USTAR

UTAH'S TECHNOLOGY CATALYST

USTAR PROGRAM ASSESSMENT AND RECOMMENDATIONS

AUGUST 2015

SRI International

USTAR

Dear Reader,

As the Chairman of the Utah Science Technology and Research Initiative (USTAR) Governing Authority (GA), I am pleased to present you with this independent Assessment and Recommendations for USTAR and the Utah Technology Ecosystem.

Over the last eighteen months the USTAR GA has comprehensively focused on (1) assessing the current portfolio, (2) examining best practices for technology economic development programs, and (3) implementing sweeping recommendations of the Legislative Auditor General. We concluded that to set USTAR on the path which will be most successful and most compliant with our governing statutes, we must know what successful, mature state-sponsored technology and innovation initiatives are doing and how USTAR compares with them. We engaged the services of SRI International, a nonprofit independent research organization, to studyUSTAR programs and the Utah technology ecosystem AND to "benchmark" USTAR's programs and practices against these other initiatives. We also assigned SRI thoroughly to assess USTAR's current programs, make recommendations program alignment, and identify best practices for program implementation and metrics.

We look forward to applying these strategic recommendations moving forward as we continue aligning the organization to its original legislative intent.

Greg Bell,
USTAR Governing Authority Chairman

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USTAR Program Assessment and Recommendations

August 2015

SRI International

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Executive Summary

The Utah Science, Technology, and Research (USTAR) initiative is the State of Utah's premier technology-based economic development program. Created in 2007, USTAR seeks to stimulate innovation, strengthen the state's innovation system, and transfer ideas and technology to companies. In its first phase, the program largely sought to accomplish these objectives by funding innovative research with high commercialization potential at state universities. However, the 2013 legislative audit brought to light serious misalignment with regard to both program objectives and program design, and with program design and realistic expectations.

Key Finding: USTAR's current emphasis on research-capacity building at universities is misaligned with its shorter-term goals and metrics of revenue generation and job creation in Utah-based technology companies.

SRI found that USTAR invested heavily in expanding university research capacity, while providing limited and diffuse entrepreneurial assistance around the state over the past 7 years. In the very long term (20-30 years), this research capacity-building strategy could lead to new technology companies and jobs. However, the legislature expects faster and more significant job creation in technology companies supported by the USTAR program. This misalignment between USTAR's goals and program design is at the heart of the frustration with current program results.

While the longer-than-expected time horizon and the type of economic impact to date are different than anticipated, Utah did attract top researchers to state universities through the program, and USTAR did contribute to growth in university research jobs and the expansion of follow-on federal research dollars. This is a valid form of economic impact, but not one that directly generates significant revenue and jobs in technology companies in the near term.

SRI identified strengths in Utah's innovation system, such as the state's strong entrepreneurial culture, growing university research capacity, and above average business R&D expenditures. However, we also found weaknesses in Utah's innovation system that can hinder Utah startup technology companies from scaling beyond 5-10 employees. These weaknesses include:

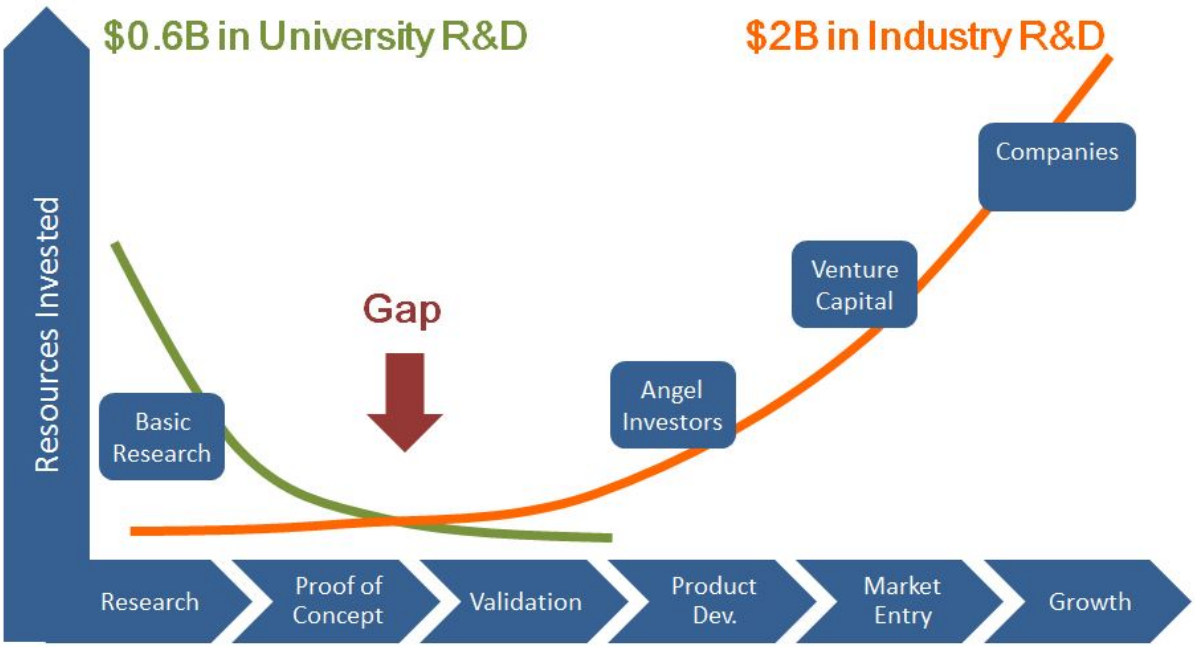
- Limited pool of managerial talent with experience taking a company from 10 employees to 200 or 500 employees;
- High concentration of venture capital investment in later stage, IT sector deals;
- Dearth of pre-seed risk capital; and
- Weak industry-university linkages, which represent one important commercialization pathway.

Our evaluation of similar technology commercialization programs in other states finds that these states have used funds in a very targeted way to change university and private sector behavior: incentivizing companies to look for ideas and subject matter experts at regional universities and encouraging

universities to recruit faculty with a commercialization orientation in areas aligned to priority industry sectors.

When one looks at the total amount of funding going into technology commercialization in a state, from basic research through to market entry and commercial-scale production, state money is dwarfed by federal money supporting research at universities and private sector R&D expenditures. For example, USTAR's $20 million in annual funding represents only 3% of Utah universities' total R&D expenditures each year. Therefore, smart states use their limited funds in a very targeted way to change behavior and incentivize new connections and commercialization pathways between universities, companies, and government labs, including military installations.

Figure 1 Where to Target USTAR Efforts



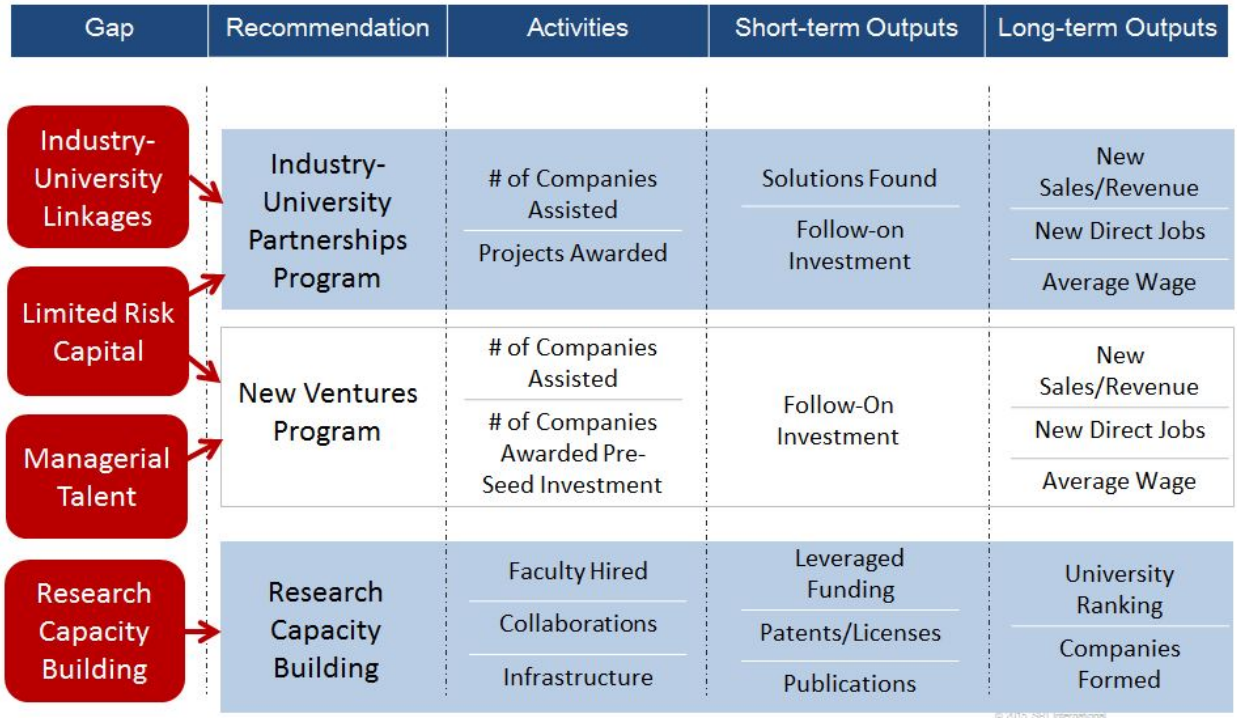
Recommendation: USTAR should refocus its program to provide greater support for technology commercialization and early-stage companies and to incentivize strong university-industry linkages.

