasizes programs in computer management, computer information systems, and related programs. In view of the university's size the university is not represented in any NSF database dealing with research expenditures or support, thus there are no comparative data that are standardized.

Specific Research Strengths

While DSU does offer a PhD program in Information Systems, it has historically operated as primarily a small undergraduate teaching institution. In recent years the university leadership has begun to emphasize building more of an applied research profile with some good results. Dakota State reports $1.8M in FY2007 research awards. Building on this success, university officials indicate that Dakota State has made applied research consistent with their information technology mission, a priority. To that end, the university's strategic plan adopts a grant/contract 2012 funding goal of $5M.

- Information Systems
- Health Informatics
- Information Assurance

- Digital Arts and Design

Avera Research Institute

The Avera Research Institute operates as a department within Avera McKennan Hospital and University Research Center. Avera reports operating R&D revenues of $3,271,614 for 2009 and projects 2010 revenues at $3,957,406.

Specific Research Strengths

- Photochemical tissue bonding compounds (numerous application areas
- Neuroscience research
- Kidney disease, filtration and growth
- Clinical trials: The Avera Research Institute is conducting multiple industry sponsored Phase II, III, and IV clinical drug trials involving a wide range of therapeutic areas. These studies test new drugs or medical devices to evaluate their safety and efficacy both prior to and after approval by the Food and Drug Administration

Sanford Research

Sanford Research was created as a non-profit research organization by Sanford Health and the University of South Dakota in 1998. In 2007 Sanford Research received a $400 million gift to expand research operations with the intent of becoming one of this country's top research institutions. Sanford Research has a series of dedicated research centers. However, its major mission component is to cure type 1 (juvenile) diabetes. Sanford Health has acquired a former technology manufacturing center site and is renovating the 299,000 square foot facility to convert to research space to house the Sanford Research operation. The facility is located on a 71-acree campus with ample room for expansion.

Sanford Research provided the project team with research expenditure data and some information on sources. While not directly comparable to the data reported to NSF by USD and SDSU and cited above, nonetheless the trends are quite interesting indeed, indicating a doubling of expenditures and grants/contracts. Their goal is $100 million/year in research by 2017. They have gone form $1M to $10M in the last 10 years.

Table XX: Sanford Research, 2007-09

Year	Total Research Expenditures	Total Grants Contracts
2007	$5,833,786	$3,146,916
2008	$8,969,767	$4,674,165
2009	11,272,459	$6,812,798

Organizing the 2009 data by domain and disorder, the largest category of expenditures was in cardiovascular research.

Specific Research Strengths

- Cardiovascular health
- Cancer biology
- Genomics
- Pediatrics
- Metabolism / nutrition
- Women's health
- Clinical trials: Sanford Research operates an active clinical trials center with a Phase 1 focus.

A Scan of Various Published National Ranking Sources for University Research and Research Disciplines

The object of this portion of the examination is not to construct a comprehensive rankings profile distilled from the various approaches and services but to develop some sense in what domains, if any, these universities with modest sponsored research profiles might register in national sources and publications other than the NSF and NIH. Any findings here might signal some areas of R&D strength that are worth further investigation. Among the sources consulted were the National Research Council, *US News and World Report* and the *Chronicle of Higher Education* (Academic Analytics Faculty Scholarly Productivity Index) and The Center for Measuring University Performance's *2008 Top American Research Universities Report.*

As *US News and World Report* Tier 3 and 4 research schools, The University of South Dakota and South Dakota State University and their various departments, disciplines and sub-disciplines would not be expected to appear in the upper echelons of the various ranking services and approaches nor did they. For the most part, though they were often listed, they did not receive a numerical score or rankings. There were a few exceptions including South Dakota State's Graduate Pharmacy Program (*US News and World Report,* 2008 Ranking 61) South Dakota State's Graduate Nursing Program (*US News and World Report*, 2007 Ranking 95) and the University of South Dakota's Graduate School of Clinical Psychology (*US News and World Report*, 2008 Ranking 116).

South Dakota State University and The University of South Dakota also received research level classifications from the Carnegie Foundation for Advancement of Teaching. Carnegie's research level classification system is applied to doctorate-granting institutions that award at least 20 doctorates a year and is derived from an index that takes into account aggregate institutional

R&D expenditures and per capita (full time faculty) institutional R&D expenditures. The classification assignments are based on 2003-2004 data. There are three classification levels:

1. RU/VH: Research Universities/Very high research activities – 96 universities are included in this category.

2. RU/H: Research University/High research activity – 103 universities are included in this category including South Dakota State University.

3. DRU: Doctoral/Research University – 84 universities are included in this category in The University of South Dakota.

The Center for Measuring University Performance's *2008 Top American Research Universities Report* also includes a listing of the top 200 universities for Federal research expenditures and for total research expenditures for 2006. No South Dakota universities were included these listings.

Findings: Knowledge Development

- The lack of emphasis on research and graduate programs within the state's universities during the 80's and 90's has constrained the region's capacity to produce and support knowledge-intensive, higher value commerce jobs and companies and placed the universities in a catch-up position relative to their peers throughout the country.

- After this twenty year hiatus in state-based research & development, South Dakota's universities and private non-profit organizations are making significant gains in building a research infrastructure, becoming competitive in winning R&D grants and contracts and increasing the scope of research expenditures and activities.

- Private sector R&D support is one of the strongest indicators of innovation capacity. There is a low level of private research support within the region's universities. This is not surprising as the resurgence of research programs, graduate programs and research faculty is a recent occurrence.

- While there is growing across-the-board excellence in R&D, the most nationally competitive area of knowledge development lies in the life sciences – broadly defined. Electrical engineering should also be noted as a strength area.

- While growing R&D generally, it has become increasingly obvious that the state's research organizations cannot be nationally competitive in a wide array of areas, but must "pick their spots" carefully toward niche areas of expertise and opportunity.

- Areas of R&D that cut across traditional disciplines and are often expressed in interdisciplinary Centers, Institutes and programs hold particular promise for the state's research community.

- The growth of R&D provides much greater economic development impact than just the hiring of PhDs and functions as a powerful multiplier in terms of opportunities for new college graduates, experienced support personnel and more general economic activity.

- The leveraging power of upfront "investment capital" to build programs and attract talent has been illustrated by the Sanford endowment and provides a model that could be emulated.

Knowledge Deployment

As previously discussed, this analysis is focused on identifying, organizing and leveraging the most productive assets and roles for higher education and research institutions within a regional growth strategy for the I-29 Corridor. There are several ways that knowledge emanating from universities can reach and impact the private sector of a state. One is through the "embodied knowledge" that graduates carry forward and apply in their jobs after graduation. Of course, if graduates leave the state that mode of knowledge dissemination is lost. This is discussed above. Another time-honored deployment mode is through publication and public presentation. For the purposes of this initiative though two modes are of specific interest because their explicit and only purpose is to produce private sector economic outcomes. One is direct outreach to business and industry and the other is technology transfer.

Outreach

This knowledge deployment activity disseminates practical, research-based knowledge using publicly funded outreach and education programs -- the most prominent example being this country's Cooperative Extension System with its national network of land-grant colleges and universities and state and county offices. Agricultural extension has engaged with agricultural producers, small business owners, consumers, and youth in rural areas throughout the U.S. for a century and is often credited with ushering in the age of modern agriculture in the US and the world. Certainly, this is the case in South Dakota with its statewide Cooperative Extension Service and its strong Cooperative Extension program at South Dakota State University as well as the South Dakota Crop Improvement Association (SDCIA) which is administered within the Plant Science Department in the South Dakota State University College of Agriculture and Biological Sciences.

More germane to this analysis is yet another national knowledge deployment outreach network – the Manufacturing Extension Partnership (MEP). The MEP is essentially the United States' industrial extension service. It exists to strengthen this country's industrial base. Like agricultural extension, the original goal of the manufacturing extension deployment model was to disseminate knowledge into the public domain and distribute it through outreach rather than through markets. In the MEP's case, this approach has been modified over time to include affordable fee-for-services activities as well. Housed within the U.S. Department of Commerce's National Institute of Standards and Technology (NIST), the MEP program has a presence in all 50 states with 59 manufacturing extension centers and several hundred satellite offices. Each center works directly with local companies to help them identify and implement productivity, efficiency and business practice and process improvements. The centers themselves comprise a diverse network of non-profit, state-based, and university-based organizations. The federal government provides one-third of their funding through NIST-MEP. The other two thirds comes from a combination of state funds, funds from the non-profit partners and from fees paid by manufacturers for the services they receive.

While the national industrial extension network is only about 20 years old, the concept of direct university-based outreach to manufacturers has a rich history of accomplishment dating back to the 1950s with land grant university-based industrial extension services in North Carolina (North Carolina State), Georgia (Georgia Tech) and Texas (Texas A&M).

Relevant Data

Outreach or extension to firms as a university-based knowledge deployment mechanism in South Dakota and the I-29 Corridor, when compared to other states and regions, is limited. During its on-site meetings and interviews, the project team was briefed on or learned of a number of university- to-business technical assistance connections. These connections were occurring through the day-to-day efforts of individual faculty members, department chairs, deans, technology transfer or research-related administrators and so on. The College of Engineering also has an external advisory board that meets at least once a year for each one of its programs. In addition, all College of Engineering senior undergraduates are required to complete a capstone project that is often sponsored by local employers. There is a good bit of outreach interaction with regional industry and, no doubt, these activities are an important part of the region's economic development fabric. However, in view of funding levels and, in some cases, by their very nature, they are not scalable or routinely structured to systematically respond to the needs of the region's manufacturing community – especially the very strong advanced manufacturing presence in the Sioux Falls, Brookings, Watertown and Yankton communities. There is no organized university-based manufacturing outreach presence either through a formal industrial extension program or through affiliation with the national extension system - the MEP. The MEP presence in a number of states is established through university–based centers.

The actual MEP presence through the national network is constrained in South Dakota and the I-29 region when compared to other states because South Dakota is the only state without an MEP Center being physically located in the state. MEP services for South Dakota are delivered through the Dakota MEP, which is headquartered in Bismarck, North Dakota with another staffed office in Fargo. It maintains a presence in South Dakota through MEP consultants/contractors in Sioux Falls and Watertown. Of the fourteen Dakota MEP staff members listed on the organization's web site, only the two individuals listed mentioned above are located in South Dakota. The South Dakota partner and funding contributor for the Dakota MEP is the South Dakota Governor's Office of Economic Development.

Another less obvious but nonetheless important university outreach activity focuses on the creativity, arts and design as an economic development force. In recent years, the importance of art and design in promulgating economic growth in a region has begun to be recognized. Quality arts and entertainment can attract businesses and residents to a community. And arts are not just an amenity—design-intensive products allow regions to compete beyond just making things cheaper—regions can excel developing products that gain competitive advantage because they are created using a process that reflects the region it was built; for example, crafted wooden doors in Montana that retail for thousands of dollars or mass produced hot sauce in Louisiana that is marketed around the world.

In many regions of the country, universities are leading the charge in helping the creative economy prosper. Whether it be the University of Southern Mississippi which helps its students learn how to run their own music label or North Carolina State University which teaches advanced design techniques to individuals hoping to craft new furniture or community colleges around the country that work with businesses to develop new design techniques, post-secondary institutions can and do play a major role in the development of the creative economy. University-based creative arts and design outreach activities include assistance to companies in adding value to products through design (this service could be delivered through existing industrial extension channels where they exist) and work with non-profit and public en entities to develop a community's cultural amenity profile. It is important to note that the type of outreach activity described above focuses on creative enterprise as opposed to "creative classes" of individuals.

Technology Transfer

Third is a more exotic and novel mode of university knowledge deployment activities that has only been practiced on a wide scale among US universities since the early 1980s. Known as "technology transfer" it is typically tied to cutting-edge research that may result in novel inventions with commercial potential, and in turn intellectual property protection via patenting, copyrighting or other means and various combinations thereof. Enabled by the Bayh-Dole legislation of 1980, universities are now authorized (and in fact encouraged by the history of legislative intent) to evaluate faculty inventions derived from federally-funded research and protect them it commercialization potential exists, then commercialize them via licensing arrangements and also mandated to share proceeds with faculty inventors.

The key part of the overall process is to "transfer" the protected invention into the hands of private sector entities that can add significant value. It should be noted here that "technology transfer" is a somewhat archaic term that connotes a process that is much more orderly than it really is. The processes of technological innovation – a better term - are much more chaotic, overlapping and involve many more actors than technology transfer metaphors imply. In fact, those universities that do well at this tend to staff and operate their technology transfer offices accordingly.

Nonetheless, there are typically two technology transfer paths or trajectories that have different implications for state and regional economic development impacts. One is to license inventions to already established, often-larger national companies that can commercialize them via enhancement of their product lines and/or via process improvements. The typical payback to the university (and inventor) is via royalties on sales and other fees. From an economic development perspective, economic development in terms of job and wealth creation in the state where the university is located and the invention was developed are often fleeting or absent. Thus, for example, a hypothetical license to an out-of-state corporation may be a victory for the university but not necessarily a victory for the state, if jobs and income generated by the licensee are created elsewhere.

The second university technology transfer trajectory has become more prominent in the past 15-20 years, particularly as changing research directions have yielded inventions that may be both unsettling for large established corporations but ideal for development by fast-moving startup companies. Some universities have become particularly adept at this, in particular Stanford, MIT, Cal Tech, Florida and a few others. Their contiguous regions are richer as a result of the traffic. Their experience suggests that when we talk about or encourage South Dakota technology transfer we should also ask, "To Whom?" This begs the question of developing strategies to increase the number of potential private sector licensees for startups and existing South Dakota companies. Another caution is the potential deal flow of commercially viable technologies emerging from South Dakota universities, both now and in the foreseeable future.

Relevant Data

One of the most comprehensive sources of quantitative data on university technology transfer are the reports periodically compiled and issued by the Association of University Technology Managers (AUTM). Among other information, these reports provide useful information on patent applications, patents awarded, licenses, startups, royalties and staffing patterns. Other primary data, which are somewhat less comprehensive, include search engines provided by the US Patent and Trademark Office (USPTO), as well as databases maintained by entities independent of AUTM or USPTO.

On a more qualitative level, the team has also gathered information on technology transfer ancillary functions and activities, including partnerships with business incubators, research parks, angel or VC funders and the like.

South Dakota State University

Background

SDSU's technology transfer activities were initially housed within its research function and managed directly by the university's Vice-President for Research. During this period SDSU was engaged in licensing activities but this was done on an ad hoc basis within the flow of the Research VP's array of day-to-day duties and activities. In spite of these multi-tasking challenges, a significant measure of success was achieved as evidenced by SDSU's participation in the patenting and licensing of its porcine reproductive and respiratory syndrome (PRRS) vaccine. However, for the most part, according to SDSU officials, during this period the only FTE research positions within SDSU were at the Agricultural Experiment Station but as discussed elsewhere in this documents that has changed in recent years.

In 2008, with new leadership emphasizing the role of research as an economic development asset, SDSU created a formal Technology Transfer Office (TTO) and recruited and hired an experienced licensing professional, Dr. Denichiro Otsuga, as its first full-time Technology Transfer Director. This action signaled both a boost for technology transfer as a university priority and the intent to do this day-in and day-out on a systematic basis. At the outset a good bit of time had to be devoted to organizing and transforming a historical set of practices and documentation into an on-going structured and staffed program. The focus then shifted to prioritizing and addressing pent-up demand while doing outreach within the university about the new office to generate new disclosures.

Operations

The table below uses conventional university technology management metrics to offer a snapshot of recent SDSU technology transfer history.

Table 20. South Dakota State University Technology Transfer

	Invention Disclosures	Patent Applications	Patents Issued (US)	Licenses Executed	Commercialization Income	Income Producing Sources
2007	6	1	0	2	$897,955	3
2008	10	2	0	1	$665,738	3
2009	18	3	0	3	$809,680	5
2010	42 to date					

Source: South Dakota State University Technology Transfer Office

The impact of the TTO, created in 2008 (FY 2009), begins to manifest itself in 2009 with a sharp increase in invention disclosures as well as up-ticks in patent applications, licenses executed, commercialization income and income producing sources. According to the SDSU TTO, about ninety percent of the commercialization income emanates from one license in its late stages so the increases in disclosures, licenses and income sources bode well for the future. In terms of patents issued, according to the United States Patent and Trademark Office (USPTO), average patent pendency time for FY 2009 was 34.6 months without the one year provisional period, which SDSU TTO uses to increase patent terms. Using this measure, one would not anticipate seeing any patents associated with 2008 and 2009 filings until 2011 at the earliest. University personnel also indicated while they were not aware of any new university-generated startup companies in the 2004-2008 time period there was one new startup in 2009 and at least one more is anticipated in 2010.

External Relationships

Though still in its nascent stage, the TTO appears to be on the way to developing a robust external resources network. The TTO works closely with the area's early stage venture capital fund, South Dakota Innovation Partners, as well as other organizations throughout the region with substantive science- and technology-based entrepreneurship and economic development interests such as the Brookings Economic Development Foundation, the South Dakota Enterprise Institute, the South Dakota Biotech Association, and the Sioux Falls Economic Development Foundation.

University of South Dakota

Background

USD's Technology Transfer Office is located on the Vermillion campus within the Office of Research and Sponsored Programs. In addition to its main campus activities, the TTO is also responsible for technology transfer at USD's Sanford School of Medicine in Sioux Falls as well as the university's Biomedical Engineering Program and its Center for Research and Development of Light Activated Materials – both report to the USD graduate school and are located in the Graduate Education and Applied Research Center (GEAR) in Sioux Falls. The USD TTO was established in 2006. It received its first dedicated staff in 2008 with a half-time Director. While this position is a full time position, it includes other duties outside the TTO such as public relations and business relations. As of this writing date, the TTO Director had just resigned and a search committee had been formed to recruit a new director.

Operations

The table below uses conventional university technology management metrics to offer a snapshot of recent USD technology transfer history.

Table 21: University of South Dakota Technology Transfer

	Invention Disclosures	Patent Applications	Patents Issued (US)	Licenses Executed	Commercialization Income	Income Producing Sources
2007	5	4	2	0	0	0
2008	5	0	0	0	0	0
2009	5	4	0	1	0	0
2010	0	2 to date	0	0	0	0

Source: University of South Dakota Office of Research and Sponsored Program

As indicated above, for FY2009, the USD TTO filed six patent applications, had one patent issue and executed its first license. This momentum has continued into FY2010 with another license negotiation pending, a spin-off start-up company based on a USD-generated trade secret, a pending master research agreement as well as receipt of $25,000 of royalty income. Of particular note, one of the applications from the Biomedical Engineering Program's antimicrobial technology platform, antimicrobial paint, was identified by the Cable News Network (CNN) as one of the top ten health innovations of 2009 while another application, germ fighting socks, has been licensed to a Sioux Falls start-up.