If the state's priority remains supporting the growth of startup technology companies, then SRI recommends shifting USTAR's program balance toward providing greater support for early-stage companies and for de-risking technologies that are closer to commercialization. Our analysis identified weaknesses in Utah's innovation system, such as early-stage risk capital and managerial talent, where USTAR could play a catalytic, bridging role.

Specifically, SRI recommends that USTAR:

- **Revamp and expand existing TOIP programs into a USTAR New Ventures Program:** Redirect a portion of the funding currently going to university research capacity building to provide more early-stage funding and business coaching and mentoring for startup technology companies. This is an expansion of the Technology Outreach Innovation Program (TOIP) incorporating best practices from similar programs in other states.
- **Create a USTAR Industry-University Partnerships Program:** Pilot a new program to help Utah companies solve technical challenges related to product commercialization through sponsored research projects at Utah colleges and universities.
- **Pivot USTAR Research Capacity-Building Program:** Shift from talent recruitment to enhancing the productivity of both USTAR-recruited and existing faculty. This includes providing competitive funding for commercially-oriented research projects and other mechanisms to incentivize interdisciplinary and university-company connections. Align any future talent recruitment priority industry sectors and adopt best practices in implementation.
- **Refine USTAR Metrics:** Adopt a new metrics framework that provides better alignment between USTAR programs and anticipated impacts.

Figure 2 Recommended Programs and Metrics



Many of the stakeholders interviewed said that the creation of the USTAR program sent an important message to investors and companies outside the state that Utah is committed to supporting and

investing in its innovation system. While there were differences of opinion among stakeholders about what changes are needed, there was consensus that the USTAR program has been valuable and should continue in some form.

About SRI

SRI International (http://www.sri.com) is a major not-profit, independent research center serving government and industry. We work on some of the world's most important problems, collaborating across technical disciplines to spark new ideas and solutions. This study is being conducted by SRI's Center for Science, Technology and Economic Development based in Washington, DC. We provide consulting services on science, technology, innovation, and economic development to governments, universities, and companies in the U.S. and internationally.

Introduction

The Utah Science, Technology, and Research (USTAR) initiative is the State of Utah's premier technology-based economic development program. Created in 2007, USTAR seeks to stimulate innovation, strengthen the state's innovation system, and transfer ideas and technology to companies. In its first phase, the program largely sought to accomplish these objectives by funding innovative research with high commercialization potential at universities. However, the 2013 legislative audit brought to light some key misalignments with regard to both program objectives and program design, and program design and realistic outcomes.

SRI International's Center for Science, Technology and Economic Development was hired by USTAR to conduct a nine-month study to refocus USTAR's strategy and program design with its intended objectives and anticipated outcomes:

- Conduct an independent, credible review of the USTAR program against its stated objectives;
- Benchmark USTAR's existing programs against best practices from similar programs in other states; and
- Recommend programmatic changes and metrics to improve the alignment between objectives, strategy, and anticipated outcomes.

These tasks constitute Phase 1 of this assignment. In Phase 2, SRI will develop a forward-looking prospectus that will be realistic, fact-based, and informed by the experiences of other state programs.

SRI's approach to this study used a gap analysis of Utah's innovation system, drawing on science, technology and economic indicators, as well as direct interviews with key Utah stakeholders. SRI's assessment employed a standard framework for state and regional technology-based economic development to assess factors that are essential for supporting a thriving regional innovation system. These factors include: research capacity, managerial talent, industry-university linkages, risk capital, and entrepreneurial culture, among others. SRI analyzed Utah's innovation system through two lenses: (1) the strengths and weaknesses of each of these essential elements and (2) the adequacy of support by stage of the innovation process, from basic research to market entry and commercial-scale production. We also assessed how well current USTAR programs address weaknesses in the innovation system with regard to program design and implementation.

The SRI team interviewed over 50 key stakeholders from March to April, including: members of the state legislature, current and past USTAR Governing Authority members and staff, university administrators, USTAR faculty, USTAR TOIP managers, startup companies, investors, industry associations, and economic development organizations. We also examined a variety of data on R&D performance, new venture formation, venture capital investment, employment, and other economic indicators to assess Utah's performance against other states and the national average. Finally, SRI studied other established

state technology commercialization programs with similar objectives. SRI synthesized this information to compare USTAR to best practices in program design and implementation.

This report presents SRI's preliminary recommendations based on a Utah innovation system gap analysis and assessment of USTAR programs against similar programs in other states. The SRI team presented these findings and recommendations to USTAR stakeholders in Salt Lake City at the end of May 2015. The workshop provided an opportunity for the SRI team to report back on what stakeholders told us, to present recommendations based on our findings and best practices in other states, and to build consensus on goals and objectives going forward.

Utah Innovation System Gap Analysis and Current State Assessment

To establish a foundation for our recommendations, SRI assessed: (1) the strengths and weaknesses of Utah's innovation system and (2) how well current USTAR programs address weaknesses in the system, with respect to both design and execution. The analysis of Utah's innovation system examined how well the system supports the generation of ideas and intellectual property, commercialization pathways, and support for new company formation and scale-up. The assessment of the USTAR program examined USTAR's program structure, major activities and investments to date, as well the view of programs participants on the program balance and their implementation.

Utah's Innovation System Elements

✚R&D Capacity

✚Entrepreneurial Culture

O Managerial Talent

O Industry-University Linkages

O Risk Capital

Utah Innovation System Gap Analysis

SRI analyzed Utah's innovation system through two lenses. First we analyzed the system by looking at key functional elements. Second, we analyzed the adequacy of support by stage of the innovation process, from research/idea generation to technical and market validation to market entry. State and regional innovation systems require a variety of elements, each of which are essential to produce innovations that contribute to economic development.[1] These include, among others:

- **R&D capacity:** To generate ideas and technology
- **Managerial talent:** To scale a company from 5-10 employees to 200 or 500 employees; to take a product to commercial-scale
- **Risk Capital:** To finance technology development and commercialization
- **Industry-University Linkages:** To support commercialization pathways and workforce development
- **Entrepreneurial culture:** To supports new venture creation and innovation.[2]

SRI's analysis of the strengths and weaknesses of these elements are shown in the table below. From left to right, the table presents the key success factors needed for well-functioning regional innovation systems, common challenges encountered by regions, and Utah's performance on each of these factors,

[1] For example, see Organization for Economic Co-operation and Development (2009), *Clusters, Innovation and Entrepreneurship*; National Research Council (2013), *Best Practices in Regional Innovation Initiatives: Competing in the 21st Century*; and Council on Competitiveness (2005), *Measuring Regional Innovation: A Guidebook for Conducting Regional Innovation Assessments*.

[2] This is not an exhaustive list. Other innovation system elements include a supportive regulatory environment, adequate infrastructure, and a quality of life that attracts talent.

based on both qualitative interviews with stakeholders and statistical data. We describe our analysis of how Utah rates in each of these factors in more detail below.

Table 1 Summary of Utah Innovation System Gap Analysis Findings

Success Factors	Common Challenges	Utah
R&D Capacity	University R&D	++
	Business R&D	+
Entrepreneurial Culture	Risk Aversion	++
Industry-University Linkages	Information Gaps & Networks	–
Managerial Talent	Serial Entrepreneurs	–
	Sector Specific Knowledge	–
Risk Capital	Pre-seed/seed	–
	Venture Capital	+/–

✚ **Research Capacity.** Research indicates about half of the ideas that lead to innovations come from within companies. However, the other half comes from outside the firm—from other firms, universities, technology specialists, etc.[3] Therefore, the amount of R&D activity performed by a region's firms, universities, and government labs is an indicator of a region's ability to create, acquire and absorb new technologies and ideas. Utah's universities and industry both rank fairly well in research capacity when compared to other states.

- Utah's universities ranked in the 1st quartile of states in university R&D expenditures per GDP in 2012.[4]
- The state's universities have increased their ability to win competitive federal research dollars. Federal R&D funding per worker has grown much faster in Utah than the national average since 2008, and Utah is now among the leading states on this indicator (see figure below).[5]
- Utah also ranks above average in industry R&D performance, ranking in the 2nd quartile of states in business-performed domestic R&D per private industry output in 2012.[6]

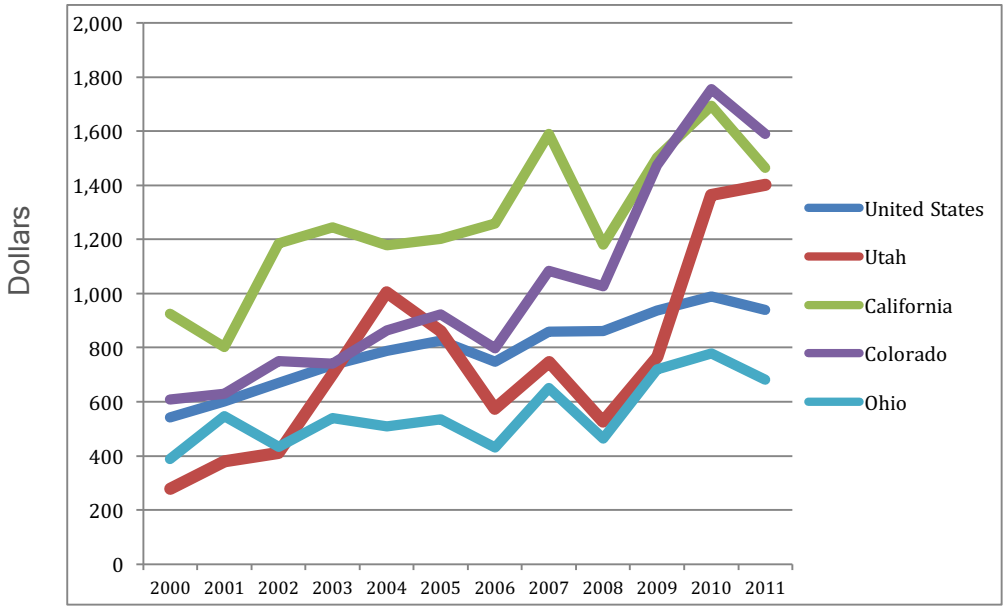
[3] Arora, A, WM Cohen and JP Walsh (2014). "The Acquisition and Commercialization of Invention in American Manufacturing: Incidence and Impact," NBER Working Paper Series, http://www.prism.gatech.edu/~jwalsh6/w20264.pdf

[4] National Science Board (2014). *Science and Engineering Indicators 2014*. Available at http://www.nsf.gov/statistics/seind14/

[5] National Science Board. 2014.

[6] National Science Board. 2014.

Figure 3 Federal R&D obligations per employed worker (current $)



Source: National Science Foundation, NCSES

– **Managerial Talent.** A key success factor for regional innovation systems is having a supply of experienced entrepreneurs and technical managers. Such entrepreneurs and managers are needed to help startups and new product lines grow into larger successful businesses. University faculty may invent new technologies and may be interested in seeing them commercialized, but most faculty do not have the skills and motivation required get these products into the market and to grow a startup company. Economies need a vibrant pool of experienced entrepreneurs to start and build these new ventures, and to provide mentoring to other new startups. In our interviews in Utah, many stakeholders cited a lack of experienced talent within Utah for scaling small, 10-person technology companies into 200 and 500-plus person companies. This is a common challenge in many regions of the U.S. and the world (outside of major technology hubs like Silicon Valley and Cambridge, MA.)

– **Industry-University Linkages.** Research-enabled discoveries and new technologies need strong pathways from the lab to the marketplace. These commercialization pathways are critical to a region's ability to grow new businesses and technology industries. Industry-university linkages, government lab-industry linkages, tech transfer offices, accelerators and incubators all represent commercialization pathways. Industry-university linkages are specifically important, because companies can benefit from:

- Having faculty subject matter experts consult on technical problems;
- Outsourcing R&D projects that are pre-competitive or would benefit from a novel approach;

- Gaining access to specialized equipment and facilities; and
- Getting a firsthand look at talented students they may wish to hire through sponsored research projects.

Universities benefit from:

- Being exposed to the applied research problems faced by companies;
- Building relationships that can be leveraged in the future to pursue Federal grants that require industry-university partnerships; and
- Having their students employed by Utah companies upon graduation.

Utah ranked 8th nationally in industry R&D expenditures.[7] Research shows that industry R&D tends to focus on incremental product improvement and quick-delivery new products. As industry has focused on the more applied and development-focused end of the R&D spectrum, companies look externally from new ideas and technology that represent an entirely new approach to meeting a market need.

SRI interviews with Utah companies and universities indicate that industry-university connections are relatively weak and could be significantly improved. They stated that there is a major informational barrier—generally speaking, Utah companies do not know what research is occurring in the universities, and the universities do not know what kind of technical assistance companies require. Utah has no NSF-supported Engineering Research Centers or Industry/University Cooperative Research Centers (two examples of industry-university collaborative research partnerships), although a USTAR faculty member at USU did submit an NSF Engineering Research Center proposal application, which ranked very highly but was ultimately unsuccessful.

– Risk capital. Venture capital data show that Utah does well attracting investment in later stage IT sector deals. However, SRI's interviewees reported that there is a lack of pre-seed and seed funding in the state. Funding in these early stages is critical to helping companies perform technical and market validation to attract the interest of private sector investors. Interviews also suggest that local venture is very limited outside of the IT sector, forcing Utah startups in other technology sectors (e.g., biomedical,

Utah VC Megadeals

Utah companies Domo, Qualtrix, Pluralsight, Instructure and InsideSales.com all secured megadeals of $100 million or more in recent years. Qualtrix, a custom analytics software company founded in 2002, received a $70 million Series A round in 2012 and a $150 million Series B round in 2014. Qualtrix had $48 million in revenue and 300 employees when it received its Series A round ten years after its founding.

[7] National Science Foundation, National Center for Science and Engineering Statistics. 2014. *Business R&D and Innovation: 2011.* Detailed Statistical Tables NSF 15-307. Available at http://www.nsf.gov/statistics/2015/nsf15307/

advanced materials, etc.) to leave the state.

- Utah ranked 9th nationally in total venture capital dollars ($800 million) and 19th in the number of venture capital deals in 2014.[8]
- Utah's dollar-per-deal average was the second highest ($18.6 million) in the country in 2014. This indicates that the deals are concentrated in later stage deals in revenue-positive companies.[9]

✚ **Entrepreneurial Culture.** A challenge in many regional innovation systems around the world is the absence of an entrepreneurial culture and a low ability to tolerate and manage risk, especially business and finance risk. However, SRI found that Utah has a strong entrepreneurial culture and Utahans have little hesitation in starting new ventures.

- The state ranked 5th in high tech business formation as a percentage of all business establishments in 2010 (latest available data), but is only 20th in high tech employment as a percentage of total employment.[10]
- 95 percent of private sector companies in Utah are small companies with fewer than 50 employees. Within this category of small companies, the average firm size is fewer than five employees.[11]

The interviews supported these data and underscored that Utah has a strong entrepreneurial culture. The data and the interviews pointed to an environment conducive to creating new technology companies, but lacking in some factors required to grow them to an economically meaningful size.

Finding: SRI identified strengths in Utah's innovation system, such as the state's strong entrepreneurial culture, growing university research capacity, and above average business R&D. However, we also found weaknesses that hinder Utah startup technology companies from scaling beyond 5-10 employees. These weaknesses include limited a pool of managerial talent, a lack of pre-seed and seed stage capital, and weak industry-university linkages.