Dakota State University

With its tightly focused mission, Dakota State University emphasizes programs in computer management, computer information systems, and related programs. In view of the university's size and its attendant level of grant/contracts funding, one would not expect to see a formal technology office at DSU, nor is there one. From a technology transfer standpoint, commercializeable technologies and products in DSU's specialty domains tend to be software intensive and thus result in copyrighted material as opposed to patents.

However, it is important to note that the need for technology transfer assistance in areas other then patenting and licensing may well be significant. The very high level of focused expertise at DSU's Centers for Health Information Technology and Protection of Financial Infrastructure is likely to continue to generate spin-out companies as well as cooperative research and consultancy engagements with industrial clients for design and technical services. As the above types of activities continue to play out, it is very likely that technology transfer counsel for the university and its faculty on a host of issues such as conflict of interest, conflict of commitment, faculty consulting policies and release time. faculty participation or ownership in spin-out companies will be of substantial value.

At present, DSU's technology transfer needs are addressed through a Memorandum of Understanding with the TTO at SDSU. As activity on both campuses increases, it is doubtful this relationship is workable over the long run without more funding and staffing for the TTO at SDSU.

Avera Research Institute

The Avera Research Institute is early in the process of establishing a technology commercialization function and dedicated staff. However, two related and important activity areas should be noted. First, as noted in a prior section, the institute has a strong multiple industry sponsored clinical trials program (Phases II – IV) involving a wide range of therapeutic areas and both inpatients and outpatients. Second, the institute actively works to support spin-off companies within its midst and has had some success in this regard.

Sanford Research

The Sanford technology transfer office has been in operation for a little over a year. It is headed by Dr. Whitney Robertson, who comes to Sanford with advanced degrees in the biological sciences, as well as an extensive background in the practice of technology transfer and technology-based economic development. Because of the newness of the technology transfer function at Sanford, only data from 2009 are available.   There were 16 invention disclosures and 7 patent applications in that program year. To date, there are no issued patents or licenses, and obviously no revenues.

The office has spent much of the first year of operation establishing policies and procedures, reaching out to researchers, conducting training and briefing sessions and building working relationships with potential partners outside of Sanford, including investors, incubation programs, venture forums, the universities and South Dakota government officials.

The organization also conducts clinical trials (predominantly Phase I) through the Sanford Clinical Research Center.

Findings: Knowledge Deployment

Outreach

- Though there is a good bit of outreach-related activity within some of the region's locales (examples include activities associated with SDSU College of Engineering and Dakota State information technology and computer information systems interactions with the private sector), they are not scalable or routinely structured to systematically respond to the needs of the region's manufacturing community – especially the very strong advanced manufacturing presence in the Sioux Falls, Brookings, Watertown and Yankton communities or to other important established and emerging sectors such as financial services/information technology, alternative renewable energy and biomedical devices, processing and materials.

- There is no organized university-based manufacturing outreach presence either through a formal industrial extension program or through affiliation with the national extension system -- the MEP. The MEP presence in a number of states is established through university–based centers.

- The actual MEP presence through the national network is very limited in South Dakota and the I-29 region when compared to other states. In fact, it is the only state without a physical MEP center location.

- University-based outreach to companies and communities in creative arts and design is a potential economic development asset for the region.

Technology Transfer

This section on Knowledge Deployment yields the following conclusions:

- Relative to institutions in other states, South Dakota is playing a twenty-year game of catch-up, as most of their peer institutions established technology transfer functions following the 1980 Bayh-Dole Act and by the mid 1990s most US universities with research activities had functioning TTO's.

- As a resuscitated function, much of the current work of technology transfer officers at the state's R&D organizations has been focused on implementing practices and policies, reaching out to potential customers among the ranks of researchers, building the "culture" of the activity and also doing the more normal work of technology transfer such as processing invention disclosures, filing patent applications and the like.

- Because of both startup and catchup demands noted above, the level of staffing across the state of technology transfer functions and offices is limited and stressed given the task at hand.

- There is a Memorandum of Understanding in effect among the three universities for cooperative technology transfer efforts and some information sharing relative to best practices and collaborative activities have taken place. However, there is no mechanism in place that makes information sharing and collaborative activities a matter of established routine and that includes Sanford Research and Avera Research Institute as well as the universities.

- On many university campuses, entrepreneurship centers or program provide ancillary services to the established technology transfer offices, however in South Dakota those program are themselves in early stages of development and mostly confined to instructional activities and student-focused programs.

- In the world of technology transfer and commercialization there are "pitchers and catchers", with the former being the university-based technology transfer offices and staff, and the latter being community-based assets. These latter include business incubators or research parks, SBDC activities, angel investors and the like, and South Dakota has developed a growing network of such programs.

Entrepreneurial Culture

This portion of the analysis addresses university engagement in economic development at the regional and state level and institutional cultures that shape how that engagement occurs. While the most significant economic development benefit will emanate from the knowledge, skills and character of the thousands of people they graduate into the regional or state economy over time, there are numerous other roles universities assume within the regional and state economic development sphere and all of them can generate major impact. They include:

- Faculty member public service endeavors with businesses and industry
- Community leadership involvement
- Consulting, technical assistance and outreach for business, agribusiness and government
- Contributions and leadership in defining amenities and culture that are an important part of the economic development milieu
- Provider of innovation infrastructure such as research parks and incubators
- Major employment and wage source
- Development and commercialization of technology and the products, processes and services in which it is embodied

For the purposes of this initiative, this portion of the analysis will focus specifically on the entrepreneurial culture dimension and how that culture can govern the university economic development role, especially as it relates to generating commercializeable science and technology and supporting and accelerating the growth of knowledge-based companies.

Those universities that have succeeded in commercializing technology and impacting their regional economy tend to look different and look at the world a little differently. They have different assumptions and perspectives on the world, which are expressed and acted upon in business, government, and the non-profit settings. In a word, they have different cultures. A strategy to foster technology development and technology commercialization must address cultural assumptions concerning entrepreneurial venturing and its apparent conflict with established academic norms. The most significant challenge is NOT to attack or demean those established academic norms, but to articulate strategies and tactics that both support the historic priorities of the university while at the same time supporting the enhancement of technology development and deployment.

Success in this realm tends to associate with universities who are more aggressive in developing, implementing and supporting organizational policies and programs that enable a more aggressive and effective execution of technology development and deployment. Unfortunately, these factors in our analyses are not discoverable in any quantitative database. They tend to be more qualitative in nature, and perhaps more notable by their absence.

For a more detailed discussion on the challenges and dimensions of growing an academic culture to support science- and technology-based entrepreneurship including benchmark examples, see Appendix A, *Toward An Entrepreneurial Culture in Academia,* at the conclusion of this document.

Relevant Data

South Dakota State University

As the state's largest university, SDSU's self-image and mission are also well within the land-grant tradition, which has some implications for any role it might play in technology-based regional economic development. The Cooperative Extension Service and the Agricultural Experiment Station present at land grant colleges throughout the U.S. has a long and storied history of technology transfer success through teaching, research and outreach. However, throughout most of its history the extension service generated huge impact by getting as much useful information into the public domain as possible and into the hands and minds of practitioners and people in the field free of charge.

In the 1980's as other schools and departments on campuses began to engage in this activity they quickly discovered that the most effective way their knowledge and research could be developed as a commercial product, process or service and useful at scale was if it was first protected as property so it could be distributed through the free market system. Engagement with the private sector and patents, licensees, trade secrets, proprietary cooperative research agreements, and entrepreneurial behavior on the part of some became the order of the day.

For many land grant schools these developments represented a major shift in the practice and objectives of technology transfer from free public dissemination to dissemination to private business entities for a fee. At times movement toward protecting knowledge and research outcomes as intellectual property and entrepreneurial engagement with the private sector was resisted. As a consequence, for many schools it can be argued that at one point their successful land grant history functioned as a cultural deterrent to technology transfer, entrepreneurship and related activities. These circumstances have certainly changed over the last several decades but many land grant schools are just now catching up with their sister institutions in the technology transfer arena and in fostering an entrepreneurial culture to accommodate and advance that activity.

The learning, discovery, and applications network represented by the College of Agriculture and Biological Sciences, the Agricultural Experiment Station and the Cooperative Extension comprise the largest research and teaching sphere at SDSU. The colleges that form SDSU include Agriculture & Biological Sciences, Arts & Sciences, Education & Human Sciences, Engineering, General Studies, Nursing and Pharmacy. Notable by its absence is a college of business. Since Colleges of Business typically are hosts of Centers or curricular programs in entrepreneurship, a significant influence on fostering technology transfer & commercialization, this is a potential shortcoming.

There is an Entrepreneurship program that operates out of the Economics Department, and offers to students across the campus a Major, Minor and Certificate curricula. It also offers various activities such as clubs and business plan competitions. There is limited connection to faculty across the campus, nor is there a Center that is starting to have a larger programmatic and culture-building role. However, it is the research team's understanding that SDSU leadership is exploring approaches to reconfiguring its Entrepreneurial Studies program to make it more prominent, visible and robust. The reconfigured program is slated to include an entrepreneurial extension component, will be led by a named endowed chair and will include a named endowed center for innovation and entrepreneurship. In this regard, as of the date of this writing an action plan is being developed with the guidance of a nationally known expert, the search for an endowed chair is underway, and donors are being solicited to endow the center. Implementation begins fall, 2010.

The culture at SDSU is in the middle of dramatic change. With the arrival of the new President approximately three years ago, all major units have been tasked to develop new strategic plans, that reflect the University-wide document which includes major emphases on building the scope of sponsored research as well as being a player in fostering regional economic development. Illustratively, nearly three years ago President David Chicoine and Vice President Kevin Kephardt were involved in presentations to the university community that in many ways launched anew an enlarged focus on technology transfer, commercialization and state economic development. This included materials developed by MIT's Richard Lester, who has been a significant national advocate and researcher in this policy area.

Further advancing this cultural shift, SDSU hired an entrepreneurial-experienced person to lead the technology transfer office. In addition to providing services to faculty – disclosures, patent filings, portfolio management – the office has also been involved in educational outreach to faculty members and units, which in itself can be an important vehicle for changing mindsets and perspectives about the value of this kind of activity. As previously mentioned, there has been a resulting sharp increase in invention disclosures, patent applications, and licenses executed over the last two years.

One of the more knotty challenges in growing a supportive culture regarding technology-based economic development at SDSU (and at other intuitions in the state as well) is the limited supply of role models of success in technology commercialization, starting companies and the like. There is an interesting theme in the research literature on these matters that suggests that if you have department chairs and faculty peers who have a history in these areas (such as having a degree from a Stanford or an MIT, arguably two of the more successful entrepreneurial and technology commercialization campuses) this tends to yield cultural spillover. That tradition is relatively weak in South Dakota.

Nonetheless, there have been programmatic initiatives that also have cultural implications and impacts. For example, the development of the Innovation Campus and its promotion by the research administration and technology transfer functions on campus is one. The linkage to South Dakota Innovation Partners LLC is likely to become even more important. The participation and visibility of the forthcoming Student Venture Competition (hosted by South Dakota Innovation Partners in cooperation with the College of Engineering, the

Entrepreneurship Studies Program and the Technology Transfer Office) will be an interesting benchmark of the linkage between SDSU and the external entrepreneurial community. Students from around the region will compete for upwards of $25,000 in investment capital and organizational support. Interestingly both individual students and students as part of a team can compete and the team can include faculty members as well as business professionals. The competition will take place through May of this year.

The reconfigured Entrepreneurial Studies program that is scheduled to begin implementation in the fall of 2010 should accelerate and expand this cultural shift especially if the plans include the successful creation of a comprehensive endowed Center for Innovation and Entrepreneurship. Such a Center would be a place for a full range of entrepreneurship education elements to coalesce. It would allow for the blending of curriculum-based learning and practicums and with experiential learning, propelled by visiting practitioners. It could employ expert faculty and successful practitioners under the leadership of the holder of the endowed chair. It could function as a vital hub for entrepreneurial activities such as competitions, team-building, capstone courses, public lectures, and continuing education. Finally it could function as the entrepreneurial outreach channel to the community and the region.

University of South Dakota

The University of South Dakota sees itself very much in the liberal arts tradition. It does not have a college of engineering, and among the undergraduate-oriented colleges, the College of Arts and Sciences is clearly a dominant player. Of note, however, there is a School of Medicine that is a rapidly growing R&D center, as well as supplying a large fraction of physicians in the state. Nonetheless, the range of degrees and disciplinary emphases at USD is distinctly different from its sister institution, SDSU. USD hosts the Beacom College of Business, and although the unit does not offer a major in entrepreneurship, it does offer Minors in Entrepreneurship for both Business majors and non-business majors. There are student clubs such as E-Team and a local chapter of SIFE (Students in Free Enterprise), but participation rates are unclear. Recently E-Team held an Extraordinary Idea Competition, with guidance provided by their faculty advisor, who is a recent faculty (Instructor) hire whose personal background is steeped in being an entrepreneur as well as an academic. As at SDSU there is no Center for Entrepreneurship at USD to possibly be a locus of fostering interest among students and faculty. There is a functioning incubator facility on campus that will be available to entrepreneurial-oriented students, but this is a new initiative and utilization is still building. The recently hired faculty member noted above is providing leadership for this effort.

While USD has had an annual President's Award program for some time to acknowledge notable faculty, it has recently changed the nomination process (going from a Dean-initiated process to self-nomination) and notably for our purposes added a new category. Thus there is now a President's Award for Innovation and Entrepreneurship. The latter award has recently been redesigned with increased funding land now emphasizes a broad definition of "innovation" to encourage more applications. This is a relatively new award so it is unclear how this is impacting the campus community's collective mindset, but other institutions doing this kind of thing often experience significant symbolic value.

USD did staff a technology transfer office a few years ago, and the early results realized by that function are noted above. However, the incumbent director has recently left the university and as the date of this writing, the university has formed a search committee to identify and recruit his replacement. Although this was a half-time position, the former director did devote a significant portion of this time to building awareness among the faculty of the technology transfer process and encouraging them to interact with the university's intellectual property committee.

Dakota State University

Among all the state universities in South Dakota, this institution seems to have undergone the most dramatic cultural and mission change. Within the last few years the school has transformed itself, across all the undergraduate colleges and programs, to focus on information technology. So one important cultural component of the whole Dakota State community is to embrace the notion that the campus aspires to be laser-focused on providing to the state economy a growing cohort of graduates well trained in information technology applications, who will hopefully be excellent matches for hiring needs in the state.

There is also an entrepreneurship element in programming and culture at the Heartland Technology adjacent to the campus. The facility houses both institutional lab space but also functions as a de-facto incubation space for information technology startups coming out of the university.

Avera Research Institute

As described above Avera is an early development stage for its technology commercialization activity and is just now getting to the point where it can think through ways to legitimate and champion this enlarged mission. Nonetheless, also as described above it is growing its research portfolio in some key domains and the rest of the organizational features such as mission and culture will follow. In spite of its early-stage status, the institute has already established a precedent and culture for supporting spin-offs. In addition, its clinical trials program through Phase IV can enable productive private sector connection and a "closer-to-market" orientation.

Sanford Health

As described above, Sanford has been getting traction on expanding its research capacities and performance as well as its technology commercialization activities. According to our respondents, there seems to be a slowly growing buzz within the research community, and as suggested above having a widely experienced technology transfer director will help.

South Dakota State Experimental Program to Stimulate Competitive Research (EPSCoR)

South Dakota is an EPSCoR state, and has had a active program for many years. EPSCoR traditionally has been focused most on building research expansion and a research culture in universities. However, there are also examples of EPSCoR activities and projects that are more focused on technology transfer, commercialization and entrepreneurship. Two recent activities of South Dakota EPSCoR are worth noting. One is the launch of a program that will provide up to a dozen $16,000 half-time Innovation Fellowship positions targeted for entering graduate students in the state. The program will focus on technology commercialization, venture development and entrepreneurship, with participation by state-based organizations such as South Dakota Investment Partners, Sanford Research and Prairie Gold Ventures. Awardees will serve up to two years, and "learn-by-doing" by shadowing and working with experienced entrepreneurs. Over time, the potential impacts on the graduate school cultures at the state's universities could be considerable.

More proscribed but nonetheless interesting, was a recent conference that was sponsored by EPSCoR and held at Dakota Wesleyan College in Mitchell. It was organized into two parallel thrusts: a Student Track and an Educators Track. The former was intended to foster awareness and enthusiasm (including an Extreme Entrepreneurship Tour) among students to think about entrepreneurial career paths; the latter was focused on discussing best practices in entrepreneurship education and mentorship, with guest speakers from more established entrepreneurship programs (e.g., Iowa State). Dakota Wesleyan, a small liberal arts college, which has entrepreneurship curricular programs as well as a Center, was the host.

Findings: Entrepreneurial Culture

This information in this section on Culture, Policy and Program Development suggests the following conclusions:

- Organizational cultures, policies and programs relating to technology commercialization, entrepreneurship and technology-based economic development are in an early stage of maturity in South Dakota.
- Private sector R&D organizations, and non-profit economic development organizations, are farther along in terms of "getting the culture thing".
- There are many national best practice models about how to move the internal culture of universities.
- There are interesting opportunities to collaborate across sectors and organizations to build cultural awareness and enthusiasm.

University – Community Linkages

Background

University – community linkages are the major and strategic connections that enable university participation in generating economic development results at the regional level. These enabling channels allow and impel higher education talent and knowledge into the region's private sector. As they are generally part of the regional innovation infrastructure they were included in the earlier presented economic analysis; however, in view of their significance to any strategy that would seek to optimize the university role in regional development, it is important to understand the strengths and weaknesses of the existing network of regional university-community links.

These links assume numerous forms and structures so, at the risk of some overlap, some taxonomy is useful in order identify them and organize them for economic development considerations.

Knowledge And Know-How Conduits

These types of links enable movement of knowledge and know-how from the higher education institutions to their surrounding communities and the regional economy. They include:

- Outreach Activities. This category includes connections to the private sector such as industrial extension, private sector advisory groups, and technical assistance and faculty consulting. It can also include links to other public sector organizations and efforts such as support for state, regional and local industrial recruiting efforts or public service activities.

- Public Private Partnerships And Ventures. This includes university-industry R&D or training centers as well as economic development-related services typically delivered through these partnerships and ventures such as very early stage risk funds, technical assistance for entrepreneurs and startups, prototyping services, commercialization support, local and regional economic development foundations and so on.

- Shared Infrastructure. These are “harder” economic development assets that engage both sides of the university - private sector divide such as research parks, incubators, accelerators, wet labs, some GMP facilities, etc.

- Networks. More specifically, activities and initiatives that assist in building transaction networks among key institutions, organizations, companies and people. As mentioned in the key design specs at the beginning of the section, the processes of technological innovation and commercialization involve an interacting set of organizations and individuals, almost all of who are external to the research university. They may include: law firms with IP expertise, equity investment firms and solo angels, outsourcing specialists, management and human resource experts, product development specialists, manufacturing engineers, plant designers, and many other experts. These are specialty assets - the denser and more connected the better.

Talent Conduits

These channels enable the deployment of talent cultivated and nurtured within higher educations institutions into the private sector. Once again, for the purposes of this initiative, the emphasis here is on deployment into local and regional markets,

- For Established Companies. Links here include internship programs, placement services, senior projects as well as relationships between specific higher education instructional programs and departments and businesses.

- For Startups, Early Stage Companies and Entrepreneurs. Talent conduits for this dimension include entrepreneurship education, training and extension, capstone programs, commercialization and business planning competitions that include private sector sponsorships and mentoring, internships designed for startups, etc.

Findings

Strengths

The region has very significant knowledge conduit strengths within two of these university-community linkages categories.

- For the size of this regional market, the shared infrastructure is very advanced. As described in this report's innovation infrastructure section the constellation of existing and planned research parks and campuses and incubators throughout region - all with existing and potential university connections - should as a group function as a formidable economic development asset, especially when effectively coupled with the second major strength.

- There are vibrant informal networks and communications channels between two important groups. First, university officials and the professional economic development community are in constant contact as a matter of routine practice. This is not always the case. Second, there is a good bit of networking and routine communications among a number of the region's technology-based companies – both early stage and older – and researchers from all three universities as well as Avera and Sanford Research Institutes. The infrastructure players such as the Sioux Falls Technology Business Center, the GEAR Center, the Heartland Technology Center in Madison and the Innovation Campus in Brookings enable much of this information flow.

In addition, on the talent deployment side, activities at the three higher education degree granting institutions feature a number of strong connections into industries, companies and communities. Included among these are:

- The Action component of the IDeA (Interdisciplinary Education & Action) program at the University of South Dakota. This program is part of an institutional graduation requirement and can be community service-learning, research, or creative activity.

- The various industry advisory boards and capstone courses that involve industry associated with South Dakota State University's College of Engineering as well as the university's relationship with the South Dakota Crop Improvement Association as a key intermediary with private sector interests.

- The very high placement rates and strong industry connections associated with Dakota State University's information systems and information assurance programs and graduates.

- Use of the Dakota Seeds program to place interns in knowledge intensive companies – especially those with university connections.

Weaknesses

- In spite of the ad hoc and effective activities that represent some outreach strength in particular cases, the region lacks a systematic, scaleable university outreach program to aid its industry - especially trade sector firms and the area's advanced manufacturing community. It is important to note that in addition to more traditional industrial extension assistance activities such as lean manufacturing, ISO certification help, process improvements, plant layout, etc., the extension service program can also be expanded to include more information system and assurance services as well as manufacturing design and even access to intern placement programs. Many MEP offices are now refocusing on helping firms think more strategically as opposed to their former focus on efficiency and quality control.

- While some elements are in place or on the drawing board, strong university-connected entrepreneurship support systems are still needed.

- There is little or no funding for proof of concept or pre-seed stages for university technological opportunities. These funds are often more effectively administered and managed through public-private partnerships, non-profits and even university foundations. This may be about to change as the SDSU TTO has received a modest grant from the Small Business Administration. The funding for only one year but it is a start. In addition, the SDSU TTO and South Dakota Innovation Partners have prepared a proposal to form a public-private partnership to administer and manage a proof of concept center that would provide public funding support with private cost-sharing to conduct proof of concept experiments to de-risk opportunities for seed-stage investment.

- Finally, university talent deployment should also be viewed as a weakness as well as strength. Laudatory existing programs can be expanded and new initiatives created. For example, internship programs need to be more widespread and should also specifically target into startups. SEEDS could be connected to other outreach activities such as TTO licensing and start-up company activities, the new student ventures program, capstone course that involve industry and industry advisory panels.

Key Findings from University Benchmark Communities

The project team looked at four comparable universities from around the United States to examine their economic development programs. The institutions were chosen for their similarity to South Dakota State and the University of South Dakota, for operating in similar economic environments and for offering some best practice examples of effective community-university partnerships or efforts. The four institutions that were examined are:

- Brigham Young University in Provo, Utah
- Michigan Technological University in Houghton, Michigan
- Montana State University in Bozeman, Montana
- Ohio University in Athens, Ohio.

The full profiles of the universities are included as Appendix B to this report. In this section, we offer some key findings from our examination of the university programs that we think have particular resonance for the I-29 Corridor.

Finding 1: A university's rural location can be an advantage. While being out of the economic hub of activity might seem on the surface to be a crippling disadvantage, effective universities can leverage their rural location into a competitive advantage. For instance, Ohio University has been able to attract funding for its business incubator specifically it is serves a rural, traditionally disadvantaged region. That university and others have also been able to attract faculty by promoting a higher quality of life that can be found in rural communities.

Finding 2: Sectoral focus is important. Some of the most effective university-industry partnerships have occurred when institutions focused and provided assistance around a set of industrial sectors in which the community excelled. Playing to a region's economic assets reaps benefits for both the university and its host community. For instance, Ohio University offers detailed technology transfer programs around alternative energy matching up with Athens' desire to be a center of sustainability for the Appalachian region.

Finding 3: Entrepreneurial efforts pay off. Much of university-community economic development work focuses on technology transfer. While this more research intensive activity is undoubtedly critical is not the only way in which universities can impact their communities future. For instance, Montana State's Center for Entrepreneurship of the New West provides detailed assistance to start up companies in the Bozeman and surrounding area providing needed technical assistance to some of the fastest growing companies in the area. In addition, the university makes training of new entrepreneurs a priority. Students at the college work closely with companies not only providing the firms with needed assistance but helping the students gain a comfort level in working in business. These same students when they graduate can then be encouraged to plant their roots in the town in which they gained their education. Entrepreneurship centers can also have the added benefit attracting technology entrepreneurs from the community to become more involved in the life of their university.

Finding 4: Cooperation among departments is critical. In some institutions such as Ohio University, the technology transfer and economic development departments are located in the same office. But in most cases, several different departments are responsible for different activities. One might handle technology transfer and one might focus on operating an incubator. At Montana State, university staff believe a reason for their success is ensuring that each component of the program knows what the other is doing and that they work together on a regular and committed matter to communicate their activities.

Finding 5: Staffing of technology transfer programs matters. Having a staff equipped to meet the intense demands of technology transfer is key to making such an effort a success. Brigham Young for instance has a staff of four licensing agents, an impressive number for a university of its size, but one that shows the commitment of that university to ensuring effective economic development efforts.

Finding 6: "Cultural" issues matter: The most effective efforts at universities require a campus culture that values economic development and technology transfer. At Michigan Tech, there is an absolute focus on technology. That term pervades everything, including the research and curricular programs that are nominally not technology-centric. For instance the business college emphasizes management and business exploitation of technology.

Finding 7: Universities that overtly aim to impact economic development in their community and region are often more successful. Most universities with research capabilities have technology transfer programs. But not all of these efforts necessarily are about economic development for the university's host community. Each of the universities profiled in Appendix B believed strongly that a part of their core mission was to promote the economic prosperity of their community or region as a whole. For instance, Ohio University works with community based organizations around issues such as entrepreneurship, helping low-income individuals gain an economic foothold by operating a small business. Michigan Tech works with state and regional economic development organizations to promote the development of locally-based technology programs. The Michigan Tech Enterprise Corporation (MTEC) Smart Zone. MTEC emphasizes business incubation facilities and services and has resulted in two dozen businesses getting started and achieving some degree of business stability while creating more than 750 jobs in the Houghton area, an extremely large number for a relatively small community.

Key Findings Revisited

The following key findings from this university and linked non-profit research institution analysis summarize the basis for the recommended actions that conclude the Phase 2 section of this report.

- South Dakota's colleges and universities (particularly in the I-29 corridor), turn out significant numbers of science and technology-oriented degrees at the baccalaureate level and compare favorably to other states. However, this is not the case at the graduate level where science and engineering degree production lags behind other states.

- The South Dakota economy, compared to other states, employs relatively fewer degreed individuals, at every level and particularly in the sciences and engineering.

- South Dakota, compared to other states, seems to export relatively more of its talented young people.

- Private sector R&D support is one of the strongest indicators of innovation capacity. There is a low level of private research support within the region's universities.

- The lack of emphasis on research and graduate programs within the state's universities during the 80's and 90's has constrained the region's capacity to produce and support knowledge-intensive, higher value commerce jobs and companies.

- The universities have lost much ground to their peers in a very competitive environment. They will need to be very strategic about support for graduate education and research if these activities are to be funded at a level that will allow them to get back in the game.

- While there is growing across-the-board excellence in R&D, the most nationally competitive area of knowledge development lies in the life sciences – widely defined. This includes the historical and proven strength in plant and animal bioscience as well as emerging strengths in biomedical and medical engineering. The broad technology platform associated with light activated materials and whose applications cut across campuses, research institutes, companies and targeted within a 2010 Center should be noted. Electrical engineering should also be acknowledged as a strength area.

- The three universities have distinctly different missions, profiles and economic development engagement strengths that can lead to very different roles in regional development.

- There is a good bit of effective outreach activity to employers activities associated with SDSU College of Engineering and Dakota State information technology and computer information systems but it is not scalable or routinely structured to systematically respond to the needs of the region's manufacturing community – especially the very strong advanced manufacturing presence in the Sioux Falls, Brookings, Watertown and Yankton communities.

- The presence of the national industrial extension system, the MEP, is very limited in South Dakota and the I-29 region when compared to other states. In fact, it is the only state without a physical MEP center location.

- Relative to institutions in other states, South Dakota is playing a twenty-year game of catch-up, as most of their peer institutions established technology transfer functions by the mid 1990s. Because of both startup and catch-up demands, the level of staffing across the state of technology transfer functions and offices is limited and stressed given the task at hand.

- On many university campuses, entrepreneurship centers or programs provide ancillary services to the established technology transfer offices (see case studies), however in South Dakota these programs are themselves in early stages of development and mostly confined to instructional activities and student-focused programs. Strong university-connected entrepreneurship support systems are needed.

- The university cultures and related policies and practices for entrepreneurial behavior and economic development engagement are in early formation stages.

- The public and non-profit capacity to support university-associated science and technology-based economic development is well ahead of the universities' research enterprises and entrepreneurial cultures capacity to generate opportunities. For the size of this regional market, the shared university-community innovation infrastructure is very advanced. The constellation of existing and planned research parks and campuses and incubators throughout region – all with existing and potential university connections should as a group function as a formidable economic development asset.

- Universities that overtly aim to impact economic development in their community and region are often more successful. Most universities with research capabilities have technology transfer programs. But not all of these efforts necessarily are about economic development for the university's host community. Each of the universities profiled in the case studies believed strongly that a part of their core mission was to promote the economic prosperity of their community or region as a whole.

A University and Non-Profit Research Organization-Based Economic Development Strategy for the I-29 Corridor.

The recommendations and actions presented below define a regional economic development strategy based on the current and emerging capacities within the higher education institutions and non-profit research organizations within the I-29 Corridor. As such it focuses on producing and deploying the talent and knowledge that will govern the region's future economy by (1) building capacity across all campuses to produce economic development outcomes and (2) fusing with the previously presented private sector economic development strategy to support and leverage that strategy's specific objectives and outcomes. The goal remains a constant: generating greater numbers of higher wage jobs and building wealth in the region's communities.

Institutional Roles

The three universities and two research institutions have distinctly different missions, profiles and economic development engagement strengths that suggest different roles in regional development strategy based on what they do best. Because of the limited resources that are available and the need for strategic focus it is recommended that each institution be viewed as the lead actor in the domains where it is in position to lead but not that activities and participation be limited to that domain. A role for the capacity associated with the Sioux Falls University Center (UC) and its GEAR Center facility should also be factored into this strategy. On behalf of all South Dakota's public university, the UC functions as an attendance center for non-traditional undergraduate students and for selected graduate degrees. The GEAR center offers lab space for lease for university researchers with grant funded projects that benefit from being in Sioux Falls rather than their main campuses as well as incubation space for emerging laboratory-based companies. The facilities together represent a substantive hard innovation infrastructure asset that can link to and leverage resources within the Sioux Falls region and accommodate collaborative research efforts that focus on commercializeable outcomes.

South Dakota State University

For the purposes of this plan, it is recommended that SDSU function in the lead position in forging and advancing the region's university-private sector nexus based on the existing scope and volume of its activities in this area. SDSU has a long and successful history in agricultural extension and agricultural biotechnology development (including private sector outreach and licensing), the state's college of engineering (including private sector connections previously described), and the region's only full time university technology office and director with experience in industry and academic administration. SDSU working with its Foundation should accelerate the recruitment of endowment funding for a comprehensive center for innovation and entrepreneurship that is aligned with the Entrepreneurial Studies academic program, is cross-cutting and leads both in-reach within the university and outreach in the region. SDSU should also house a newly created South Dakota MEP for the eastern half of the state (discussed as a separate recommendation later in this section.) The existing technology and know-how base associated with USD's activities – especially biomedical engineering in Sioux Falls and DSU's information systems and assurance technological prowess and connections into industry also need to be explicitly supported and advanced as part of this regional effort to build out the university-private sector linkage network.

Dakota State University

Capacity to create and deploy information technology and IT know-how is a ubiquitous and essential regional competitiveness asset. The good news here is that one of the distinguishing features of the I-29 corridor as an economic region is that is has a strong university with a singular dedicated IT mission. The bad news is that, to an extent, DSU's value as an economic development asset is one of the region's best-kept secrets. It is recommended that DSU function as the lead economic development-related resource in IT matters related to information systems, information assurance, and digital arts and design.

University of South Dakota

As the state's liberal arts university with a strong on-campus research profile in several science domains (neuroscience, behavioral sciences, et al) as well as an emerging but already strong position in several biomedical engineering areas within its smaller Sioux Falls campus, the basic research enterprise at USD needs continued and greater support. This plan contemplates leadership from USD in two specific areas. First, USD's Sanford School of Medicine is a critical asset in the region's bioscience future by virtue of its research portfolio and its connection to the Sanford Research's Sioux Falls campus. The constellation of medical/biomedical assets in Sioux Falls represented by the School of Medicine, the USD Graduate School's Biomedical Engineering Program, the Center for Research and Development of Light-activated Materials, Avera Research Institute, and the Sanford Health Research facilities offer a major development opportunity. Leadership is required from both the public and private sides of this development path. USD is the natural entity to lead on the public side. Second, creative endeavors associated with arts and design not only add value to products and services, in a broader sense they define a community and a region's amenities and cultural identity. Their presence, or lack thereof, is part of the economic development fabric. Through its College of Fine Arts USD is the region's most important asset in this area and should be viewed as a leader and critical resource in developing and implementing strategies to build the region's arts, design and cultural amenity profile.

Avera Research Institute and Sanford Research

As private, non-profit research organizations, Avera Research Institute and Sanford Research are not educational institutions but tightly focused mission driven organizations. Their ability to participate in the development and implementation of this regional strategy should be viewed through that lens. Although there is a considerable difference in scale between the two organizations, both are enthusiastic participants and entrepreneurial with substantive, focused research agendas. They should be supported in their plans AND also factored into regional endeavors and collaboration research initiatives where appropriate including innovation infrastructure networks.

Talent Development and Deployment: Actions to Retain and Recapture Talent

While, relative to its population size, South Dakota does well at producing baccalaureate science and engineering degrees, it lags behind at the graduate degree level, it employs relatively fewer degreed individuals in the private sector and exports relatively more of it newly degreed people.

For the purposes of the strategic focus within this economic development initiative, the region's three pubic higher education institutions have somewhat differentiated and complementary degree granting roles.

- Arts and Science degree production at USD, especially those associated with life sciences, biomedical engineering, materials chemistry and, to the extent they can support a creative and cultural amenity development, fine arts.

- SDSU's important role in the production of degrees in life sciences – especially veterinary and plant sciences, engineering-related degrees, and pharmaceutical science degrees. The entrepreneurial studies program that is currently being revamped also looms as an important asset.

- DSU's role as the main producer of IT-related degrees, especially those associated with information systems, information assurance, and health informatics and digital arts and design.

In addition, the Associate, Bachelors, and Masters degree programs offered at the University Center in the region's commercial hub and largest population center - Sioux Falls - should also function as a major talent production and retention asset.

Recommendation: The I-29 Corridor Task Force should launch and support an initiative to retain higher education graduates, especially those in science and engineering fields and recapture talented graduates that have left the state.

Action 1: Internship programs either modeled on the statewide Dakota Seeds program or functioning as adjuncts to the program should be established with a physical and robust presence on the campuses of Dakota State University, South Dakota State University, the University of South of Dakota and the University Center in Sioux Falls.

The most obvious and quickest way to retain graduates is to connect them to real and challenging job opportunities. The Dakota Seeds program affords an early start on this process by serving as an electronic matchmaker between companies and organizations seeking undergraduate interns and graduate assistantships and South Dakota students. For businesses seeking interns or graduate assistants, Dakota Seeds will provide a grant that will cover up to one-half of the position's wages with a graduated payment scale ranging from $2,000 for student internships to $10,000 annually for PhD students working as an R&D assistant. Applications are submitted to the Governor's Office of Economic Development and approved by the South Dakota Workforce Development Council. Officials associated with the Dakota Seeds program indicate that the demand from business for interns is strong and there are often positions that go unfilled.

It is recommended that the Dakota Seeds program establish on-campus adjunct offices or, if not feasible, that the region's universities establish their own internship placement programs with grants to cover a portion of the costs to business. Individuals committed to aggressively marketing the program and placing students in South Dakota companies should staff on-campus offices. Connection to TTO activities can be important here as the internship program can work with Sponsored Research Agreements. They should be prepared to work effectively within an academic environment in which students are often counseled to leave the community to seek positions in more prestigious markets.

These internship programs should explicitly market to startups and early stage companies in addition to established companies. If an industrial extension service is created, it should also connect to and market through this organization.

Implementation Notes

- This position could be funded on a .5 FTE basis if resources are lacking at the outset.
- The expeditious approach is for the state to fund and for each university to staff the on-campus offices through the Dakota Seeds program. The cost of these on-campus positions will be very modest when compared to the potential benefit. If it is not feasible for the state to participate (most likely through the Governor's Office of Economic Development or the Workforce Development Council) then the I-29 Corridor Task Force should consider launching its own effort to establish these offices.
- The positions could be staffed on a part-time or full-time basis within existing placement and career counseling functions such as USD's Career Development Center, DSU's Career Services Office and SDSU's Career and Academic Planning Center. A position should also be established at the University Center in Sioux Falls. This position would place interns on behalf of all participating institutions and would be located within the most dense business population.