SRI also used the same data to assess the resources available to inventors and innovators from a different lens: at different points along the innovation continuum. This continuum (see figure below)

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[8] National Venture Capital Association, *Yearbook 2015*. Accessed May 10, 2015. nvca.org/?ddownload=1868

[9] Mochari, Ilan. "Move Over Silicon Valley: Utah Has Arrived; When it comes to staggering sums of venture capital raised in 2014, there's Utah, and there's everyone else," Inc.com, http://www.inc.com/ilan-mochari/silicon-valley-utah.html Accessed June 17, 2015.

[10] National Science Board. 2014.

[11] U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages data presented in, Knold, Mark (2012), "The Influence of Company Size on the Utah Economy," Utah Insights: An economic and labor market analysis of the State of Utah, https://jobs.utah.gov/wi/pubs/localinsights/winter2012/localinsightsstatewide.pdf

conceptualizes the stages of technology commercialization, from ideation (research and proof of concept) to commercialization (validation, product development and market entry) to business success (commercial-scale production and growth). Bridging gaps or weaknesses in the innovation continuum, where there is too much risk or too little information for the private sector to invest on its own, represents one of the key areas where government can play a catalytic role in a regional innovation system.

Figure 4 Innovation Continuum

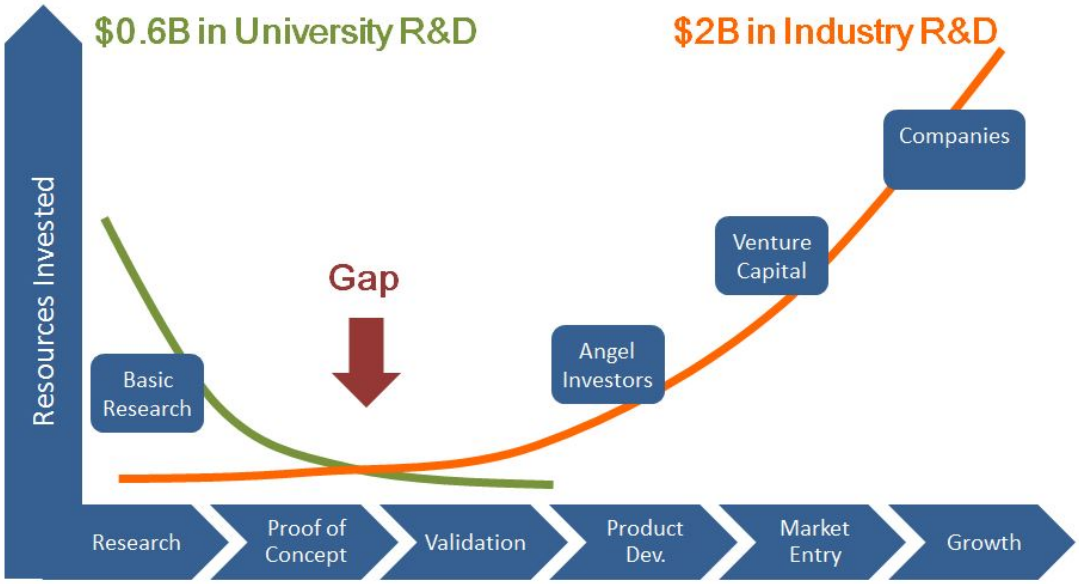
Figure 5 (below) shows the magnitude of Utah's current investments across this continuum. This further confirms the findings from SRI's analysis of innovation system components, which indicated major investments are being made in basic research and later stage product development. Utah universities, which are focused primarily on basic research, had R&D expenditures of $608 million in 2012,[12] and Utah industry, which is primarily focused on later-stage commercial product development, spent $2.1 billion on R&D in 2012.[13]

However, risk capital and government support are critical in the transitional area between basic research and the very applied product development work that existing companies. Utah has some local venture capital and angel investors and is able to attract venture capital from outside the state for later stage deals, but there is a gap in pre-seed and seed stage funding. Availability of funding during these higher risk stages is critical to help startup companies de-risk their products to move through technical and market validation and early stage development.

[12] National Science Foundation, National Center for Science and Engineering Statistics. 2013. *Higher Education Research and Development: Fiscal Year 2012*. Detailed Statistical Tables NSF 13-325. Available at http://www.nsf.gov/statistics/nsf13325/.

[13] National Science Foundation, National Center for Science and Engineering Statistics. 2014. *Business R&D and Innovation: 2011.*

Figure 5: Utah R&D Investments along the Innovation Continuum



Source: NSF NCSES

While USTAR's $20-$25 million in annual funding may seem large in absolute terms, it is small (roughly 3%) compared to the total amount of investment, mainly from the Federal government, going into basic research at universities in the state.

Other states or regions that are successful at supporting innovation face the same challenges with early-stage risk capital and managerial talent. They have worked to create more pre-seed and seed stage capital and to provide targeted business mentoring to help startup technology companies move across the "valley of death" to a stage where private investors will invest on their own.

In its interviews, SRI found that Utah stakeholders recognize this "valley of death" in the early translational stage of the innovation continuum. A large number of interviewees stated that USTAR should devote more resources to addressing these gaps in the innovation system at the expense of funding research. Interviewees identified opportunity areas for USTAR, which included investing more resources in business coaching and mentoring, expanding USTAR's Go-to-Market funding to provide more seed stage funding, and helping to incentivize and strengthen industry-university connections. Interviewees spoke specifically about the need for more pre-seed and seed funding in the state to help de-risk and validate technologies in early stage development.

Many interviewees also felt that USTAR should also provide more commercialization and entrepreneurship support to inventors and startups across the state. Some noted that while University of Utah has a well-resourced technology transfer office and many entrepreneurship programs for students, Utah State University and other state universities need more support. Other interviewees

noted that even in the Wasatch Front (the metropolitan region of north-central Utah that includes Salt Lake City, Provo, and Ogden), there are an insufficient number of facilities that provide lab space and prototyping equipment. For example, the BioInnovations Gateway often has a waiting list of firms.

Assessment of USTAR Current State

SRI reviewed USTAR's current program structure, major activities, and investments to date. We examined USTAR program data and collected qualitative input from USTAR stakeholders regarding the program balance and implementation. From this assessment, we draw implications for recommended changes to USTAR going forward.

USTAR Investment by Program

To date, USTAR resources have been heavily focused on research capacity building. USTAR is funded at approximately $20 million to $25 million per year through a business and economic development appropriations committee. From 2007-2014, nearly 90 percent of USTAR funds ($140.3 million) went to the startup packages and salaries of recruited faculty at the University of Utah and Utah State University. Ten percent ($16.9 million) of total USTAR funding went to the statewide Technology Outreach and Innovation Program (TOIP) program to support Utah technology entrepreneurs and startup companies.[14] While not part of the USTAR budget appropriation, an additional $225 million, including matching university funds, was invested in the construction of two university research buildings to provide research space, core facilities, and specialized equipment that are available to researchers across the state and industry partners.[15] Figure 6 shows the breakdown of these funds by major program:

- **Researcher Recruitment (87%).** USTAR's most significant investment to date has been the recruitment and retention of top researchers to the state's research universities. Beginning in 2007, University of Utah and Utah State University recruited approximately 50 world-class faculty based on their academic credentials and alignment to the universities' existing research strengths, but also their interest in more applied and commercially-oriented research.
- **Statewide Technology Outreach and Innovation Program (10%).** USTAR's TOIP program supports several outreach centers across the state that offer a range of business services to entrepreneurs and startup companies. These services include formal entrepreneurship training programs (i.e., Nail It Then Scale It, Launchpad, etc.), as well as one-on-one mentoring and business plan assistance. TOIP centers provide some access to early-stage risk capital through the provision of competitive Go-to-Market grants (for product and market validation and prototyping), assistance in writing SBIR/STTR proposals, and preparing entrepreneurs for

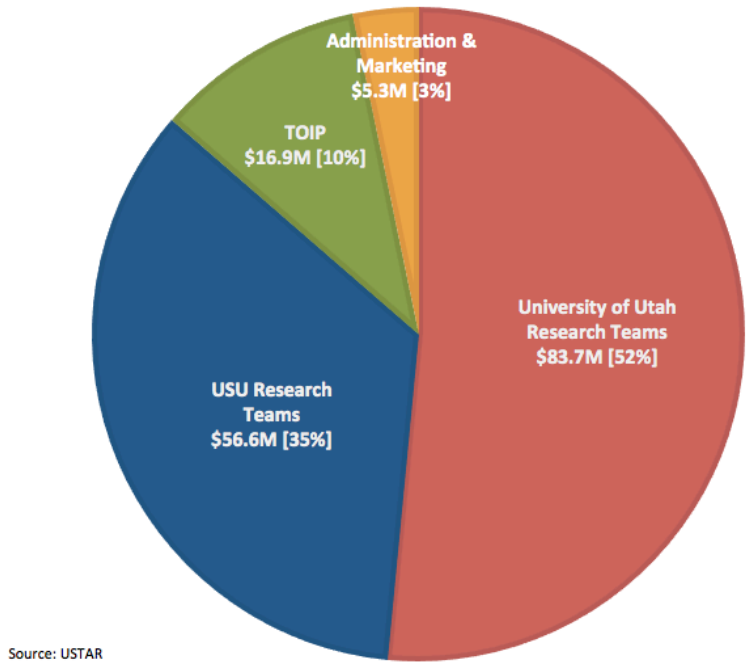
[14] This figure does not include investments in new university facilities, which did not come out of the USTAR budget.

[15] The two new facilities: the James L. Sorenson Molecular Biotechnology Building at University of Utah and the USTAR BioInnovations Center at Utah State University.

investor pitches. Centers also provide technical assistance and access to equipment, office space and lab space (including prototyping labs and wet labs).

- **Administration and Marketing (3%).** A very small share of total USTAR funding goes to program management, monitoring, and outreach activities.

Figure 6 USTAR Investment by Program, FY2007 to FY 2014 ($ millions)



Source: USTAR

Interview Findings About USTAR Program

Overall, interviewee's view of the impact that USTAR's research investments have had on the state research universities was positive. Most interviewees believed that USTAR had strengthened research capacity and quality at University of Utah and Utah State University, and had helped to bring additional federal research funding to the state. There was also wide belief that USTAR had helped to raise the visibility of Utah as a state committed to supporting research and technology commercialization. However, as noted earlier, USTAR's $20 million per year investment represents only 3% of Utah's total university R&D expenditures.

SRI's interviews found some disagreement about the impact of the USTAR program on technology-based economic development and about the strategy of emphasizing university research capacity building over other types of innovation system support. Many interviewees noted that research capacity is a long-term investment, and it often takes 20-30 years before university research gets to the point where a commercial application or product materializes. The spider silk research at Utah State University is a case in point. Dr. Randy Lewis's research on spider silk proteins began in the 1980s and builds on the

work of many other researchers.[16] [17] This is the nature of scientific discovery, and one important role of government is to make the long-term investments in education and research that the private sector cannot.[18]

While some stakeholders believed that the program focus on recruiting world-class faculty is the right strategy, a large portion of interviewees believed that USTAR should devote more resources to addressing other gaps in the innovation system at the expense of funding university research. Gaps that were identified as opportunity areas for USTAR included devoting more resources to entrepreneurial support and mentoring, providing early-stage risk capital, helping to strengthen university-industry connections, and making funds available for university researchers to go after larger federal grants and projects.

There was also broad agreement that there is misalignment between the USTAR's current program activities (university research capacity building) and program expectations (technology companies that generate private sector revenue and jobs). Many agreed that focusing USTAR investments at the early stages of the innovation continuum are unlikely to lead to the type of private sector job creation in technology companies in the near term that the legislature had expected. So, either expectations for revenue and jobs need to be reset or USTAR needs to focus its efforts further downstream in the commercialization process. However, even then, at the translational stage of the innovation continuum where there is a gap in financing and business assistance, investments are high risk. Many small technology companies fail. The upside gain in revenue and jobs is still 10-15 years out. However, the objective of such programs is to strengthen the overall innovation system. Government investment, even on a small scale, can help catalyze co-investment by the private sector in higher risk early-stage technologies and companies if they are based on strong, market-driven value propositions.

Finally, many of those interviewed said that, when it was first announced, USTAR sent an important message to people outside of the state that Utah cares about supporting and investing in its innovation system. While there are disagreements among interviewees about what changes are needed, all of those people interviewed by SRI agreed that the USTAR program has been valuable and should continue in some form.

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[16] Xu, M. and Lewis, R.V. (1990). "Structure of a protein superfiber: spider dragline silk," *Proceedings of the National Academy of Sciences* 87:7120-24.

[17] Earlier seminal papers by other researchers include Gosline J.M., Denny M.W., DeMont, M.E. (1984). Spider silk as rubber, *Nature*. 1984;309:551–2 and Gosline, John M., M. Edwin DeMont, and Mark W. Denny. "The structure and properties of spider silk." *Endeavour* 10.1 (1986): 37-43.

[18] Utah makes investments in higher education and research through the higher education appropriations committee.

Recommendations

If the state's priority remains supporting the growth of startup technology companies, then SRI recommends shifting USTAR's program balance toward providing greater support for early-stage companies and for de-risking technologies that are closer to commercialization. Our analysis identified weaknesses in Utah's innovation systems, such as early-stage risk capital and stronger industry-university connections, where USTAR could play a catalytic capacity building and bridging role.

Specifically, SRI recommends that USTAR:

1. **Revamp and expand the existing TOIP program into a USTAR New Ventures Program:** Redirect a portion of the funding currently going to university research capacity building to provide more early-stage funding and business coaching and mentoring for startup technology companies. This is an expansion of the Technology Outreach Innovation Program incorporating best practices from similar programs in other states.
2. **Create a USTAR Industry-University Partnerships Program:** Pilot a new program to help Utah companies solve technical challenges related to product commercialization through sponsored research projects at Utah colleges and universities.
3. **Focus USTAR Research Capacity-Building Program:** Align any further recruitment of faculty with priority industry sectors and get broader input into recruitment decisions based on defined criteria. Pilot a small grant fund to incentivize collaboration to go after larger federal grants.
4. **Refine USTAR Metrics:** Adopt a new metrics framework that provides better alignment between USTAR programs and anticipated impacts.

Each of SRI's four recommendations are described in more detail below.

Recommendation 1: Revamp and Expand Existing TOIP Program into a USTAR New Ventures Program

What: The USTAR New Ventures Program will support and invest in Utah-based technology startups, accelerating the rate at which early-stage businesses can scale and deliver significant benefits to the state's economy. The New Ventures Program represents an expansion in scope for the TOIP, and SRI recommends that the GOED Technology Commercialization and Innovation Program (TCIP) be folded into this new program achieving two objectives: (1) streamlined administration of the state's funding for technology commercialization and (2) clarity of purpose and messaging in marketing this competitive "one-stop" commercialization funding opportunity to Utah technology startups. The existence of multiple funding programs with different award criteria complicates outreach to the target audience.

Like the existing TOIP, the USTAR New Venture Program will continue to provide targeted business services, screening, and capital to Utah-based startup companies throughout the state to de-risk technologies to get to the next stage, but in a more robust way. (Currently, the maximum investment that TOIP can make in companies is $15,000.) There are different models for implementing a new ventures program. SRI recommends taking a year to assess the capabilities of for-profit and non-profit organizations in different parts of the state, such as existing accelerators or incubators, as well as deal flow. Other states often use non-profit intermediary organizations to deliver business services and to manage pre-seed funds and investments in early-stage companies, because these organizations have a successful track record. They can point to evidence of helping companies scale and exit; they bring extensive business networks; and they bring private sector co-investment and matching funds. However, the ability to outsource this function to an experienced third party depends on the existence, capacity, and track record of such institutions.

SRI recommends that Utah market the USTAR New Ventures Program to technology startups nationally and even internationally that are willing to relocate to Utah. In this way, the program complements the state's business attraction efforts by attracting early-stage, scalable technology companies and entrepreneurial talent to Utah.

Innovation System Gaps Addressed: Targeted business assistance for early-stage technology companies, pre-seed funding, access to network of investors, technical subject matter experts, experienced entrepreneurs, potential customers, and professional services

Metrics: SRI recommends the following indicators for tracking program activities and performance over time.