Action 2: The I-29 Corridor Task Force and economic development professionals in the three communities that host the universities should work with the respective alumni organizations to identify and "claw back" talented graduates that reside outside the region.

Alumni organizations are fertile sources of information for educational and work profiles and locations of graduates. Understandably, because they use this information for fund-raising purposes they typically are protective of this information. However, if they are comfortable with the way in which the information will be used and that it is secure, they may be a valuable partner in efforts to attract graduates "back home."

This effort should pay special attention to targeting 30- to 40- year old graduates in knowledge-based companies as well as South Dakota ex-pats that are running or managing small, growth-oriented regional companies. Through survey and interviews it will be important to gain an understanding of what issues, opportunities and amenities are important to these folks. Over the last several decades some states and communities have offered incentives to recruit accomplished individuals in high demand occupations such as engineers to "move back home."

Implementation Notes

- This initiative should be coordinated with other graduate retention and recapture efforts throughout the region and state.
- Other states have "claw back" programs, some of which are regarded as effective (http://www.comehomemontana.org/). A thorough "lessons learned" analysis should be performed as part of the design for this program.
- The claw-back activities and campaigns associated with all three universities, if possible, should be blended into a regional claw-back strategy.
- The regional claw-back strategy should, if possible, be connected to an overall regional marketing strategy. This becomes easier if there is a regional marketing organization (see final group of recommendations.)

Knowledge Development

Three of the key findings bear restating at this juncture because they give rise to one of this report's most important and most challenging recommendations.

- The lack of emphasis on research and graduate programs within the state's universities during the 80's and 90's has constrained the region's capacity to produce and support knowledge-intensive, higher value commerce jobs and companies.
- The universities have lost much ground to their peers in a very competitive environment. They will need to be very strategic about support for graduate education and research if these activities are to be funded at a level that will allow them to get back in the game.
- Private sector R&D support is one of the strongest indicators of innovation capacity. There is a low level of private research support within the region's universities.

Recommendation: The I-29 Corridor Task Force should lead an effort to significantly ratchet up the research funding levels at the state's universities. New funding should target basic research with clear paths to commercial application or translational research; that is, is should be oriented toward producing economic development outcomes.

The above recommendation focuses on support for basic research with commercial promise and translational research for two reasons.

1. This is a strategy to employ university assets to produce economic development outcomes.

2. As this research will be funded by South Dakota taxpayers, it is reasonable to expect a public return to the state whenever possible and practical.

As evidenced in this report, while the region's universities have been making exceptional progress in recent years in starting the building process for their research and graduate programs after roughly a 20-year hiatus, a much greater level of activity is needed for them to get back in the game at a nationally competitive level.

While it is tempting to identify research domains as rallying points for the creation of facilities to house new research centers of excellence, in the judgment of the research team, this would be imprudent at this juncture for four reasons.

1. There are already ten 2010 Centers of Excellence in operation. Some of these have the capacity to generate impact in the private sector and, under the appropriate circumstances should be able to compete and win funding from the research alliance suggested below.

2. *Economic development* success for a dedicated research facility within a specific research area or mission usually requires a jelling of independently validated scientific excellence (and thus the ability to compete at the national level), a real sense of the attendant technological opportunities and the range and/or generations of commercial applications and support from private industry. In the opinion of the research team, it is not apparent that these circumstances exist at needed levels in any new areas.

3. Strategic investment to develop dedicated R&D facilities is a dicey proposition by nature in that they aim at a moving target. The worldwide academic R&D environment is very dynamic and constantly shifting, and I-29 Corridor universities' R&D strengths are in (or should be in) a continuous process of development. In the opinion of the research team, at this point it is more important to develop the capacity to analyze the competitiveness of existing and emerging investment targets on an on-going basis.

4. Under the present circumstances, any funding that might be available to support university R&D should be devoted to cultivating, acquiring and supporting scientific talent with an entrepreneurial bent rather than building facilities to house the talent. In the opinion of the research team, to put it bluntly, strategic choices are imperative in this very constrained fiscal environment and it is better to have the talent than the building.

Virtual research centers that emerge from a body of work that can attract funding are a different matter and should be encouraged. However, for the purposes of this initiative, it is suggested once again that these virtual centers (which often need core labs) be funded on a competitive basis.

Action: The I-29 Corridor Task Force should work with its collective legislative delegation to lead an effort to create a South Dakota Research Alliance (SDRA) with the single goal of building the university and non-profit research enterprise as an economic development asset.

RTS understands the fiscal situation that South Dakota' s state government is confronting and the financial challenges posed for this recommendation; however, in view of the stakes and the relatively modest funding requirements, it would be a disservice not to offer this recommendation.

It is further recommended that SDRA be structured to accommodate the following programs and design elements.

As a statewide public – private research partnership with an economic development mission, the South Dakota Research Alliance's (SDRA) purpose would be to accelerate the growth of the state's economy by enhancing technology-based research, developing and attracting talent, encouraging technology commercialization, and nurturing entrepreneurial skill and spirit.

Programs

Three programs are recommended.

1. The Endowed Chair Program: SDRA should plan to fund two endowed chairs per year for five years. In addition to superior scientific credentials, candidates should have a profile that includes intellectual property creation, a commercialization history or entrepreneurial activities. For planning purposes, the chairs are budgeted at $2 million a year with a 25% match requirement from university sources. The funding can also be used for cluster recruitments to support the chair.

2. The Research Enhancement Program: This program is designed to support the work of the endowed chairs. Eligible funding activities would include laboratory capital improvement projects, post-award enhancements of projects with significant commercialization potential, planning grants to develop commercialization-oriented consortia and virtual centers, etc. For planning purposes, funding is budgeted at $2 million a year with a 25% - 50% match from university sources.

3. The Technology Transfer Support Program: This program will concentrate on building capacity to improve technology transfer of university intellectual property and/or expertise to already-established technology companies, as well as accelerating the successful launch of startups based on university inventions. It is intended to enable on-campus technology transfer operations, not to centralize them or displace them. (See technology transfer discussion in knowledge deployment recommendations.) Representative funded on-campus activities would include:

    - Training and professional development grants to technology transfer offices;
    - Grants to expand the scope and quality of commercialization training for faculty;
    - Awards to expand the activities with existing community-based technology councils, alliances, networks, or similar organizations;
    - Grants and matches to expand training and assistance in SBIR/STTR programs;

- Assistance for technical assessments, marketing analysis, intellectual property prosecution
- Salaries for staff

Governance

It is strongly recommended that a Board of Directors with a supermajority of the Board representing private sector interests govern this independent public-private partnership. The Board membership should also include the state's public university presidents. This Board of Directors will have final approval of all investment of funds and be responsible for setting policy for the organization. Once the initial Board is appointed, it is recommended that the Board be self-perpetuating.

Funding

Based on national best practice and on the experience of the members in running state and regional science- and technology-based economic development organizations (Ben Franklin Partnership, Louisiana Partnership for Technology and Innovation, Minnesota Technology, Inc, the Southern Technology Council) the following funding recommendation is offered.

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

The relationship between SDRA, an independently created non-profit organization, and state government will be very clear-cut. SDRA would propose an annual budget to be approved by the state legislature, which will include the various program funding levels. Once these requests are approved, the Sate would appropriate funding to SDRA through a state agency.

Public funds will not be provided directly to SDRA. These funds will be released to academic institutions participating in SDRA programs through a contractual arrangement between SDRA and the designated state agency.

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

Budget

For preliminary planning purposes, the annual program budget is estimated at $10 million a year. This includes $4 million for the two endowed chairs, $5.5 million for the Research

Enhancement Program and $500,000 for the Technology Transfer Program. This budget should be viewed only as a "point-of-departure" estimate.

The administrative annual budget to be funded by the private sector is estimated to be $500,000.

Implementation Notes

Getting Started

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

- It is recommended that SDRA begin with a fifteen member board with at least nine members coming from the private sector.

- As this is fundamentally an economic development initiative, it is recommended that the Governor's Office of Economic Development function as the designated state agency that contracts with SDRA and holds the program funding.

Budget

- The budget estimate assumes the following staffing: President, a Vice President or Operations Director, Administrative Assistant, and an Office Manager/Bookkeeper.

Knowledge Deployment

Outreach

As stated earlier, a key outreach finding is that although there is a good bit of effective ad hoc university outreach activity with industry in some locales, there is no scalable or routinely structured industrial extension activity to systematically respond to the needs of the region's manufacturing community – especially the very strong advanced manufacturing presence in the Sioux Falls, Brookings, Watertown and Yankton communities or to other important established and emerging sectors such as financial services/information technology, alternative renewable energy and biomedical devices, processing and materials.

Recommendation: Establish the South Dakota Industrial Extension Service

This recommendation aims at creating a statewide industrial extension service through affiliation with the previously described federal outreach program, NIST's Manufacturing

Extension Partnership (MEP). As is the case in a number of states, it recommended that the MEP presence be established through university-based centers and that the center for the eastern half of the state reside at South Dakota State University and affiliate with SDSU's College of Engineering.

Action: The I-29 Corridor Task Force should create a Committee to lead an initiative to establish the South Dakota Industrial Extension Service

South Dakota is the only state without an MEP Center being physically located in the state. MEP services for South Dakota are delivered through the Dakota MEP, which is headquartered in Bismarck, North Dakota with another staffed office in Fargo. . Of the fourteen Dakota MEP staff members listed on the organization's web site, only two individuals are located in South Dakota. The South Dakota partner and funding contributor for the Dakota MEP is the South Dakota Governor's Office of Economic Development.

It is recommended that the Committee in concert with the South Dakota congressional delegation and the Governor's Office work with the national MEP leadership in Gaithersburg, MD to establish a South Dakota center. The existing match funding now being submitted through the Governor's Office of Economic Development to the Dakota MEP office in Fargo should be used as the initial funding match.

Additionally, this also represents an opportunity, while meeting MEP program and metrics objectives, to design an industrial extension operation tailored to specific needs within state's regional economies and to deploy industrial extension is a way that extends its scope and effectiveness. Specifically, it is recommended that:

- The new industrial extension service link with and market the previously recommended on-campus internships programs and with SEEDS,

- That it link to the information systems and assurance capacity at DSU and offer these services to industry, and

- That it include manufacturing design assistance within its service menu by linking to design and engineering capacity within the region's universities.

Implementation Notes

- A good starting point for this initiative is to obtains a NIST MEP funding commitment if the state can deliver the match.

- The North Carolina State University Industrial Extension Service pre-dates the MEP by several decades and is a good best practice model to explore when it is time to develop an operating plan.

Recommendation: The I-29 Corridor Task Force should form a committee to explore ways to establish and market a creative economies initiative at the regional level.

Although an analysis of creative economy assets are well beyond the scope of this study, the subject is being introduced here in the form of a recommendation because university-based creativity, arts and design capacity represents a significant outreach opportunity.

The importance of art and design in promulgating economic growth in a region has become widely recognized. It can define a community's and region's amenities and culture and become part of its economic development fabric. Quality arts and entertainment can attract businesses and residents to a community. And arts are not just an amenity—design-intensive products allow regions to compete beyond just making things cheaper—regions can excel developing products that gain competitive advantage because of their aesthetics or because they are created using a process that reflects the region it was built—for instance crafted wooden doors in Montana that retail for thousands of dollars or mass produced hot sauce in Louisiana that is marketed around the world.

Action: As this Task Force Committee promotes a regional creative economies initiative it should consider the University of South Dakota as a major resource and map out a driving role for USD assuming the university leader is willing to participate. The digital arts and design program at Dakota State University should also be included in this effort as well arts and design capacity at SDSU.

As stated earlier in this section, in many regions of the country, universities and community colleges are leading the charge in helping the creative economy prosper. Whether it be the University of Southern Mississippi which helps its students learn how to run their own music label or North Carolina State University which teaches advanced design techniques to individuals hoping to craft new furniture or community colleges around the country that work with businesses to develop new design techniques, post-secondary institutions can and do play a major role in the development of the creative economy.

The University of South Dakota's College of Fine Arts is poised to do the same. The University offers BFAs in music, theater and the arts, and MFAs in such subjects as graphic design. These graphic designers can graduate from Vermillion and go into business for themselves, work at an advertising agency, or any number of creative careers. In many communities around the country, MFA programs provide services directly to companies with faculty and students acting as interns or consultants to help local firms become more creative.

In addition, Dakota State University's Digital Arts and Design Program features BS degree specializations in Computer Game Design, Audio Production, Computer Graphics, Digital Storytelling, Production Animation and Web Design and Production. This program bolsters the region's capacity to add value to products, processes and service through design and art and should be factored into any regional initiative.

Finally, academic communities can also be a significant source of amenities for a region. For instance, the world-renowned National Music Museum on campus marks Vermillion as an important cultural destination for lovers of all kinds of music. And the campus attracts performers and artists in residence who want to practice their art in a college town environment. More entertainment options can help communities, particularly those in rural areas, attract and keep highly skilled professionals.

Implementation Notes

- Graphic arts and design capacity and especially the Digital Arts and Design Program at DSU should also be included and marketed in industrial extension/SDMEP plans and services for industry.

- Any regional arts initiative should the corridor's economic development directors and it should also connect to the various arts and design-related organizations distributed throughout the I-29 Corridor.

- The Action component of the IdEA(Interdisciplinary Education & Action) program at the University of South Dakota, part of an institutional graduation requirement, can be community service-learning, research, or creative activity. It might be worthwhile to explore using this program and its capacity to involve students in community-based creative endeavors as one way to help develop and implement creative economy projects throughout the region.

Technology Transfer

The university and non-profit research organizations technology transfer offices and functions are a critical economic link to the regional economy because they are the channel through which commercializable intellectual property moves into the private sector. The key findings for this portion of the analysis outline a circumstance in which the technology transfer offices through the region, all of them created within the last few years, are playing a twenty-year catch-up game as most of their peer institutions began established full service office throughout the 1980's and early 90's.. As a result, these offices are trying to both startup and catch-up; i.e., they are implementing practices and policies, marketing the program and reaching out to faculty and connecting to private sector players, building the "culture" while also conducting the work of technology transfer such as processing disclosures, filing patent applications, constructing and negotiating licenses, performing market assessment, processing non-disclosure agrements and so on. Given these demands, the level of staffing across these offices is limited and stressed in view of the task at hand. To complicate matters, on many university campuses, entrepreneurship centers or programs provide ancillary services to the established technology transfer offices, however in South Dakota those program are themselves in early stages of development and mostly confined to instructional activities and student-focused programs.

Recommendation: The economic development community throughout the I-29 Corridor should work with the region's universities and the non-profit research organizations when appropriate to bolster, connect, focus and support their technology transfer efforts as they have a vested interest in their success.

It is suggested that this recommendation be implemented through the following actions.

Action 1: Support the establishment of the South Dakota Research Alliance.

As previously described, the SDRA Technology Transfer Support Program is designed to support and enable on-campus technology transfer functions.

Action 2: Support efforts to make South Dakota companies, startups and jobs the top Technology Transfer Office priority for publicly funded universities as opposed to maximizing licensing revenues.

Hearkening back to the key design principle #3 for this phase:

> **Premeditated Technology Transfer:** Simply bolstering the research enterprise won't work unless you have a good mechanism to move the research outcomes into the private sector. Simply moving the research outcomes into the private sector is inadequate if the intent is grow jobs, companies, incomes and wealth within South Dakota. While licensing a technology to an out-of-state company is a victory for the university it is not a victory for South Dakota when the jobs and income are captured elsewhere. In short, we must be good at licensing to, starting and supporting the growth of South Dakota companies. When we talk South Dakota technology transfer we should also ask, "To Whom?" This begs the question of developing strategies to increase the number of potential private sector licensees for startups and existing South Dakota companies.

This is easier said than done in that there will be instances when, in order to honor this priority, the university will have to forgo a larger upfront payment or take additional risk when electing to deal with a company in the region. Pursing the longer term economic gain for the region and state rather than the short term income from the upfront payment requires understanding and support from the university leadership.

Action 3: Seek funding support outside the general university budget.

Support efforts to secure additional funding support for Technology Transfer Office operations and staffing from sources outside the university such as alumni organizations, local and regional foundations with economic development missions, private donors and companies, and state and federal sources. More support is often needed for technical assistance for intellectual property management, commercial assessments, patent prosecution, marketing and technical feasibility assessments.

Action 4: Seek to enable the Technology Transfer Offices but don't centralize them.

In the judgment of the research team, centralizing the technology transfer function for all the universities and campuses is destined not to work – especially as the disclosure volume increases. Campus cultures, not just in teaching and research, but also for outreach and marketing activities tend to be very different and often not compatible. Perhaps more importantly is the likelihood of conflict of interest, conflict of commitment and favoritism issues when dealing with multiple campuses.

Action 5: Connect technology transfer personnel to the local and regional economic development community's awareness of new and established technology and knowledge intensive firms.

A communication vehicle or practice should be established that gives the local economic development organization in each university's community the responsibility of assuring that the technology transfer and sponsored research operations are aware of new and existing technology companies in their areas of R&D and applications interest. This should be an on-going function and a helpful response to the local versus out-of-state licensing issue. On one hand, it makes no sense to expect a technology transfer office to license in-state when there are no licensing candidates. On the other hand, it is possible to structure even-handed agreements that would allow in-state startups and young companies to fairly compete for licenses against major corporations by lowering upfront cash requirements but back-end or performance-based payment terms. However, the university must first be aware these companies exist.

Action #6: Support the formation of an I-29 Corridor Technology Transfer Alliance

It is recommended that representatives from the technology transfer and sponsored research operations from South Dakota State University, the University of South Dakota, Dakota State University, Avera Research Institute and Sanford Health meet as a group once a quarter to trade information on disclosures, research capacities, and facilities that are being actively marketed by the groups members as well as needs of licensees and area companies that they interact with (capital, personnel, etc.)

Action #7: The economic development professionals in the three university communities should support on-campus efforts to build a fully realized technology transfer and commercialization network that connects to the local and regional innovation infrastructure and to the private sector.

As stated in the key design principle #5 for Phase 2 that addresses the need for networks,

> Excellence of university R&D and the astuteness of university technology transfer offices notwithstanding; early stage technology from academia does not commercialize itself. The processes of technological innovation and commercialization involve an interacting set of organizations and individuals, almost all of whom are external to the research university. They may include: law firms with IP expertise, equity investment firms and solo angels, outsourcing specialists, management and human resource experts, product development specialists, manufacturing engineers, plant designers, and many other experts. In order to facilitate the processes of commercializing academic science and technology, these specialty assets need to be relatively dense within a region—and hopefully adjacent to a university—as well as extensively "networked" with each other.

The on-campus networks can be built in a series of small steps and initiatives such as business startup courses and training for faculty and graduate students or courses that teach intellectual property management and commercialization analysis to more comprehensive approaches that integrate commercialization package competitions based on faculty disclosures and business plan competitions based on commercialization packages to activities connect to incubators, university research parks, student internships in technology companies, and risk capital providers including angel investors.

Entrepreneurial Culture

A number of the recommendations and actions suggested in the Talent Development and Deployment, Knowledge Development and Knowledge Deployment sections above are also designed to enable and advance *entrepreneurial* culture on-campus. The research team offers one additional recommendation in this section.

Recommendation: The I-29 Corridor Task Force should actively encourage the creation of an Entrepreneurship Center at South Dakota State University.

Such a Center would be a place for a full range of entrepreneurship education elements to coalesce. It would allow for the blending of curriculum-based learning with experiential learning. It could employ expert faculty and successful practitioners as lecturers. It could function as a vital resource for entrepreneurial activities such as competitions, teambuilding, capstone courses, public lectures, and continuing education. It could also function as the entrepreneurial outreach channel to the community and the region (see implementation notes below). Finally, it should be noted that such a center should connect to and "feed" the region's private, non-profit organizations that support startups and entrepreneurial behavior.

Implementation Note

- A process that could lead to the creation of such a center is already underway at SDSU. If successful, it could 1) provide entrepreneurial outreach and technical assistance support to companies throughout the region, 2) work through the industrial extension network (if and when that is established) to provide entrepreneurial assistance to the manufacturing community and 3) support entrepreneurial activities at the other I-29 campuses and incubators outside of Brookings including the South Dakota Public Universities and Research Center (University Center) in Sioux Falls, Sanford Research, Avera Research Institute. the Technology Business Center in Sioux Falls and the Heartland Technology Center in Madison.

- Consistent with Sioux Falls University Center's mission to provide local lifeline learning access to academic services and programs from the state's six regental universities, consideration should given to establishing an SDSU entrepreneurship center satellite presence at the UC with links to its GEAR Center and to the Technology Business Center as well as Sanford Research and Avera Research Institute. Credit and non-credit courses in entrepreneurship-related subjects such as business planning and commercialization analysis might prove to be a substantive economic development asset in view of Sioux Falls' position as the regional growth engine, the local population and establishment density, and the constellation of medical, biomedical engineering and materials research activities associated with the GEAR Center, Avera Research Institute, and/or Sanford Research. Courses should be offered on nights and weekends to accommodate demand from part-time students and those who are already employed.

University-Community Linkages

As described earlier in this document, university – community linkages are important because they are the major and strategic connections that enable university participation in generating economic development results at the regional level.

The major finding from this portion of the analysis is that the public and non-profit capacity to support university-associated science and technology-based economic development is well ahead of the universities' research enterprises and entrepreneurial cultures capacity to generate opportunities. In a nutshell, the infrastructure and elements are there to enable the movement of knowledge, know-how, talent, and valuable intellectual property from universities and research institutions into the private sector. There needs to be more commercially viable knowledge, know-how, talent and intellectual property to enable.

Recommendation: The economic development professionals in the four communities with university research facilities (the GEAR Center is included in this mix) should support efforts to build more comprehensive and robust entrepreneurship, commercialization, talent deployment and outreach activities on campus and help organize efforts on their innovation infrastructure side to connect to the on-campus networks.

While the economic development community isn't responsible for the "university side" of this relationship, it can support university efforts in two ways. First it can play the role of public advocate and help the university identify outside funding sources when appropriate. Second, the economic development community can make sure that the innovation assets they control like incubators, research parks, early stage capital funds in non-profit settings, and internship programs establish policies and practices that make it easier to work with universities – not more difficult.

Action 1: The economic development community should specifically support efforts to build strong university-connected entrepreneurship support systems.

See Technology Transfer Recommendations Actions 5 and 7 and the Entrepreneurial Culture recommendation.

Action 2: The economic development community should help the universities establish and expand on campus internship programs that place undergraduate and graduate students in the region's companies (including startups) and research institutions.

See Talent Development and Deployment Recommendations, Action #1.

Action 3: It is recommended that the economic development community form a formal regional innovation infrastructure network.

Connecting these very substantive assets into a network that can move information quickly, effectively resolve differences and address common issues is a good first step toward forging a regional innovation system. Examples of the groups that should be in the network include the Innovation Campus and BioSpace in Brookings, the South Dakota Technology Business Center, GEAR Center, and Sanford Research Park in Sioux Falls, the Heartland Technology Center in Madison and the incubator in Vermillion.

Action 4: Establish a Proof of Concept Fund to validate promising university-based technological opportunities and to bridge the gap between research grant funding and early stage private investment funding.

This recommendation is presented in the university-community linkage section of the analysis because these proof of concept funds are often administered by non-profit organizations that are part of the innovation infrastructure. From a private, for profit perspective, these are very high risk funds that target the earliest stages of the commercial development process. Because they are invested in small amounts (usually $25,000-$100,000) this means they are also expensive to administer (high overhead per deal). Private providers shy away from these kinds of funds because they are basically a bad for-profit business model. Providers can take less risk by moving to a later stage, and be subject to less dilution without sacrificing a big decrease in return.

The fund could be administered by an organization like the South Dakota Research Alliance if it existing. Otherwise, it is recommended that the fund be administered outside of government by a non-profit and professionally staffed organization. They should be awarded on a competitive basis using good practice venture investing criteria. It should be noted that a proposed plan for such a fund has recently been developed by South Dakota Innovation Partners and the South Dakota State University Technology Transfer Office.

The Region Works

A number of the recommendations and actions offered at the conclusion of Phase 1 and 2 focus on opportunities at the local and sub-regional level. This makes sense as each of the I-29 Corridor's communities have different assets and aspirations. In addition, as discussed at various points in this document, the economic realities of the I-29 Corridor highlight a series of overlapping sub-regions that shift depending on the sector or cluster or need. . For example sub-regional workforce development efforts appear to offer significant value particularly due to the strength of the region's manufacturing sectors. Additional roles for sub-regional collaboration include urban-rural connections, integrating university assets into sub-regional economies and developing the creative economy to enhance tourism and quality of life. However, there is still an important aspect of a future growth strategy for the I-29 Corridor that has not been addressed.

There remains a powerful argument and strong need to organize and function at the regional level. The I-29 is Corridor connected through common infrastructure and its communities are networked in employment and trading patterns, one way or another, to its Sioux Falls hub. The need for some joint action at the regional level has never been more acute. The region's companies, economic development organizations, and education and training service providers function in an intensely competitive environment in which even multinational corporations form networks to extend resources and reach. Broad partnerships are required among those parties with common interests to bring the region's full range of economic development assets in to play, to extend and leverage local resources and to create new regional competitive advantage

Recommendation: A regional SD29 Alliance should be established to market the I-29 Corridor and support economic development initiatives that benefit the entire region.

ACTION – The natural starting point for this effort is for the I-29 Task Force to explore ways of transforming itself into this type of organization. The Task Force membership already includes the region's major economic development actors and could be expanded as warranted.

ACTION – At the outset, the Alliance should come together as a way of marketing the region, leveraging the assets of the economic development, business and academic communities. Opportunities will arise from this joint marketing, that will, in time, strengthen the relationships between the various organizations and lead to new economic activity and growth.

The region has a broad range of assets including the substantial advanced manufacturing presence, the strong financial services and information services sectors, burgeoning concentrations in alternative energy and biomedical technology, three public universities with distinctive and different profiles, research parks, recreational options and so on.

After it begins its marketing work, the next logical step for this organization is to lobby for economic development initiatives that benefit the entire region. As the most populated area of the state with the largest legislative delegation, the regional organization could serve as the vehicle to forge consensus and lead lobbying efforts. As a starting point, there are several recommendations and initiatives offered in this strategic plan that the new organization could embrace, including:

- The I-29 Corridor Task Force should work with its collective legislative delegation to lead an effort to create a South Dakota Research Alliance (SDRA) with the single goal of building the university and non-profit research enterprise as an economic development asset.

- The I-29 Corridor Task Force should create a Committee to lead an initiative to establish the South Dakota Industrial Extension Service.

- The I-29 Corridor Task Force and economic development professionals in the three communities that host the universities should work with the respective alumni organizations to identify and "claw back" talented graduates that reside outside the region.

- The I-29 Corridor Task Force should launch and support an initiative to retain higher education graduates, especially those in science and engineering fields and recapture talented graduates that have left the state. Internship programs either modeled on the statewide Dakota Seeds program or functioning as adjuncts to the program should be established with a physical and robust presence on the campuses of Dakota State University, South Dakota State University, the University of South of Dakota and the University Center in Sioux Falls.

- The I-29 Corridor Task Force should form a committee to explore ways to establish and market a creative economies initiative at the regional level and, if appropriate, the sub-regional level.

- The I-29 Corridor Task Force should support the formation of an I-29 Corridor Technology Transfer Alliance

- The I-29 Corridor economic development community should establish a formal regional innovation infrastructure network.

Implementation Notes

- The new regional alliance could be established as a public-private partnership or as a private economic development corporation with no government funding. Other states have found these to be effective organizational structures through which regional cooperation could be achieved. In either case though, it should seek a 501(c)(6) non-profit charter.

- Another option is to organize the alliance as a formal network (but not a formal organization) based upon a memo of understanding and operating agreement among the members. The network executive director position could be rotated among the CEO's of the region's economic development organizations on an annual basis.

- Depending on organizational form, staffing and scope of operations, the funding could range from minimal (less then $100,000) with contributions from the region's economic development organizations to more significant levels ($500,000 or more) with contributions from the economic development organizations and cities and a business membership base. In some states such as Virginia and North Carolina, the state government also contributes support to regional partnerships.

Appendix A: Toward An Entrepreneurial Culture in Academia

The Culture Issue

It is useful to first develop some understanding of what is meant by this term in this context, how it manifests itself in the university environment, and how it relates to the issue of developing a university-based economic development strategy for the I-29 Corridor and eastern South Dakota.

Conceptions of Group and Organizational Culture

Following from Edgar Schein,[14] who has written widely in this area, one can define a group's culture as:

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

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

Assumptions about the nature of work. In the normal world of academia, work is defined as scholarship, research, and instruction, usually done in a thoughtful and measured manner. The work and decision patterns in a fast-moving startup company may be seen as foreign and hostile—so too, the faculty member who gets involved therein.

Assumptions and beliefs about what is truth or evidence. In normal science, truth is defined by the paradigms of the disciplines and the norms of the research publication. Truth or evidence in the context of a startup may be much more qualitative, approximate or "good enough." Illustratively, the patents that may form the basis of a technology enterprise (in which a faculty member may be become deeply involved) are typically not seen by academic peers as embodying truth in the same manner as a peer-reviewed journal article

Assumptions about legitimate communication patterns. In the world of scholarship and research, communication patterns are very precise, measured and often drawn out. In the entrepreneurial world communication is much more attuned to norms of trust, engagement, speed, and directness.

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

Assumptions about time, schedules, and deadlines. In the entrepreneurial world time is critical and non-adherence to deadlines may mean betting the company. In the world of the academic scientist working on a grant, the typical plan of work may be flexible and iterative and milestones adjusted as the work unfolds over a period of years.

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

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

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

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

Growing an Academic Culture FOR Technology Entrepreneurship

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

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

"Goddamnit, science has to produce something useful. That's the payback to society for support of the enterprise." [15]

The Role of Culture Leaders

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

The Potential for Tipping a Culture

The most important aspects of entrepreneurial culture are in people's heads, not written down on paper. At critical points in a career (e.g., graduate school), science and technology professionals become imprinted on key assumptions, beliefs, and values. Henceforth they carry those cognitive and affective structures from one job to the next, and once in a job they try to execute their beliefs—and convince others to do the same thing. Ergo, the easiest way to positively tip a culture—such as a university—along the lines of being more entrepreneurial about technology development and commercialization, is to get the right heads in the right chairs. A vocal, articulate minority can slowly tip an organization's culture, and hence its practices, behaviors, policies and outcomes. A fascinating recent study[16] of the technology

15Collins, H. The Man Who Saved Your Life – Maurice Hilleman – Developer of Vaccines for Mumps and Pandemic Flu. The Philadelphia Enquirer, August 30, 1999.

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

transfer performance of departments in two nationally prominent medical schools found that a key predictor of invention related activity (e.g., disclosures) was the number of department chairs and faculty members who had graduate degrees from Stanford—a widely acknowledged national leader in research, technology development and technology commercialization. Thus the "right heads" shifted the culture in the right direction.

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

The Power of Intellectual Engagement Around Culture

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

Entrepreneurial Education and Training

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

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

Benchmarking Academic Culture: The Problem

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

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

Entrepreneurial University Cultures: Indicators and Examples

This section focuses on "cultural reinforcing" activities among a small group of universities that are very good indeed at commercializing technology through the startup mechanism. The focus is particularly on the recent Milken Institute analysis of university technology transfer and commercialization, and focus on the top-2017 public and private U.S. institutions in terms of

17 In the Milken report the University of California is treated as a single institution. It is actually made up of many institutions, and each campus has quite distinct cultures. It was eliminated. So was

startup performance. Various activities are identified—primarily outside the confines of the technology transfer office per se, but that arguably help in campus excellence in and acceptance of entrepreneurial technology commercialization. These include:

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

MIT

Not surprisingly, MIT ranks first on the overall Milken index and also 1st on the Startups Score. Entrepreneurship is endemic in the culture of MIT, and people talk in terms of culture. If one types "MIT entrepreneurial programs" into a search engine the number of hits is phenomenal. They span the gamut18—clubs, the nationwide MIT forums, entrepreneurial awards, entrepreneurial competitions, a world class Entrepreneurial Center, training and seminar programs for startup executives and technology transfer officials, the Cambridge-MIT Institute to foster UK entrepreneurship, and on and on. One important part of all this is that MIT people talk comfortably about their entrepreneurial culture—something that adds significant value to the institution.

Cal Tech

A long-time center of technology startups, Cal Tech ranks 2nd on the Startup Score index of the Milken rating scheme, despite a student body of only 900 undergraduates and 1200 graduate students. The relative emphasis on entrepreneurship is strong, starting at the top. The president, Dr. Jean-Lou Chameau, is a vocal advocate of entrepreneurial careers and activities, and built much of Georgia Tech's prominence in that area while Provost there. A number of organizations and groups carry on the message. There is a Caltech Enterprise Forum, modeled after the MIT forum, which meets regularly with speakers directly involved in tech startups and related activity. There is an active student Entrepreneurs Club and coursework and seminars

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University of British Columbia given the distinct differences in Canadian fiscal and governance practices.

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

around the topic. Pasadena Entretec, a non-profit that is independent of the university but located on campus, is a source of advice for budding entrepreneurs. The Caltech Industrial Relations Center also provides seminars with technology-based companies, and is a host of the Venture Forum. Caltech and the renowned Art Center College of Design in Pasadena were supported by the NSF Partnership for Innovation program to create entrepreneurship fellowships oriented toward developing startup business skills.

Stanford.

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

University of Florida

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

Brigham Young University.

BYU ranks 4th on the Startup score of the Milken rankings. In addition to its strong, startup-oriented technology transfer office, entrepreneurship themes are present throughout the institution. The Center for Entrepreneurship has been ranked 12th in a national survey of such program, and given plaudits for its hands-on emphasis. The latter is enabled by a network of

Entrepreneurial Founders (now more than 140), each of whom commit to a minimum gift of $15K plus annual sustaining contributions. More importantly, the founders assist in classroom teaching, mentor students in starting their own business, and host or arrange internships. This emphasis on entrepreneurship goes beyond the business school. In the Department of Electrical and Computer Engineering, the second objective of the degree program is to prepare graduates to "obtain industry employment, *engage in technology-based entrepreneurship*, or complete further study in postgraduate programs." (Emphasis added.)

University of Minnesota

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

University of Michigan

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

University of Utah

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

Appendix B: University Benchmark Communities

In this Appendix we will be presenting case-based observations and lessons that frame the overall strategy for university economic development engagement within the I-29 Corridor communities and inform this document's recommendations and actions.

The college town cases in this section of the report were selected because they mimicked many features of the South Dakota context:

- They were for the most part distant from major metropolitan areas
- They were modest but growing in their university-based sponsored research activities (generally between $25-100M)
- They tended not to have a large company "anchor tenant" in the contiguous community that could drive the development of a technology cluster

On the other hand the cases represented positive stories, novel policies and practices and things that might be adopted or adapted in South Dakota. It is important to mention that there were no examples among these cases in which one single factor or influence accounted for success. In contrast, the stories illustrated the interactions of several influences that seemed to reinforce one another. These included: visionary university and/or town leadership, at several levels; aggressive and smart approaches to technology commercialization and/or "transfer"; a burgeoning culture that supported change and trying new approaches; and the presence of notable efforts to foster entrepreneurial curriculum, programs and activities that also engaged the non-college community.

There was no perfect example of a robust town-gown growing like wildfire, although our team had favorites. In approaching these cases the reader should not look for perfect translations into the South Dakota setting, but look for things that pique the imagination and which can be modeled to some degree.

The four institutions profiled are:

- Brigham Young University in Provo, Utah
- Michigan Technology University in Houghton, Michigan
- Montana State University in Billings, Montana
- Ohio University in Athens, Ohio

Brigham Young University

The University

Brigham Young University (BYU) is a private selective university located in Provo, Utah. While not as geographically isolated as other cases reviewed here – it is 44 miles from Salt Lake City – it is nonetheless notable by being a primarily undergraduate teaching institution that was founded and is still supported and owned by the Church of Jesus Christ of Latter-day Saints (LDS or Mormon Church). Virtually all of the students are LDS by religious affiliation, and the linkage with the church has enabled a relatively lower cost educational experience (for LDS students). Notably, most male students will at some point undertake a 2-year mission somewhere in the world to advance the message of Mormon Church.

A precursor to BYU, the Brigham Young Academy, was established with basically a secondary school mission. In 1903 the Academy was dissolved and replaced by Brigham Young University along with a parallel Brigham Young High School. Over the course of the early 20th century BYU evolved from an institution that was somewhat shackled by its religious affiliation to one that is a nationally respectable center of education and scholarship across the disciplines, including the sciences.

The university enrolls approximately 30,000 students (fall, 2009), evenly split between men and women, with average high school GPAs of 3.8. Enrollment is highest in the College of Life Sciences, closely followed by Family, Home & Social Sciences, then the College of Management, College of Fine Arts & Communication and the College of Engineering. The College of Humanities, College of Education and College of Physical and Math Sciences occupy the next rung by enrollment. Bachelor's degrees are offered in 186 majors, master's degrees in 64, doctorates in 64, plus a juris doctorate.

According to NSF statistics[19] in FY 2007 Brigham Young realized $26.6M in total R&D expenditures, with the largest fractions coming from engineering ($11.3M), life sciences ($7.6M), physical sciences ($3.1M) and social sciences ($2.0M).