- **Program Activities:** number of companies assisted, number of companies receiving pre-seed investments
- **Short-term Outputs:** follow-on investment, revenue, new products

- **Long-term Outputs:** follow-on investment, revenue, employment, average wage

Best Practice Model: Ohio Third Frontier Entrepreneurial Signature Program

Ohio's Entrepreneurial Signature Program (ESP) is a major component of the larger Ohio Third Frontier (OTF) initiative, a $2.1 billion set of technology commercialization and financing programs begun in 2002 to strengthen Ohio's innovation economy.[19] Administered by the Ohio Development Services Agency, the OTF funds a portfolio of programs across a common technology commercialization framework, with a shared goal of moving technology from ideation to the marketplace. The purpose of the ESP is to accelerate the growth of technology startup companies in the state and increase their capacity to deliver significant economic benefits to Ohio in the form of new jobs, investment capital, and revenues.[20]

Ohio's ESP funds a regional network of non-profit organizations that provide business mentoring and coaching and manage pre-seed funds. These organizations are listed in the table below. The ESP program is currently funded at approximately $42 million a year (by the state), but requires a 1:1 match for both its operational funding and pre-seed fund making this an $84 million a year program. The state sends out a solicitation for this funding opportunity, and intermediary organizations submit proposals demonstrating their experience, impacts, and ability to provide matching funds through a competitive process. The ESP supports six non-profit organizations across six defined geographic regions in the state. Ohio is a $583 billion economy compared to Utah's $141 billion economy. As a rough benchmark, one might expect Ohio's entrepreneurial support programs to be four times the size of Utah's. However, the current funding for Utah's TOIP program is $2 million per year compared to Ohio's $42 million.

Table 2 OTF Entrepreneurial Support Program

OTF Entrepreneurial Support Program	
Region (anchor city)	**Intermediary Organization**
Central (Columbus)	Rev1Ventures
Northeast (Cleveland)	JumpStart
Northwest (Toledo)	Rocket Ventures
Southeast (Athens)	TechGROWTH (Ohio University)
Southwest (Cincinnati)	CincyTech
West Central (Dayton)	Accelerant

[19] http://development.ohio.gov/bs_thirdfrontier/background.htm.
[20] http://development.ohio.gov/files/otf/Entrepreneurial%20Signature%20Program%20RFP.pdf, 5.

Currently, selected intermediary organizations for funding and pre-seed funds hold ESP contracts for an average of two to three years. In order to qualify for assistance through the ESP, client companies must be based in Ohio or committed to locating a "principal place of business" in the state. This requirement helps attract new businesses and startups to the state. Additionally, companies must fall under one of the three earlier phases of business development (Imagining, Incubating, or Demonstrating) as defined by the OTF Technology Commercialization Framework.[21] The Ohio Development Services Agency anticipates awarding up to $50 million through the program in calendar years 2015 and 2016.[22]

The ESP centers provide capital to early-stage businesses in several forms. JumpStart (Cleveland, OH) primarily invests in companies through convertible debt—loans that convert into equity—which avoids the complications of placing valuations on early-stage startups.[23] Through its OTF-supported funds, Rev1Ventures (Columbus, OH) provides pre-seed funding of up to $100,000 to startups, with the majority of the investments taking the form of convertible debt. Depending on specifics of the startup and the presence of other investors, they may make equity investments. This flexibility among investment vehicles allows the ESP organizations to tailor their services and investment mechanisms to the needs of early-stage companies.

OTF reports that over 900 companies have utilized ESP center services or funding since 2006, with roughly half of those receiving pre-seed investments. Less than a third of the companies (287) received at least $100,000 in investment. A rigorous study of the performance of these 287 companies who had received the targeted support services and a minimum of $100,000 of investment found that $134 million in program investment from 2006 to 2014 generated 2,130 new jobs, $1.3 billion in follow-on private sector investment, and $833 million in product sales and revenues at assisted companies.[24] The program is beginning to see a "J-curve" with some sizeable numbers for the 22 companies in the 2006 cohort in terms of follow-on investment ($14.2 million), product sales ($246 million), and jobs (476) as the program approaches the 10-year mark.

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[21] See http://development.ohio.gov/files/otf/CY2015-16%20ESP%20Bidders%20Conference.pdf, 7.
[22] http://development.ohio.gov/files/otf/Entrepreneurial%20Signature%20Program%20RFP.pdf, 7.
[23] http://www.jumpstartinc.org/entrepreneursupport/funds/~/media/JumpStartInc/Images/Entrepreneur%20Programs/JumpStart%20Investment%20Terms.ashx.
[24] http://development.ohio.gov/files/otf/4.16.15%20advisory%20board%20meeting.pdf, 10.

Table 3 ESP Impacts To Date by Client Company Cohort Year

	Totals	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total Companies	**287**	22	19	27	40	32	43	40	35	29
Total Investment $M	**$134**	$14.2	$9.1	$14.8	$20.5	$16.3	$20.1	$17.4	$11.1	$10.1
New Jobs	**2,127**	476	134	137	389	381	152	238	92	127
Follow-on Equity $M	**$1,337**	$237	$318	$141	$162	$260	$124	$54	$30	$11
Product Sales $M	**$847**	$246	$37	$108	$189	$123	$42	$48	$20	$31

Other states with similar programs: Oklahoma (Innovation to Enterprise [i2E]), Pennsylvania (Ben Franklin Technology Partners)

Recommendation 2: Create USTAR Industry-University Partnership Program

What: The USTAR Industry-University Partnerships Program will help Utah businesses solve technical challenges in existing products and processes and supports the development and commercialization of new products and processes through sponsored research projects at Utah Universities. Specifically, the USTAR Industry-University Partnerships Program will help Utah companies identify university researchers with relevant subject matter expertise and provide matching funding, on a sliding scale, to help Utah companies pay for these R&D projects. The program will award matching funds on a competitive basis for proposals submitted jointly by Utah companies and researchers from any of Utah's 10 university system institutions.

Innovation System Gaps Addressed: New product and process development and commercialization at established and early-stage companies, industry-university linkages

Metrics: SRI recommends the following indicators for tracking program activities and performance over time.

- **Program Activities:** number of companies seeking subject matter experts from Utah universities, number of proposals submitted, number of projects selected for investment
- **Short-term Outputs:** technical solutions found, new products and processes developed, follow-on investments in projects
- **Long-term Outputs:** product sales, jobs, average wages

Best Practice Model: The Maryland Industrial Partnerships Program

The Maryland Industrial Partnerships (MIPS) Program accelerates corporate technology development and commercialization through industry-university research partnerships. Specifically, MIPS helps Maryland companies identify and leverage the research infrastructure and subject matter expertise of Maryland universities to solve pressing technical challenges and develop new products and processes. Established in 1987, MIPS is a state-funded program administered by the Maryland Technology Enterprise Institute (Mtech) at the University of Maryland, College Park. MIPS helps businesses throughout Maryland partner with faculty across the 12 member institutions of the University System of Maryland, as well as Morgan State University and St. Mary's College.[25]

To incentivize industry-university collaboration, MIPS grants matching funds to selected industry-sponsored, university-based research projects. Maryland companies and researchers from any of the

[25] Morgan State University and St. Mary's College of Maryland are state-funded public universities, but are administered outside the University System of Maryland.

state's 14 public universities develop proposals jointly, and MIPS funds are awarded on a competitive basis. The maximum MIPS contribution to any single project is $100,000 per year. The required portion of industry funding of projects is on a sliding scale, and increases with company size.[26] MIPS awards two rounds of grants per year, with each round typically awarding a total of $3 million to $5 million (combined MIPS and industry contributions) in funding across 15-20 projects. The first 2015 round of MIPS grants awarded a combined $3.3 million to 15 technology development projects, with projects ranging in size from $135,000 to $511,000.[27]

MIPS reports that it has helped over 400 faculty researchers partner with more than 500 Maryland companies since the program's inception 27 years ago. An independent 2012 economic analysis of MIPS found that among other impacts, the program has brought the following benefits to the state:

- MIPS-funded products generated over $3 billion in sales and supported over 3,600 jobs in Maryland in 2011. MIPS now estimates 6,600 direct jobs in Maryland at companies whose early product development was supported by the program.[28]
- The economic impacts associated with MIPS-funded technology generated an estimated $87.3 million in state and $70.6 million in local tax revenues in Maryland in 2011, far exceeding the lifetime cost of the MIPS program.
- Technologies that were developed and commercialized with the assistance of MIPS have attracted $884.2 million in additional financing into the state of Maryland.[29]

Other states with similar programs: California (UC Discovery Grant), Florida (Florida High Tech Corridor), Georgia (Georgia Research Alliance), Massachusetts (InnovateMass)

[26] See appendix for further information on funding.
[27] http://www.mtech.umd.edu/media/release.php?id=367.
[28] Communication with MIPS staff, May 7, 2015.
[29] http://mips.umd.edu/docs/reports/JFI_MIPS_Report_2012.pdf.

Recommendation 3: Refocus USTAR Research Capacity Building Program

What: Going forward, SRI recommends that USTAR pivot its current university investments from talent recruitment to enhancing the productivity of both USTAR-recruited and existing faculty. This includes providing competitive funding for commercially-oriented research projects and other mechanisms to incentivize interdisciplinary and industry-university connections. If USTAR considers faculty recruitments in the future, SRI recommends that these recruitments align more closely with the state's priority industry sectors and that USTAR adopt several best practices in implementation. These two recommendations for enhancing USTAR's Research Capacity Building Program are described in more detail below:

1. Use USTAR money to enhance the productivity of both USTAR-recruited and existing faculty:
    - Convene/support periodic events to bring interdisciplinary groups of researchers together around big research themes, providing a venue for faculty introductions and the exchange of ideas that can lead to future development of proposals.
    - Convene/support periodic events to bring Utah startups and larger companies together with researchers to discuss corporate R&D needs and university capabilities.
    - Develop a small pilot grant program ($30,000 to $50,000 grants requiring a university match) to develop data and other precursor organizational activities required to pursue larger more commercially-oriented Federal grants. These grants would be open to all university researchers at any Utah college or university and should encourage multidisciplinary and cross-institutional collaboration.
2. Use USTAR money for strategic recruitments aligned to the state's priority industry sectors and adopt several best practices from other states with similar programs, including:
    - Define the criteria for selecting the research fields for researcher recruitment with input from USTAR, industry representatives, and university representatives;
    - Require a 1:1 match from the university for each faulty position (e.g., USTAR provides matching funding for the university to create an endowed chair, or USTAR provides the startup package and the university provides the salary);
    - Define the criteria for evaluating potential candidates and employ a peer review process with a defined method for scoring candidates against these criteria; and
    - Involve USTAR in interviewing and making decisions regarding the hiring of new faculty.

Innovation System Gaps Addressed: Strengthen interdisciplinary research and university-industry research connections; strengthening the R&D capacity at state research universities in areas aligned to the state's priority industry sectors.

Metrics: SRI recommends the following indicators for tracking program activities and performance over time.

- **Program Activities:** funding for start up packages/endowed chairs; number and amount of grants for commercially-oriented research projects; number and amount of funding for events to strengthen interdisciplinary and industry-university connections; number of faculty hired.
- **Short-term Outputs:** external research grants awarded; number of publications; number of patent disclosures, patent applications, and patents awarded; number of licenses
- **Long-term Outputs:** Improved university rankings; number of research jobs supported by USTAR recruited faculty (i.e., technicians, grad students and post docs); number of companies started with faculty-generated IP

Best Practice Model: Georgia Research Alliance's Eminent Scholars Program

The Georgia Research Alliance (GRA) is a 501(c)3 that partners with the Georgia Department of Economic Development and eight universities around the state, including Georgia Tech and University of Georgia. GRA is funded at approximately $17 million per year. The Eminent Scholars Program is one of the primary areas of investment of the GRA. The program aims to recruit world-class scientists to Georgia universities, with the goals of increasing research capacity and enhancing the reputation of universities in Georgia. GRA also supports technology commercialization and seed financing for Georgia startup companies through GRA Ventures. This section is narrowly focused on GRA's Eminent Scholars Program, because it embodies a number of best practices of research capacity building aligned to economic development objectives.

The Eminent Scholars Program funds endowed chair positions at Georgia's research universities. GRA provides half the money for the endowment with a 1:1 match— matching funds come primarily from the university partner, though in some cases a small portion of the matching funds may come from industry. Each chair position has an endowment of $1.5 million. GRA also provides startup packages to ensure that an eminent scholar's new lab is superior to their lab space at their previous institution. Approximately 10 percent of the GRA annual budget, or $1.7 million per year, is used for establishing endowed chairs; 56 percent goes to outfitting labs for the eminent scholars and other senior scientists; 25 percent goes to commercialization programs (GRA Ventures); 6 percent goes to program management; and 3 percent to a cancer research program that is winding down.[30]

[30] Correspondence with Georgia Research Alliance President and CEO, Mike Cassidy, on June 8, 2015.

When GRA established the Eminent Scholars Program in 1993, it began with the goal of creating 100 endowed chairs. Currently, the program has 62 Eminent Scholars and 70 endowed chair positions. GRA and the Eminent Scholars Program highlight the following benefits to the state:

- Eminent Scholar research teams had over 1,500 employees in FY2012, including faculty, technicians, post docs, grad students.
- Eminent Scholars were responsible for $270 million in research expenditures in FY2012.
- Eminent Scholars are responsible for a total of 1,042 invention disclosures, 1,207 patent applications, and 179 issued patents since the program's inception.
- GRA has elevated Georgia universities' reputation and profile nationally and internationally.

In its early days, the Eminent Scholars Program managed a small grant program to incentivize faculty from multiple institutions to work together. However, over time, the GRA found that holding annual meetings and periodic dinners to bring interdisciplinary faculty together was just an effective a means to promote collaboration. These events provide a venue for discussing ideas and lead to follow-on collaboration on proposals for external funding.

Over time, the GRA has moved further downstream in terms of support for technology commercialization. Consequently, today the GRA has two major program areas: the Eminent Scholars Program and GRA Ventures, which is the commercialization arm of GRA. Approximately 25 percent of the GRA budget, or $4.3 million annually, goes to the GRA Ventures program. GRA Ventures encompasses three key sub-programs:

1. GRA Ventures Program: Multiphase grants and loans aimed at de-risking early- and mid-stage technology development
    - Phase 1: grants up to $50K, aimed at evaluating whether or not to form a company
    - Phase 2: grants up to $100K (requires matching funds), for prototyping, animal modeling (for life sciences companies), and for market-related activities such as creating a value proposition.
    - Phase 3: loans up to $250K, used for executing business plans and/or scaling up a business

2. GRA Venture Fund: A private investment fund that makes seed, early-stage and mid-stage investments in promising companies that have moved through other stages of technical and market validation at GRA Ventures

3. GRA Industry Fellows: Seasoned industry professionals who are matched with GRA Ventures portfolio companies for mentoring

Recommendation 4: Refine USTAR Metrics

This section provides a framework that aligns USTAR's overarching goals, program activities, and anticipated short-term and long-term outputs with a recommended set of USTAR metrics for tracking program activities and outputs. We also provide examples of metrics and reported data from similar state technology commercialization and research capacity building programs. These examples are provided as benchmarks to help inform and recalibrate future expectations of USTAR program impacts.

Role of Metrics

Metrics support good governance and oversight. Well-conceived program metrics provide a framework for collecting data on program activities and assessing their impact on recipients. They, therefore, provide critical information to help governing boards and policymakers understand and answer the following types of questions of questions:

- Given the gap or weakness the program seeks to address, what is the demand for this program activity?
- How selective is the program? For example, if you are trying to recruit talented researchers, how many apply for the position relative to how many you fund? If you are providing seed money to startup companies, how many companies do you screen compared to how many actually receive seed stage investments?
- How is this program activity helping to catalyze connections to other important actors in the innovation system?
- What are the short-term indicators (2-5 years) that suggest the program is assisting companies or researchers to get to the next stage?
- What are the long-term indicators (10-15 years) that suggest the program is meeting its objectives?

Good program data are critical for assessing the effectiveness of programs—making data-driven decisions about what aspects of a program need to be modified and whether a program can be phased out as private sector capacity grows. However, metrics should be designed and implemented carefully. As the old adage goes, "You get what you measure." A patents metric can lead a program to fund the production of patents, regardless of whether the technology they embody ever makes it to the marketplace. A metrics that counts the number of startup companies can lead programs to push the formation of high numbers of new ventures, regardless of whether they have the necessary managerial talent and business plan to succeed in the market. USTAR's real objective is improving the overall innovation system in which startup companies operate, so that the best companies can advance to the next stage and grow from 5 employees to 500-plus employees without having to leave the state. Table 4 (below) summarizes common challenges with regard to program metrics.