Several programs have achieved high national rankings. For example, in 2009 rankings: the Wall Street Journal ranked the MBA program #1 among regional schools and US News and World Report ranked it #29 nationally; the Public Accounting Report ranked the Master's Accounting program #1 and the undergraduate Accounting program #3, while US News and World Report ranked it #4; and Business Week ranked the undergraduate business program #5.

[19] National Science Foundation. Table 38. R&D expenditures at universities and colleges, ranked by all R&D expenditures, by science and engineering field: FY 2007 (http://www.nsf.gov/statistics/nsf09303/pdf/tab38.pdf)

The Region

BYU is located in Provo, UT (population approximately 120,0000) which in turn is within the metropolitan area anchored by Salt Lake City (population, approximately 190,000) and extending to include Summit and Tooele counties with a total population of over 1.1 million. While Salt Lake City (SLC) has an economy that is relatively service-oriented, including much of the administrative structure of state government as well as that of the LDS church, the Provo area economy is much more diverse including a heavy representation of software companies, ranking in the top tier nationally. Thus Novell, Symantec and Corel anchor the sector, along with dozens of smaller and startup companies. There is also a growing concentration of biotech and biomedical companies that is nationally significant on a per capita basis.

While there is a fairly robust and growing technology sector in the SLC/Provo area, it should also be emphasized that Utah as a state is fairly low in population (2.8 million) and geographically isolated from the more robust technology clusters and centers of venture investment in California and elsewhere. Balancing this relative isolation however has been state policies and programs that have helped spawn technology entrepreneurship. These include, for example, the Utah Small Business Development Center, the Utah Microenterprise Loan Fund, and the Utah Office of Technology Development (including its Centers of Excellence Program).

Relevance to I-29 Corridor

BYU, while a church-affiliated private institution, is an excellent example of how a smaller school (in terms of sponsored research expenditures) can play an important role in enabling a regional technological, entrepreneurial economy. While one can argue that this is relatively easy to accomplish in an environment such as greater Provo, it is important to realize that Provo wasn't always "greater" in terms of being a center of technology-based companies. South Dakota-based institutions could emulate much that has been accomplished by BYU in Provo, and in a way the BYU story might be considered as a preview of potential future attractions in the I-29 Corridor.

Benchmark Programs

Two strongly interconnected areas of activity are notable and highly relevant for I-29 corridor campuses, and perhaps more importantly for the business community in South Dakota as well as among entrepreneurial alumni within the upper Midwest region. One concerns the operations of the technology transfer office at BYU; a second is the close connections between community technology entrepreneurs and enrolled students, and the resultant mentoring and "culture enhancement" that result.

Technology Transfer

BYU has probably the richest staffing ratio among any university belonging and reporting to the Association of University Technology Managers (AUTM). According to AUTM data[20] for 2008, BYU lists 4 licensing FTE staff in their technology transfer office, which computes to a staffing ratio of 1 licensing staff person per $6.5M of research expenditures. This is unparallel among over 200 universities and medical centers reporting to AUTM (the University of Minnesota comes close, with a ratio of one staff person per $9.7M of research expenditures, but few others). Also notable for a small institution, BYU started their office in 1986, relatively early after the passage of Bayh-Dole. As a benefit, they are decades past the "ramp-up" overloads experienced in many late starter institutions, including those in South Dakota. Even with this generous cadre of staff, the de facto staffing ratio at BYU may be considerably richer. The office claims to use upwards of 6 student interns on a relatively regular basis.

There are several other interesting approaches that the BYU technology transfer office enable its success. For one, it conducts weekly face-to-face meeting in key departments around the university to get an early awareness of findings coming out of faculty research that might have implications for commercializable technology. The office has also signed up various Utah based entrepreneurs as Entrepreneurs in Residence to assist in evaluating the potential of emerging technologies. The financial return to faculty inventors from licensed technologies is generous: 45% of royalties can go to the inventor. Moreover, if the inventor opts to forego personal return, 90% of all licensing revenues can be dedicated to his or her research program. Both of these schemes create incentives for faculty to be involved in technology transfer.

Not surprisingly, the profile of the IP portfolio tends to reflect the emphases of the more active research program on campus as well as the technology economy in the region. Thus, among technologies available for license, most are in computer software and hardware, followed by mechanical devices and processes, biotech/biomedical and chemistry.

As a result of staffing ratios and staff deployment practices enabled by a larger staff, BYU has achieved technology transfer outcomes, particularly in the area of startups, which have achieved national attention. One notable example in Business Week in December of 2009 pointed to the accomplishments of "Brigham Young's Entrepreneur Factory" (http://unicomm.byu.edu/files/byu-business-week-proof.pdf). Thus according to AUTM 2008 statistics BYU achieved one invention disclosure for every $285K of research expenditures, which is far and away better than Stanford ($1.57M/disclosure), Florida ($1.62M/disclosure) and MIT ($2.5M/disclosure). In terms of licenses/options executed in 2008, BYU achieved one license/option per $906K of expenditure. National leaders had great performance levels that were nonetheless dwarfed by BYU: MIT's ratio was one license/option per $13.4 M; Stanford's ratio was one license/option per $6.5 M; U. Florida's batting average was one license/option per $6.4M. BYU reported 9 startups in 2008, or 1 per $2.9M of expenditures. The national leaders' data were great but not at the level that BYU reported: MIT produced one startup per $66M of research expenditures; Stanford had one startup per $77M of expenditures; U. Florida produced one startup per $34.5 M of expenditures.

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[20] Association of University Technology Managers, FY 2008 Licensing Activity Survey

It should also be noted that there exists on campus a Creative Works Office, which is separate from the technology transfer office and has its own manager and staff complement. Reflecting both the religious tradition and orientation of the school, and its strengths in the fine and performing arts, the Creative Works Office has responsibility for protecting and licensing the intellectual property associated with film, curricular materials, and educational software, mostly via copyrighting. It is likely that the activities associated with the Creative Works Office contribute to the general campus orientation toward and support of commercializing the outcomes of research, scholarship and creativity.

Fostering Entrepreneurship Inside and Outside.

As noted above, the contiguous community in greater Provo and Salt Lake is quite robust for a relatively small population state that is surrounded by hundreds of miles of desert and arid land. In addition to operating what appears to be an energetic and imaginative technology transfer office, the University seems to link up with that community in various creative ways. For example, student mentoring and student project is a significant emphasis at BYU.

The Rollins Center for Entrepreneurship has been ranked 12th in a national survey of such programs, and given plaudits for its hands-on emphasis. The latter is enabled by a network of Entrepreneurial Founders (now more than 140), each of who commit to a minimum gift of $15K plus annual sustaining contributions of $5,000. Through these and other advancement activities, the Rollins Center has achieved an endowment of over $3M and an annual operating budget of $750K,

More importantly, the founders assist in classroom teaching, mentor students in starting their own business, and host or arrange internships. This emphasis on entrepreneurship goes beyond the business school. For example, the mentoring program operated by the Rollins Center (www.getmentoring.com) is open to any student enrolled at BYU. The mentoring experience is structured so as to match students seeking mentorship with a profile of an appropriate business mentor. The Center also organizes the teaching of entrepreneurship classes designed for non-business majors. The large number of student research projects, typically involving involvement by a BYU faculty member, also likely enhances the entrepreneurial tendencies of the student body.

In addition the Founders program provides classroom instruction in both an informal and as-needed basis and also as part of an Entrepreneur Lecture Series. It also hosts annual Founders Conferences plus competitions (with financial awards) for business plans and student-rung businesses. Many of the Founders arrange internships for students in their businesses or in other settings in the community.

Outside of the Rollins Center and the Mariott School of Business, there is emphasis across the campus on building awareness and endorsing innovation and entrepreneurial activities. Illustratively, in the Department of Electrical and Computer Engineering, the second objective of the degree program is to prepare graduates to "obtain industry employment, ***engage in technology-based entrepreneurship***, or complete further study in postgraduate programs" [emphasis added]. Also, in the College of Engineering, there are experimental efforts underway in the School of Technology to deliver an Innovation Boot Camp which is implementing concepts from IDEO and "design thinking" to enable students to engage in rapid development of new technologies, through brainstorming, ideation, soft prototyping and similar approaches. In addition to these activities on the Provo campus, BYU-Idaho, which is in effect a branch campus in an adjoining state, is offering an entrepreneur program which includes class work, internship placement, competitions and links to local entrepreneurs.

Lessons for the I-29 Corridor

There are two takeaways from BYU that are probably most instructive for institutions and stakeholders in the I-29 corridor:

- While the greater Provo region is a much more technologically intensive area than the I-29 corridor, it nonetheless provides some useful lessons for South Dakota. For one, in order to get traction and reach national levels of performance in technology commercialization, universities need to bite the bullet and in effect overstaff their technology transfer offices. Since the South Dakota institutions are fairly late in the game, this is doubly so. In addition, to simply adding staff, the technology transfer offices, with strong political and organizational support from institutional leadership, needs to "walk the halls" and engage with researchers and academic administrators all over the university, as well as with potential partners in the community, such as angel investors and commercialization sites.

- A robust, visible Entrepreneurship Center – working across the campus – can be an important vehicle for cultural change and for enabling "deal flow." Thus in addition to fostering and delivering entrepreneurship education and curricula, it is doubly important that entrepreneurship programs also be used as a vehicle to pull in technology entrepreneurs from the community, foster hands-on education of students (and faculty, for that matter) and build communities of interest across the institutions.

Michigan Technological University

The University

Michigan Technological University (known as Michigan Tech or MTU) is a small but nationally prominent university that dates from the late 19^{th} century, when its primary *raison d'être* was to serve the then burgeoning deep mine copper extraction region in the area. It was started as the Michigan Mining School in 1885. Reflecting that history, the enrollment (7,132 fall, 2009) is heavily weighted toward the College of Engineering (56.3%), followed by Sciences and Arts (23.9%), Business and Economics (6.9%), School of Technology (5.9%) and School of Forest Resources and Environmental Science (3.5%). The university offers 25 PhD programs and 33 Masters degree programs, with the majority of both in science and engineering areas. Graduate degree programs account for 16.7% of total enrollment, enabling to a significant degree the execution of a commendable record of sponsored research. According to NSF statistics[21] in FY 2007 Michigan Tech realized $55.3M in total R&D expenditures, with the largest fractions coming from Engineering ($33.1M) and Environmental Sciences ($12.4M). Additionally, US News & World Report ranked three graduate programs in 2009 in the top 50 nationally: environmental engineering, mechanical engineering and materials science and engineering.

The Region

Michigan Tech is located in Houghton, MI (population 15,000, including some continuous villages) on the Keweenaw Peninsula of upper Michigan. The peninsula juts into Lake Superior, and is dotted with dozens of ghost towns and abandoned mines from the glory days. When the mines ceased production, mostly by the 1950s, much of the guts of a high wage economy (except for MTU, and government-related organizations and services) left the region. Outside of these, much of the regional economy has been focused on summer tourism, winter skiing (200 annual inches of snow) and fishing. Houghton is also a jumping-off port to take backpackers to Isle Royal National Park, which is 70 miles out in the lake. A popular item for sale in the MTU bookstore is a picture postcard depicting a road sign (fake) announcing relevant local mileage as: "End-of-Earth 2, Houghton 4." Reflecting the diverse European immigrants who came to the Upper Peninsula to mine copper and iron ore, the region also has the largest population of individuals with Finnish ethnic backgrounds outside of Finland. MTU is well over 200 miles from any major metropolitan area, which would include Detroit and Grand Rapids in southern Michigan, and Chicago/Milwaukee to the west.

Relevance to I-29 Corridor

Michigan Tech is clearly an institution that is a somewhat "stranded asset", located in the far northern and lightly populated reaches of a technologically rich state. Nonetheless, the school -

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[21] National Science Foundation. Table 38. R&D expenditures at universities and colleges, ranked by all R&D expenditures, by science and engineering field: FY 2007 (http://www.nsf.gov/statistics/nsf09303/pdf/tab38.pdf)

in partnership with regional public and private organizations- has made a deliberate and disciplined effort to contribute to the regional and state economy, through a variety of approaches, particularly getting better at technology transfer, and emphasizing business incubation in collaboration with regional partners. While the rationale for taking this path are somewhat obscured in the fogs of history, there seem to be two that were important and mutually reinforcing: (1) being a good institutional citizen in the state and region by fostering the beginnings of a technology cluster in the contiguous area; and (2) by being successful at cluster development becoming a more attractive destination for potential faculty and staff hires with talented spouses wanting parallel careers, as well as increasingly being a magnet for graduates, new and old.

Benchmark Programs

Two areas provide some interesting examples of practices and policies that may be of relevance to I-29 corridor campuses: the evolution and successes of technology transfer at MTU and the growth of community partners in the service of startup incubation.

Technology Transfer

It is symbolically notable that the office that handles technology transfer responsibilities (disclosures, patenting, licensing, start-ups) at MTU is called Technology and Economic Development. The office is staffed at level that is commensurate with high-performing institutions, with AUTM data[22] for 2008 indicating a ratio of 1 licensing staff person per $20M of research expenditures, which is "richer" than that of USD and SDSU.

Accordingly, this level of effort yields for MTU impressive outcomes. Thus in FY 2008 they realized one invention disclosure for every $1.3 M of research expenditures, which rivals much larger institutions such as Stanford ($1.57M/disclosure), Florida ($1.62M/disclosure) and MIT ($2.5M/disclosure). In terms of active licenses, MTU had an excellent performance ratio of licenses/options executed of one license/option per $6M of expenditure. National leaders had comparable performance levels: MIT's ratio was one license/option per $13.4 M; Stanford's ratio was one license/option per $6.5 M; U. Florida's batting average was one license/option per $6.4M.

Looking at one more index, Michigan Tech reported 2 startups, or 1 per $30M of expenditures. The national leaders' data were comparable: MIT produced one startup per $66M of research expenditures; Stanford had one startup per $77M of expenditures; U. Florida produced one startup per $34.5 M of expenditures.

In trying to understand the commendable level of technology transfer performance achieved by MTU the richness of staff is only part of the picture. There is an interesting network of community partnerships that contributed, particularly in the area of startups. Moreover, more than anything Michigan Tech sees itself as a technological university; it "does technology." Or as stated in the University Vision Statement, the school sees itself as:

[22] Association of University Technology Managers, FY 2008 Licensing Activity Survey.

> "…delivering education, new knowledge, and innovation for the needs of our technological world",

and in the Mission Statement:

> "We create students to create the future."

As a result there are pockets of activity in various non-technical programs and curriculum that contribute to the overall Gestalt. Thus, for example, the College of Business and Economics has implemented a Business Development Experience required of all students with options that include:

- Developing, writing and presenting a business plan for a College of Engineering Senior Design Project
- Developing, writing and presenting a business development plan and a management plan for a campus enterprise and manage the enterprise
- Successfully completing the Applied Portfolio Management Program (APMP)

These kinds of expectations for non-technical majors are relatively unusual and contribute to the institutional culture and dialogue that touches technology commercialization.

Likewise, it is notable that the Masters and PhD programs that are offered outside of the science and engineering fields have a technological bent. Thus, there are advanced degrees in Industrial Heritage and Archeology as well as Rhetoric and Technical Communication. The MBA program is a Tech MBA: Merging Technology and Business. It emphasizes "opportunities to improve your communication skills, learn how to manage technology and innovation, and how to manage financially sound but sustainable organizations."

Community Partnerships and Business Incubation

As sketched in above, the contiguous community could not be described as anything close to a robust technology cluster. While 50 years ago the greater Houghton and Hancock (across the canal) area was a robust industrial sector, with adjacent mines, stamping mills and ore loading of lake freighters, that is now mostly ruins and historical tourist sites. Similarly, given that a few miles out of the Houghton-Hancock area one is literally in the woods or in the big lake, both of which go on for hundreds of miles, this is not an area where firm attraction and recruitment is a viable economic development strategy.

Ten years ago, the State of Michigan in partnership with Michigan Tech and regional government (the cities of Houghton and Hancock) and economic development organizations (the Keweenaw Economic Development Alliance) launched the Michigan Tech Enterprise Corporation (MTEC) Smart Zone. The program heavily emphasizes business incubation facilities and services and has resulted in two dozen businesses getting started and achieving some degree of business stability. Some are subsidiaries of larger companies and others are true startups. MTU alumni are significantly represented among the workforce. Over 250 jobs are attributed directly to the startups and another 500 as function of business relationships and spillover. The strategic focus has been to leverage the scientific and technological strengths of MTU, which has been reasonably successful.

There are four Smart Zone incubation facilities in the area: the Advanced Technology Development Complex (ATDC) located at MTU; the Powerhouse Building in the city of Houghton; the Jutila Center at the Finlandia University campus in Hancock and the Lakeshore Center, also in Houghton. The four facilities encompass 51,000 square feet and a range of equipment and facilities. It should be noted that this complex of incubators differs somewhat from more traditional incubators to the extent that there is less emphasis on prompt graduation. Thus, they functionally combine the goals of incubators and research parks. In addition, the ATDC facility is richer in labs and R&D equipment.

The tenant companies include startups and spinoffs of larger enterprises, such as:

- GE Aviation is a subsidiary of General Electric which focuses on software and hardware development, with a DOD tilt
- GS Engineering focuses on vehicle development and materials testing, with many MTU graduates as employees
- Consistacom (in the Jutila Center) focuses on automated call centers and network technologies
- Ford Motor Co. has an IT development center to deliver global information systems support

Operationally, the Smart Zone program provides or enables a wide range of services, including:

- Technology assessment
- Feasibility studies
- Business plan assistance
- SBIR and STTR assistance
- Business development mentoring
- Training
- Human resources

In addition to the companies that are tied closely to Smart Zone facilities and services there are also a growing number of free-standing small companies, technologically-oriented that have achieved some degree of success. Based on mostly anecdotal information, many or most of these have Michigan Tech roots or linkages – recent graduates, alumni, current faculty and staff.

The scope of these developments is small but growing, and most of it is confined to the relatively recent past.

Cultural Issues

The writer of this case has visited, consulted with and observed Michigan Tech for over 25 years, and from that perspective the mission and culture of the institution has changed significantly. In the 70s and 80s the school perceived itself primarily as a place that turned out excellent graduates who were fed immediately into the hiring halls of durable good industry in the upper Midwest, which was much more robust during that era. MTU's organizational response to Bayh-Dole during the late 80s and throughout the 90s was fairly tepid, partly reflecting the historical mission.

Culturally and programmatically this changed a great deal over the past 10-15 years. Partly this was a function of different emphases being pursued by State of Michigan economic development organizations; partly it is attributable to a gradual realization that technology commercialization and becoming a more research-intensive institution were in the interests of MTU. What is striking about Michigan Tech is the laser focus on technology. It pervades everything, including the research and curricular programs that are nominally not technology-centric. The business school is instructive. While there isn't an official entrepreneurship program, it seems clear that the emphases of the college are very much tied to the management and business exploitation of technology.

Interestingly, the novel naming or "branding" of the technology transfer office as Technology and Economic Development seems to be an important cultural message to the campus and the community.

Lessons for the I-29 Corridor

There are areas that are probably most instructive for institutions and stakeholders in the I-29 corridor:

- Based on national normalized comparisons, the MTU technology transfer function is excelling in terms of performance, which is attributable in turn to: (1) increased levels of quality staffing; and (2) an office function that seems to have a name and a mandate to make things happen.

- The strategic and multiple partnerships between the university (apparently through the Technology and Economic Development office, reporting to the VP for Research) that is focused on enterprise development and incubation are nationally notable. Clearly, there is not much of a viable economic cluster in greater Houghton (unless one looks closely at eating and drinking establishments) and the University allied with regional organizations is a model that South Dakota organizations could look at more closely.

- While there are no readily accessible data for MTU, there is another possible lesson that is clearly relevant to the I-29. That is the power of affiliation among a university's alumni.

Even in a place with 200 annual inches of snow the draw of one's alma mater is indeed powerful. Coupled with some focused programs to launch and nurture technology companies, it may be far more powerful than other more traditional approaches to growing clusters.

Ohio University

With the metropolitan areas of Cleveland, Cincinnati and Columbus, you might not think of Ohio as a particularly rural state. But when you drive through Southeastern Ohio it is clear that you are on the blue highways of America. Indeed, much of the state lies firmly in Appalachia with fully 32 counties being designated as part of the Appalachian Regional Commission's service area. In the middle of this traditionally economically struggling location sits the state's oldest university, Ohio University located in Athens. In many ways, the rural location of the university serves as an advantage as OU develops innovative programs that can impact the community in which it is located and the entire region. The programs range from entrepreneurial outreach, to new research programs in energy, to a technology transfer office that is consistently rated as a top one for its size.

The University

Ohio University is the oldest university in the state of Ohio, established in 1804. It has an enrollment of 20,437, 17,176 of which are undergraduate and 3,261 graduates. The university offers numerous doctoral degrees in both the humanities and sciences. In terms of research, the University earned $38.6 million in total R&D expenditures in 2007, with the largest fractions coming from Engineering ($18M) and Environmental Sciences ($9.7)[23]. The University ranked 185 nationally in terms of total research dollars.

The Region

As mentioned, Ohio University is an Appalachian university, one with an expressed mission of serving this historically impoverished region. Athens is located about 80 miles from the nearest airport of significance—Columbus, meaning the region is a fairly self-contained entity. But far from the stereotype of this part of the country, Athens itself presents as a cosmopolitan and progressive location. For instance, the community is an arts beacon, attracting national touring acts and the downtown featuring two cinemas featuring independent films. In terms of economic development activities, the region also boasts several institutions that focus on innovative strategies to reach lower income individuals. The Appalachian Center for Economic Networks (ACENet) is one such example. ACENet has developed innovative business incubators in the food processing industry, helping small entrepreneurial start-ups get a foothold, and help provide people with a pathway out of poverty. The Athens-based organization looks to interns from OU as a major source of staff and faculty as sources of research dollars.

[23] National Science Foundation. Table 38. R&D expenditures at universities and colleges, ranked by all R&D expenditures, by science and engineering field: FY 2007 (http://www.nsf.gov/statistics/nsf09303/pdf/tab38.pdf)

Relevance to the I-29 Corridor

The rural location of Ohio University makes it a natural for comparison to the institutions of higher education in South Dakota. Although Appalachia is far poorer than those communities along the I-29 corridor, the ways in which the university reaches and strives to reach those in non-metropolitan areas makes it appropriate institution to benchmark against. Two of the institution's primary areas of research focus—bioscience and alternative energy also have special relevance for South Dakota as they are currently or are planned areas of sectoral expertise at universities in the I-29 corridor.

Benchmark Practices

The University's outreach efforts are centered in the office of the Vice President for Research providing a centralized focus for the efforts. The Office of Research itself is staffed by 11 full time professionals. In Fiscal Year 2009, the University as a whole received $32 million in awards. $19.5 million of those awards came from Federal sources, with the largest grantor being the U.S. Department of Transportation, which actively funds the university's innovative research into alternative fuel technology.

One of the key elements to the University's success is it is explicit focus on economic development as a mission. There are three main components to the program. 1) An office of technology transfer which seeks to commercialize products developed at the university. 2) The Edison Biotechnology Center which has a focus on bioscience and the 3) Innovation Center, the university's business incubator. Each of these are described briefly below.

Office of Technology Transfer

The University's office of technology transfer includes two full time individuals, a fairly robust number for a relatively small institution. The school recently welcomed a new director, who comes to OU from Carnegie-Mellon one of the top research universities in the nation. A major factor in recruiting someone from Carnegie Mellon was the strength of the licensing revenue program at the institution. OU ranks first among all public universities in Ohio in licensing revenue, an impressive feat given the international renown and size of Ohio State University in Columbus.

The Technology Transfer is designed to walk through faculty at the university through the entire stage of development including the following steps:

- Invention Disclosure
- Patenting and Other Protections
- Marketing
- Licensing

- License Management
- Reporting

The success of the technology transfer office comes through in the school's release about its impact about the last reported fiscal year.

"In fiscal year 2009, Ohio University faculty made 39 invention disclosures to the Technology Transfer Office, submitted 42 patent applications and received three patents for technologies in transportation, alternative energy and nanoscience. The institution reported $6.9 million in licensing revenue, and anticipates reaching $8 million in income this year."

The Edison Biotechnology Center

Established in 1984, the Edison Biotechnology Center at OU has two separate but complementary missions. First is to operate as a research arm of the university in the area of biotechnology. Second, is to use this research to transfer technology to private industry with the expressed goal advancing economic development in the state and region. The institute draws upon several different academic departments. Faculty come from the Osteopathic Medicine, Arts & Sciences and Engineering Departments of the university, each bringing their core set of expertise.

Together the faculty and appointed researchers at the Institute are responsible for more than 40% of the intellectual property generated on campus. In addition, according to the Center it generates 95% of the licensing and royalty revenues earned by the University and receives 13 percent of external revenue research dollars that flow to the university.

In keeping with the mission of technology transfer, the Center itself had generated eight new companies as of 2006. One of the most impressive is the company that created Somavert a "treatment for people with acromegaly, a growth hormone disorder that can cause excessive growth of organs and bones in adults and can lead to premature death." The drug has been licensed to Pfizer and is responsible for much of the licensing revenue generated by the University.

One of the most important activities of the Center concerns working directly with existing bioscience companies in the region. Ohio University is the Southeast Regional location for BioOhio, the statewide network of bioscience organizations and support organizations. BioOhio provides direct research and workforce development support to the state's bioscience industry. With Bio located at the university, Ohio U is able to get more access to industry-based developments in the field.

Innovation Center

The Innovation Center serves as Ohio University's business incubator. Formed in 1983 as the state's first university-based business incubator, the Center has 36,000 square feet and currently is home to 11 companies. Companies range from EZ Asphalt Technologies, Inc., to Third Sun

Solar and Wind Power. A recent success of the center was the purchase of a 20 year tenant of the Center, Diagnostic Hybrids, by a pharmaceutical giant, Quidel for $130 million.

The Center provides much of the standard support for tenants in an incubator such as shared space, opportunities to network among peer entrepreneurs and chances for mentoring from OU faculty and graduates of the incubator program.

Although the Center is open to a wide range of companies, a few sectors have shown particular promise. As mentioned, several tenants of the incubator are from the bioscience industry. In addition, several environmental companies have started in the incubator taking advantage of Athens' growing reputation as a center for alternative energy and fuel research in Appalachia.

Lessons for I-29 Corridor

- A university's rural location can be an advantage. On the surface one of the most amazing things about Ohio University's relative success is it is right in the middle of one of the most economically distressed regions of the country and relatively isolated from major population centers. However, the University has turned that into a strength in two main ways. First, and most strikingly, the university has been able to leverage this distressed status into funding opportunities. For instance, the Appalachian Regional Commission ahs funded several efforts at the Innovation Center aimed at advancing that incubator's mission. Second, the rural location has actually been a boon in attracting entrepreneurs and faculty who were searching for a rural community to settle. For instance, the new director of the Technology Transfer office pointed to quality of life issues as a major consideration when he moved from Carnegie Mellon to take the reins at OU.

- Sectoral focus can be key. Ohio University has been successful in its efforts because it picked a few sectors to really focus its efforts on and developed expertise. For OU, the sectors were bio-science and alternative energy. The bioscience program means matching university research with companies on the ground in Athens, sometimes even in the university's own incubator. The same holds true for alternative energy. The university has developed a strong research emphasis on alternative fuels and power. Faculty and researchers have used this knowledge to start companies, which in turn attracts more companies to what one person characterized as the "Berkeley of the Backwoods."

Montana State University

The University

Montana State University is the main campus of the Montana State University system, with just over 12,000 total enrollment. The other branches of MSU in Havre and Billings and Great Falls and do not offer doctoral degrees. MSU offers undergraduate degrees in 51 fields, master's degrees in 41 fields, and doctoral degrees in 18 disciplines. The university offers numerous doctoral degrees in both the humanities and sciences. In terms of research, the University earned just under $117 million in total R&D expenditures in 2007, the vast majority coming through the life sciences program which earned $69.9 million.)[24]. The University ranked 121st nationally in terms of total research dollars.

The Region

Montana State sits in Bozeman, a small city of 27,509. The city sits 143 miles away from the state's largest city of Billings. The city continually is recognized as one of the most livable cities in the nation, including being named best small town by the BizJournal. The livability of the town is directly attributable to the perception of the town as a university community. A regional Chamber of Commerce study asking businesses their primary reasons for locating in Bozeman demonstrated that the primary decision point was proximity to the university including availability of graduates and interns in the region. The community is one of the fastest growing cities in the state and West with a population growth of 26.5% since 2000 compared to 8.1% growth for the state as a whole.

Relevance to the I-29 Corridor

Montana State shares many characteristics with the universities and communities along the I-29 corridor. First is the idea of a university located in one community charged with serving a large sparsely populated state. The challenges inherent in marrying the needs of reaching the community in which the university is located with meeting the needs of an entire state's residents are especially acute in Western states like South Dakota and Montana. Second, Bozeman like Brookings is a relatively small city that has a vibrant business community, due in no small part to the presence of the university. Finally, Montana State's emphasis on entrepreneurship has important implications for South Dakota, a state that depends so heavily on the energy of its small business community.

[24] National Science Foundation. Table 38. R&D expenditures at universities and colleges, ranked by all R&D expenditures, by science and engineering field: FY 2007 (http://www.nsf.gov/statistics/nsf09303/pdf/tab38.pdf)

Benchmark Practices

Montana State has a wide range of programs aimed at connecting university research and personnel with the larger Bozeman community. These range from the explicit efforts of the university's Technology Transfer office to TechLink that helps link local businesses with the US Department of Defense to the Center for Entrepreneurship of the New West that helps train new entrepreneurs in Montana and work to promote existing small businesses. In addition, the university is home to the state's Manufacturing Extension Partnership office meaning that the university is able to have an important say in the future of one of the state's most important sectors.

Technology Transfer

For a university of its size, Montana State's technology transfer program yields impressive results. In Fiscal Year, Montana State executed 46 licenses on a research expenditures of $311 million for a rate of $6.5 in expenditures per license

Research activities stretch across the spectrum but are organized into four main areas:

- Agriculture Technologies
- Energy Technologies
- Optical Technologies
- Biotechnologies.

In terms of staffing, the technology transfer office has two professionals, which is a fairly small number given the size of the office and the reach of its ambition. One thing the university does pride itself, on however, is the technology transfer office working closely with other parts of the university focused on economic development. For instance, the director of the Technology Transfer Office likes to meet on a regular basis with the TechRanch Program, a university-based incubator, to discuss strategies for increasing the university's impact on the local economic development community.

TechLink

TechLink is one of the university's most successful outreach programs. Through the program, TechLink links US companies to technologies developed through the US Department of Defense and NASA and vice versa. Although the program is based at Montana State it serves firms around the country. The program receives funding directly from the Federal government through an annual appropriation The funding is able to support a robust staff of fifteen individuals. Since its establishment TechLink has brokered more than 625 technology transfer partnerships between companies and DOD labs and centers. They have also helped facilitate more than 200 licensing agreements nationwide between DoD and technology-intensive companies. Indeed TechLink is responsible for more than half of DoD licensing agreements over the past three years.

TechLink also works closely with local businesses to help them apply for SBIR awards for both Phase 1 and Phase II. From FY 199 to 2006 for example, TechLink attracted more than $36 million in SBIR awards to Montana.[25]

Center for Entrepreneurship for the New West

Perhaps the part of Montana State with the most explicit economic development mission is the Center for Entrepreneurship for the New West, affiliated with the College of Business. The express purpose of the Center is to create an entrepreneurship program that makes "a significant contribution to the economic development of the state."

All students in the school of business are eligible to pursue a minor in Entrepreneurship. As part of that program students take a class that provides hands on experience with local companies. The class, entitled "The Environmental Experience," matches students with local small businesses in need of consulting. Students assist the companies on a wide usually tackling a specific company-identified project. The result is two fold. The student gets valuable real world experience and the small business gets valuable and free work to help improve their prospects.

The results to date have been impressive. According to MSU, since the Center's establishment:

- 400 plus students have provided 12,000 hours of pro-bono business analysis.
- More than 60 firms in the Bozeman area have participated including leading pharmaceutical and technology companies

Many of the Center's clients come from the university affiliated TechRanch an independently funded business incubator that shares a facility with the center. Many of TechRanch's tenant companies are faculty spin-offs.

Montana Manufacturing Center

Montana State is home to the state's manufacturing extension partnership program. This federally supported program provides advanced technical assistance to small and medium sized manufacturers. There are six field offices in the state of Montana, one of which is in Bozeman. The Center is affiliated with the University's College of Engineering and the employees of the Center are officially employees of the university, although the funding comes primarily through the US Department Commerce, the funding agency for the Manufacturing Extension Partnership, the national network of such centers.

The Center works a wide variety of small to medium sized companies. For instance, a Bozeman based agribusiness company worked closely with the Center to create an automation process to more quickly

[25] Innovation Associates

bring its product to market. The assistance included matching the company with MSU faculty who helped design the machine, while Center employees helped develop a plan to market the product.

According to the company's owner, the Center was absolutely critical in making sure that the product could be produced and marketed.

"I'm not sure I could have reached this point without the prototype design work, support, and advisory capacity of MMEC. The Center helped me with contract and detail management while the machine was in development and made sure I was happy with the product -- that it was meeting my needs."[26]

As the above story demonstrates, a key to the success of the program was the Center not operating in a vacuum—different departments of the university were involved form the get go and continue to be throughout all efforts of the Center.

Lessons for I-29 Corridor

- As can be seen by the above benchmark practices, Montana State has a wide variety of economic development activities. What makes the university particularly effective is that each element works together in support of a explicit economic development mission. For instance, the technology transfer office works closely with TechLink to help the latter organization become aware of relevant technologies with defense applications. And that cooperation extends to local businesses. The case in point being the Center for Entrepreneurship for the New West, a true example of synergistic behavior at a university. The companies need the students to provide quality technical assistance and the students need the businesses for hands on experience. None of this could happen, however, without explicit and constant communication between different departments and the university.

- MSU's focus on entrepreneurship makes a lot of sense for a community that sees its future not in large multi-national corporations but in innovative small businesses. The Bozeman community is trying to promote itself as an area where innovators come to build their business and where locals who have good ideas put down roots. By encouraging students to focus on their entrepreneurial skills there is the belief that they are more likely to start a small business and start it in a place they have grown to love while in school. Having facilities like TechRanch and access to a wide range of technical assistance through both the Center for Entrepreneurship for the New West and the Montana Manufacturing Center is key to that effort.

[26] http://www.mtmanufacturingcenter.com/SuccessStories/unibest.htm

Appendix C: Financial and Other incentives within the State and Region

Incentive	Description
	State Level Incentives
Economic Development Finance Authority Bonds	The State of South Dakota offers a pooled loan program designed for more capital intensive manufacturing projects by providing small businesses access to larger capital markets for tax-exempt or taxable bond issuances. Projects can be funded individually or they can be pooled to lower the cost of issuance. Additionally the borrower benefits from the States "A" rating by Standard and Poor's, which translate into the low interest rates.
Revolving Economic Development and Initiative Fund (REDI) **Governor's Office of Economic Development**	The State of South Dakota provides the REDI (Revolving Economic Development and Initiative) Fund to promote primary job growth in South Dakota. This low interest loan fund is available to start-up firms, businesses that are expanding or relocating and local economic development corporations. The REDI Fund provides up to 45 percent of a project's total cost. Companies should secure matching funds and be able to provide a 10 percent minimum equity contribution. Eligible costs include: * the purchase of land and the associated site improvements; * construction, acquisition or renovation of buildings; * fees, services, and other costs associated with construction; * the purchase and installation of machinery and equipment.
South Dakota Workforce Development Program	The State of South Dakota's Workforce Development Program provides grants to companies to train new AND existing employees. The Governor's Office of Economic Development will provide technical assistance to help develop the Workforce Development Program application.
Rural Electric Economic Development Fund	The REED Fund is a non-profit tax-exempt 501(c)(3) corporation, formed through the collaboration of rural electric cooperative members of East River Electric Power, Inc. REED is available in many of the MCEDA and LCEDA communities. The mission of the REED fund is to provide financing and help leverage private investment in small communities and rural areas.

South Dakota MicroLOAN	A partnership with CitiBank (South Dakota) N.A., South Dakota Development Corporation, and Governor's Office of Economic Development.The purpose of this loan is to provide low-interest financing to small businesses. It provides fixed-rate, low-interest loans for fixed-asset project costs, including working capital, equipment and real estate. The maximum amount for a loan is $20,000 and it can not exceed 5 years. The current interest rate is at 5%. For further information visit: http://www.sdgreatprofits.com/finance/microloan.htm.
No State Taxes	The South Dakota entrepreneur has a competitive edge over his/her business counterparts in 49 of the 50 United States. Per capita state taxes are the 49th lowest in the country here. The South Dakota business person pays: No Corporate Income Tax, No Personal Income Tax, No Inventory Tax, No Personal Property Tax, No Inheritance Tax. Local Sales Tax Rate: 2% State Sales Tax Rate: 4% Commercial Property Tax $25.643 per $1,000 Residential Property Tax $20.583 per $1,000
SBA 504 Loan Program	The SBA 504 loan program is another attractive financing tool. This program offers subordinated, fixed rate financing to healthy and expanding small businesses. Click here for more info.
APEX Loan Program	The APEX (Agricultural Processing and Export) Loan Program is designed to assist companies in communities with a population of 25,000 or less or which add value to raw agricultural products through processing. The program is open to for-profit businesses and local economic development corporations.
South Dakota Community Capital Fund	The South Dakota Community Capital Fund (SDCCF) offers economic development organizations serving greater South Dakota the opportunity to participate in an innovative new development financing resource. Click here for more info.
Bond Financing through Economic Development Finance Authority	This year, the Economic Development Finance Authority (EDFA) approved more than $17 million in loans to companies which invested more than $50 million in capital in South Dakota. Another financing option is the pooled loan program through South Dakota's Economic Development Finance Authority. This loan program, designed for more capital intensive projects, provides small businesses access to larger capital markets for tax-exempt or taxable bond issuances. The program can fund projects individually or pool them to help lower the cost of the bond issuance. One of the biggest advantages of this program is a long-term loan with a fixed interest rate.A major benefit to borrowers is the South Dakota Economic Development Finance Authority's "A" rating by Standard and Poor's. By maintaining an "A" rating, the Authority is able to offer a lower interest rate to the applicant.

Value-Added Agriculture Subfund	In 1999, a $3 million fund was created specifically to assist in funding feasibility and marketing studies for prospective value-added ag business. This Subfund of the REDI Fund is just one step toward improving value-added ag in South Dakota. By partnering with the Department of Agriculture, local communities, commodity organizations and others, the Governor's Office of Economic Development will work with you to take your project from conception to completion. Our goal is threefold: * To find niche markets that will add value to South Dakota ag commodities * To help fund marketing and feasibility studies, and * To help assemble the right people, capital and labor to ensure a successful project.
Tourism Enhancment Program (Department of Tourism and State Development)	Eligible Businesses can apply for loan from the subfund. Tourism is vital to South Dakota's economy. That's why helping tourism related businesses grow is a priority of Governor Mike Rounds; and his Department of Tourism and State Development. The Tourism Enhancment Program is earmarked specifically for feasibility studies and marketing of value added tourism projects. This fund is another big step toward growing tourism in South Dakota. Using funds from the Tourism Enhancment Program, the Governor hopes to: attract more visitors to South Dakota from other states and countries; lengthen the stay of visitors to South Dakota; expand the visitor season to the shoulder seasons; create primary jobs in the visitor industry and expand upon the historical, cultural, scenic, wildlife and other resources in South Dakota.
Economic Development Finance Authority (EDFA)	This year, the Economic Development Finance Authority (EDFA) approved more than $17 million in loans to companies which invested more than $50 million in capital in South Dakota. The Pooled Bond Program is designed for more capital-intensive projects, provides small businesses access to the public bond market through the issuance of tax exempt and/or taxable bonds. The program can fund projects individually or pool them to help lower the cost of the bond issuance. One of the biggest advantages of this program is that borrowers are guaranteed a long-term fixed interest rate. Another benefit is the EDFA's A rating by Standard & Poor's. By maintaining an A rating, EDFA is able to offer a lower interest rate to the borrower.
Financial Packaging	The Governor's Office of Economic Development has established five district offices to provide assistance and financial options to new and expanding businesses in the state of South Dakota. Financial packagers work closely with a company's staff to analyze their specific needs and project goals.

Industrial Revenue Bonds	These bonds are issued to motivate and expand the general economic welfare and prosperity of the state. The bonds are used to encourage and/or assist in the location and expansion of a new business or an existing business. Eligibility for the new or expanding business is determined by the municipality, county or sanitary district offering the bond.
Industrial Development Grants	This program has been established for non-profit organizations and for public bodies serving rural areas and Indian tribes. A rural area is defined as an area not located within the outer boundaries of a city with a population exceeding 50,000. Not-for-profit organizations, entities that cater to rural areas, and Indian tribes and their communities are eligible for the Industrial Development Grants. Applicants must show that new and small private businesses can emerge as a result of their grant.
FmHA Guaranteed Business and Industrial Loans	The primary purpose of the Guaranteed Business and Industrial Loans is to establish and keep employment opportunities in the rural communities. It is also designed to promote and improve the environmental and economic conditions in these areas. There is no requirement that applicants be unable to obtain credit from other sources, unlike most other FmHA programs. B & I loans take a minimum of three months to process, so borrowers of less than $500,000 are encouraged to use the Small Business Administration loan program.
Site Location Assistance	The State of South Dakota provides site location assistance for companies interested in expanding or relocating in the state. Information available is: available buildings, tax advantages, available labor force, utility rates, zoning requirements, and transportation.
Community Level Incentives	
North Sioux City (Union County) Reduced Taxation of New Structures and Additions	To encourage growth and development of North Sioux City, new structures and additions are given a property tax break. The new structure or addition must have a value of over $30,000 to qualify and must be within the city limits. In the first year following construction not more than 25% of the assessed value will be used for tax purposes. In the second year, not more than 50% of the assessed value will be used for tax purposes. In the third, fourth, and fifth years, not more than 75% of the assessed value will be used for tax purposes. Thereafter, the property will be taxed at the same percentage as is all other properties.

Property Tax Abatement	The City of Sioux Falls has an ordinance that allows new industrial structures or additions to existing industrial structures to be taxed at a lower rate. This abatement ordinance results in a savings of property tax normally paid during the first five years following construction. Percent of Taxable Value Used for the first five years of constuction found at http://www.siouxfallsdevelopment.com/incentives.cfm#ptax. A number of the smaller communities within Minnehaha and Lincoln Counties have also enacted property tax abatement ordinances. For information, contact the Lincoln or Minnehaha County Economic Development Association at 605-339-0103.
Sales Tax Refund Ordinance 42-05	Pursuant to Ordinance 42-05, the City of Sioux Falls offers a refund or credit for sales tax paid by person(s) who incur costs for the furnishing and equipping only of a new business facility that satisfies the eligibility requirements as set forth in Section 39-162 of Ordinance 42-05. The refund shall not apply to capital assets purchased to replace capital assets for which a refund has been claimed during such 36-month period or extended.
Sales Tax Refund Ordinance 39-161	Sioux Falls City Ordinance 39-161 is a powerful new tool for job recruitment and retention. This ordinance sets up a refund of city sales taxes on capital machinery and equipment for qualifying projects. Two major projects announced during 2005 will receive the two percent rebate on the millions of dollars they will spend on machinery and equipment in their new Sioux Falls facilities. To further explore your company's options for using this rebate, call the Foundation at 605-339-0103 or email danh@siouxfalls.com.
Downtown Tax Incentive Program Sioux Falls	Reduced Taxation for New Industrial or Commercial Structures, Additions Thereto, or Renovations or Reconstruction Thereto Within the Downtown Center Designated Urban Renewal Area Application
Neighborhood Tax Incentive Program	The City of Sioux Falls offers reduced taxation to real property for qualifying new commercial residential structures, additions, renovations, or reconstruction of existing qualifying structures within the boundary identified on the map above (North End, Axtell Park, West 12th Street, Folsom's Addition, All Saints, Beadle, and Whittier)
Industrial Tax Incentive Program Sioux Falls	Reduced Taxation for New Industrial Structures, Additions, Renovation, or Reconstruction of Existing Qualifying Structures Thereto Within the City
Lake Area Improvement Corporation Intermediary Relending Program (Madison)	This program allows local businesses to work in partnership with the LAIC and a local bank to obtain a low interest business loan. There is a minimum loan amount, involvement with a bank and application with approval is required. Started in 2009, the program has been a success for new and expanding businesses. Contact the LAIC for more info!

Miner County Discretionary Tax Formula (example of local county incentives)	Miner County has developed a discretionary tax formula program that reduces taxes on new structures or additions. Under this program, owners pay only 20% of the assessed value of their property the first year, 40% the second year, 60% the third year, 80% the forth, and 100% the fifth. In order to qualify, the property must be assessed at $30,000 if located in a municipality or $10,000 if located outside a municipality. This formula applies to all commercial, industrial, or non-residential agricultural property.
Miner County Revolving Loan Fund (example of local county incentive)	MCCR offers two different loan types, a Direct Loan and a Certificate of Deposit Guaranteed Loan. These loans may be used individually or as a combination. Each of these loan types offers a maximum of $50,000 per applicant or 50% of the total loan package. A combination of these two options allows a maximum loan amount of $100,000 for one applicant or 50% of the total loan package.

Appendix D: Workforce Needs in Manufacturing and Finance through 2014

While many occupations are synonymous with certain industries, such as actuaries to insurance firms, most occupations exist economy-wide and throughout each and every industry. For example, a marketing manger may work in a manufacturing plant that produces scoreboards for arenas or an aircraft mechanic may work for a postal courier. Understanding the growth potential and educational requirements of occupations within a particular sector of the economy is key when examining the training and labor needs of the workers in a sector. This section of the report looks at the workforce within the manufacturing and finance sectors of the I-29 regional economy.

Advanced Manufacturing Workforce

The advanced manufacturing sector is comprised of 272 occupations ranging from graphic designers to upholsterers. Overall, the advanced manufacturing cluster is dominated by production, transportation, and material moving occupations. Based on 2009 employment the top occupation, team assemblers, makes up 11% of the total cluster employment – larger than any other occupation in the cluster. The top occupations, shown in Table D-1, represent 42% of total 14,800 jobs in 2009 in this sector.

Table D-1. Top Occupations in Advance Manufacturing

SOC	Description	% Sector
51-2092	Team assemblers	11
51-4121	Welders, cutters, solderers, and brazers	7
51-9121	Coating, painting, and spraying machine setters, operators, and tenders	3
53-7062	Laborers and freight, stock, and material movers, hand	3
51-7011	Cabinetmakers and bench carpenters	3
51-1011	First-line supervisors/managers of production and operating workers	3
51-2022	Electrical and electronic equipment assemblers	3
51-4031	Cutting, punching, and press machine setters, operators, and tenders, metal and plastic	3
51-4041	Machinists	3
41-4012	Sales representatives, wholesale and manufacturing, except technical and scientific products	3

EMSI, 2010

Occupations within the advanced manufacturing sector require a host of different education and training at various levels of a person's career. Typically the required education can be classified into 11 educational categories with first professional degree being the highest level and short-term – on –the- job training being at the other end of the education continuum. A description of each type of degree and background on the classification system can be found at the end of this appendix.

Almost all the occupations in the industries that make up the advanced manufacturing sector require less than a bachelor's degree. Roughly 93% of the jobs in this sector need less than an associate's degree. In fact, only five the occupations in the sector require an educational attainment equal to a master's degree or higher each of which are responsible less than 10 jobs in 2009. Table D-2 shows the educational requirements of the jobs in the advanced manufacturing sector for those jobs requiring a four-year degree or less. While the 11-category system reflects the most common past into an occupation by existing candidates individual firms may require different training and education they are more (or less) than the categories presented in table below.

Table D-2. Educational Requirements – Advanced Manufacturing

Educational Level	2009 Jobs	2014 Jobs	New Jobs	Replacement Jobs	New & Replacement Jobs
Bachelor's degree	561	757	160	63	223
Associate's degree	137	183	46	20	66
Postsecondary vocational award	198	236	38	27	65
Work experience in a related field	939	1,115	176	108	284
Long-term on-the-job training	2,754	3,312	557	307	864
Moderate-term on-the-job training	6,696	7,988	1,218	832	2,050
Short-term on-the-job training	2,741	3,209	448	435	883

EMSI, 2010

Note: Jobs will not add up to sector total due to data suppression.

Projected demand for new and replacement jobs in the sector over the five-year period ending 2014 will require the need to train for more than 4,500. Since data suppression issues present some difficulty in determining a more precise number, we know that 4,500 jobs are most likely the bare minimum that will require some combination of education and training.

Overall Manufacturing Sector

The overall manufacturing sector occupational makeup looks very much like that of the advanced manufacturing sector with the exception of the numerous animal processing type occupations. A review of the occupations based on employment in 2009 shows team assemblers, welders and laborers – much like advanced manufacturing – as the top occupations. Combined these occupations make up 41% of the total 12,910 jobs in the sector and almost all of the top occupations are production or material moving occupations as shown in Table D-3.

Table D-3 Top Occupations in All Manufacturing

SOC	Description	% Sector
51-2092	Team assemblers	10
53-7062	Laborers and freight, stock, and material movers, hand	5
51-4121	Welders, cutters, solderers, and brazers	5
53-7064	Packers and packagers, hand	4
51-1011	First-line supervisors/managers of production & operating workers	3
51-7011	Cabinetmakers and bench carpenters	3
51-3022	Meat, poultry, and fish cutters and trimmers	3
51-2022	Electrical and electronic equipment assemblers	3
41-4012	Sales representatives, wholesale and manufacturing, except technical and scientific products	3
51-3023	Slaughterers and meat packers	2

EMSI, 2010

Less than 6% of the jobs in this sector need a bachelor's degree or higher. The occupations in lead manufacturing typically require some level of on-the-job training as shown in Table D-4. Although most production occupations require less formal education, many often need extensive apprenticeship training that according to the Bureau of Labor Statistics (BLS) can last for up to 4- years and incorporate classroom instruction.

These jobs that require less formal education tracks are also projected to have the highest demand for labor in the near future. In fact, occupations requiring some level of short-term OTJ training have a higher need for replacement jobs than new jobs. Replacement jobs are very important to this sector and is forecasted to be the primary driver behind total demand in I-29 Corridor lead manufacturing sector.

Table D-4. Educational Requirements – All Manufacturing

Educational Level	2009 Jobs	2014 Jobs	New Jobs	Replacement Jobs	New & Replacement Jobs
Bachelor's degree	465	626	122	52	174
Associate's degree	134	174	40	18	58
Postsecondary vocational award	94	117	23	12	35
Work experience in a related field	852	961	109	100	209
Long-term on-the-job training	1599	1894	295	182	477
Moderate-term on-the-job training	5209	5945	725	616	1341
Short-term on-the-job training	3932	4173	241	609	850

EMSI, 2010

Note: Jobs will not add up to sector total due to data suppression.

Finance Export Sector

The finance export sector is the second largest of the three sectors with 13,360 jobs spread across just 127 occupational categories. Customer service occupations dominate the sector in terms of employment, but management and analyst positions are in the top 50 occupations when compared by employment (Table D-5)

Table D-5. Top 10 Occupations in Finance Export Sector

SOC	Description	% Sector
43-4051	Customer service representatives	14
43-4131	Loan interviewers and clerks	11
43-3011	Bill and account collectors	9
43-3071	Tellers	9
13-2072	Loan officers	6
43-3031	Bookkeeping, accounting, and auditing clerks	5
41-3031	Securities, commodities, and financial services sales agents	4
43-1011	First-line supervisors/managers of office and administrative support workers	4
43-4041	Credit authorizers, checkers, and clerks	3
13-2011	Accountants and auditors	2

EMSI, 2010

Unlike the other key sectors, occupations in the finance export sector in the Corridor tend to demand more qualifications. Nearly 30% of the jobs in this sector are in occupations that require a bachelor's degree or higher (Table D06). These jobs include actuaries, financial mangers and computer systems engineers. Many of the occupations in the finance export sector will most likely also need some industry certification. For example, accountants and auditors are often required to have a CPA in addition to education and training.

Demand for employment in this sector is often concentrated at two required educational levels – OTJ and Bachelor's degrees. In the Corridor most of the demand is from the need for new jobs while less than 12% of the existing jobs need to be replaced over in the near future.

Table D-6. Educational Requirements – Finance Export

Educational Level	2009 Jobs	2014 Jobs	New Jobs	Replacement Jobs	New & Replacement Jobs
First professional degree	18	21	3	2	5
Doctoral degree	0	0	0	0	0
Master's degree	36	39	3	4	7
Degree plus work experience	715	825	99	68	167
Bachelor's degree	3062	3740	678	285	963
Associate's degree	141	169	28	20	48
Postsecondary vocational award	25	43	6	3	9
Work experience in a related field	672	787	115	75	190
Long-term on-the-job training	79	100	21	6	27
Moderate-term on-the-job training	3189	3839	650	375	1025
Short-term on-the-job training	5290	6203	913	726	1639

EMSI, 2010

Background on Education Levels

The Office of Occupational Statistics and Employment Projections of the Bureau of Labor Statistics (BLS) classifies 753 occupations into education and training categories.

The "eleven category system"[27] assigns occupations into a single education and training categories reflecting the most common path into the occupation. A category is defined as the most significant source of education and training needed to become qualified in an occupation. The categories are as follows:

First professional degree: Completion of this degree requires at least 3 years of full-time academic study beyond a bachelor's degree. This is typically the minimum requirement for occupations like lawyers, physician and surgeons, veterinarians, and pharmacists.

Doctoral degree: Completion of a Ph.D. or other doctoral degree that requires a minimum of 3 years of full-time academic works beyond a bachelor's degree. Sample occupations requiring this level of educational training include postsecondary teachers, medical scientists (except epidemiologists), and biochemists and biophysicists.

Master's degree: This type of degree usually requires 1 or 2 years of full-time academic study beyond a bachelor's degree.

Degree plus work experience: This education level is also known as "*Bachelor's or higher degree, plus work experience*". Most of the occupations in this category are management occupations typically filled with experienced staff, with a bachelor's degree, promoted into these groups after significant worker experience. Examples are engineers promoted to engineering managers.

Bachelor's degree: Self-explanatory

Associate's degree: Completion of this degree usually requires at least 2 years of full-time academic study beyond high school.

Post-secondary vocational award: These programs lead to a certificate or other award, but not a degree. Occupations in this category include some that require only the completion of a training program and some that require individuals to pass a licensing exam before they can begin work. Examples include nursing aides, orderlies, and attendants and hairdressers.

Work experience in a related occupation: Many of these occupations require work experience such as first-line supervisors/managers of service, sales and related, production, or other occupations, or are other types of managers.

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[27] BLS actually uses two different methods to classifying occupations by education and training requirements. The second method, the "educational attainment cluster system", groups occupations according to the highest level of educational attainment of current workers. This system is typically used to study the job outlook for college graduates. This system, unlike the "eleven category system", allows occupations to fall into multiple educational attainment categories (or "mixture" occupations).

Long-term on-the-job training: More than 12 months of on-the-job training or combined work experience and formal classroom instruction are needed for workers whose occupations fall into this category. Included in this group are formal and informal apprenticeships that may last up to 5 years and occupations specific, employer-sponsored programs (i.e. police academies).

Moderate-term on-the-job training: Occupations in this category usually require 1 to 12 months of combined on-the-job experience and informal training. For example, heavy and tractor-trailer truck drivers.

Short-term on-the-job training: Includes occupations that require short demonstrations of job duties or 1 month or less of on-the-job experience or instruction.

Limitations of "eleven category system":

This classification system does not show the extent to which there are multiple paths of entry into an occupation. Occupations are assigned to one of the categories based on BLS economists knowledge and judgment based on data gathered from government agencies, private organizations, interviews with educators, employers, trade associations, etc. When an occupation has more than one path of entry, BLS identifies the path that research suggests is applicable to most current entrants.