Table 4 Common Challenges with Program Metrics

Issue	Problem(s) Created
Misalignment between program goals, activities, and metrics	Unhelpful data
	Incentivizing unintended behaviors
Overly burdensome reporting requirements	Clients opting out of program participation
	Too much time and energy being spent on data collection
Qualitative nature of success factors	Factors do not lend themselves to quantitative measurement

Framework for Aligning Program Objectives, Activities, and Output Metrics

SRI developed the following conceptual framework that aligns the objectives of the proposed USTAR programs with activity, short-term output and long-term output metrics. As shown in the figure below from left to right, the framework highlights the gaps that SRI has identified in the Utah innovation system, the proposed programs to address them, key program activity metrics, expected short-term output metrics (2-5 years), and anticipated long-term output metrics (10-15 years) for each program.

Table 5 Conceptual Framework Linking USTAR Proposed Programs with Metrics

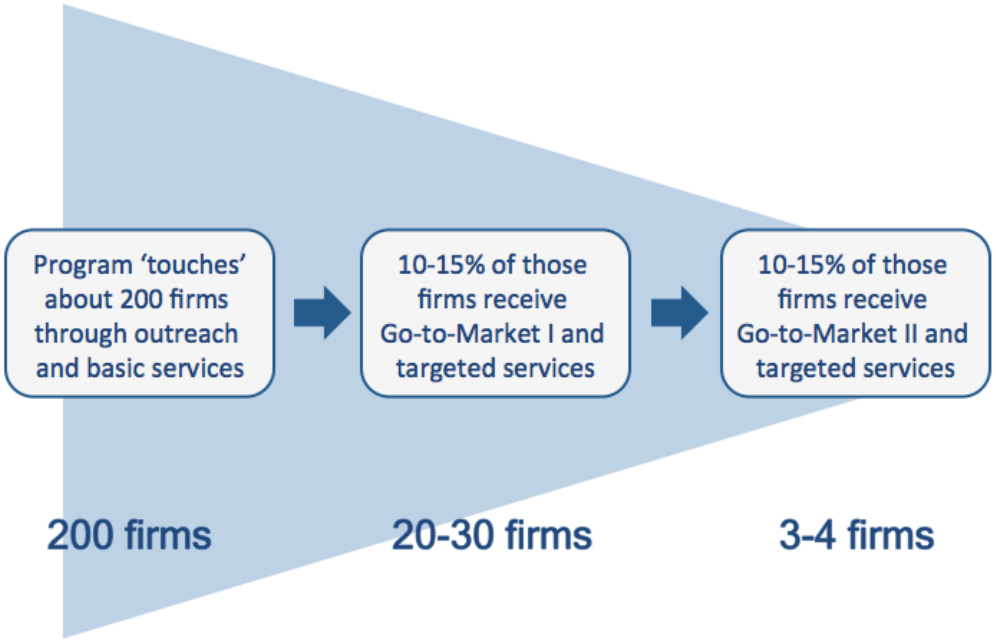
Gap	Recommendation	Activities	Short-term Outputs	Long-term Outputs
Industry-University Linkages Limited Risk Capital Managerial Talent	Industry-University Partnerships Program	# of Companies Assisted Projects Awarded	Solutions Found Follow-on Investment	New Sales/Revenue New Direct Jobs Average Wage
	New Ventures Program	# of Companies Assisted # of Companies Awarded Pre-Seed Investment	Follow-On Investment	New Sales/Revenue New Direct Jobs Average Wage
Research Capacity Building	Research Capacity Building	Faculty Hired Collaborations Infrastructure	Leveraged Funding Patents/Licenses Publications	University Ranking Companies Formed

Program Activity Metrics

These metrics capture the volume of interactions, the quality and the effectiveness of these interactions, and the screening that occurs to arrive at the targets for the bulk of the program activity. The data for these metrics can be tracked and collected by USTAR staff.

- **USTAR Industry-University Partnerships Program:** Metrics include the number of companies that seek technical assistance, the number of faculty with requisite expertise that USTAR refers to the companies, the number of company-sponsored R&D proposals submitted, and ultimately the number of R&D projects funded.
- **USTAR New Ventures Program:** Metrics include the number of entrepreneurs and companies that the program engages through the different services offered by the program. This includes those firms the program interacted with in outreach activities and a basic level of business assistance services. After initial engagement, the program will identify those firms with marketable ideas (smaller percentage of the total number of companies 'touched' by the program) –those companies are selected for more targeted business services and can pitch for pre-seed stage funding. After the first round of pitches, promising firms with validated products and business plans are selected to receive business mentoring and assistance and can pitch for stage 2 pre-seed stage investments.

Figure 7 Levels of Engagement in the New Ventures Program



- **USTAR Research Capacity Building Program:** These metrics include the number and amount of grants for commercially-oriented research projects, number and amount of funding for events to strengthen interdisciplinary and industry-university connections, and the number of faculty hired.

Short-term Output Metrics

These metrics focus on the expected outputs from program activities during the first five years following the receipt of USTAR funding or assistance. These outputs can be considered "leading" indicators on the road to the long-term desired outputs. For example, the goal of the USTAR New Ventures Program is the commercialization of new products, sales from these products, and jobs created as the company grows. However, depending on the technology sector in which the company is operating, startup companies can take 10-15 years or more to generate enough sales from commercialized products to grow beyond a handful of employees. Therefore, follow-on investment is a good leading indicator, since it suggests the company has a product and value proposition that are compelling enough to get private sector investors to co-invest.

- USTAR Industry-University Partnership Program: metrics include technical solutions resulting from the industry-sponsored R&D project at a college or university or follow-on investment in the R&D project.
- USTAR New Ventures Program: metrics include follow-on investment and product sales.
- USTAR Research Capacity Building Program: metrics include follow-on federal, private and other research dollars leveraged by faculty, as well as publications, patents and licenses resulting from commercially oriented research activities.

Long-Term Output Metrics

These metrics track the longer-term desired outputs of the USTAR programs. While data on these metrics would be collected annually via client surveys, one would not expect to see impressive results for 10-15 years, as has been the experience of similar longstanding programs in Georgia, Maryland, Ohio, and Pennsylvania.

- USTAR Industry-University Partnerships Program: metrics include the commercialization of products, sales related to these products, and jobs with higher-than-average wages supported by the growth in revenue in these companies.
- USTAR New Ventures Program: metrics include the commercialization of products, sales related to these products, and jobs with higher-than-average wages.
- USTAR Research Capacity Building Program: metrics include university reputation metrics in areas aligned to priority economic sectors and companies that have formed and scaled up based on technology licensed from Utah universities.

Metrics by Proposed USTAR Program

The tables below organize the proposed metrics for each of the three recommended USTAR programs. They are based on a review of metrics used by other state research capacity building and technology commercialization programs including the Georgia Research Alliance, the Ohio Third Frontier, and the Maryland Industrial Partnerships Program.

Table 6 USTAR New Ventures Program Metrics

Activities	Short-term Outputs	Long-term Outputs
Number of companies assisted • By technology sector • By number of employees Type of services provided to companies • Number of hours spent assisting company Seed funding investments in companies • Number of investments • Dollar amount of investment	Follow-on investment in client companies • Number of follow-on investments • Source of investment(s): federal, private, other • Dollar amount of investments	New IP New products or processes New Sales New Jobs • Average wage

Table 7 USTAR Industry-University Partnerships Program

Activities	Short-term Outputs	Long-term Outputs
Number of companies requesting expertise • By technology sector • By number of employees • By revenues Number of proposals submitted • By technology sector • By university Number of projects awarded • Dollar amount of award • Dollar amount of match	Solutions identified Follow-on investments in client companies • Number of follow-on investments • Source of investment(s): federal, private, other • Dollar amount of investments	New IP New products or processes New Sales New Jobs • Average wage

Table 8 USTAR Research Capacity Building Program

Activities	Short-term Outputs	Long-term Outputs
Number of faculty hired • Amount of funding for startup packages/endowed chairs • Amount of matching funds from university	External grant funding awarded • Source of grant(s): federal, private, other • Dollar amount of grant(s) Number of publications Number of invention disclosures, patent applications, and patent awards Number of licensing agreements Number of research jobs supported by USTAR-recruited faculty (i.e., technicians, grad students and post docs) • Average wage	Improved university rankings Number of company spin-outs
Number of seed grants for multi-disciplinary research projects awarded • Dollar amount of award	External grant funding awarded • Source of grant(s): federal, private, other • Dollar amount of grant(s)	Number of publications Number of disclosures, patent applications, and patent awards

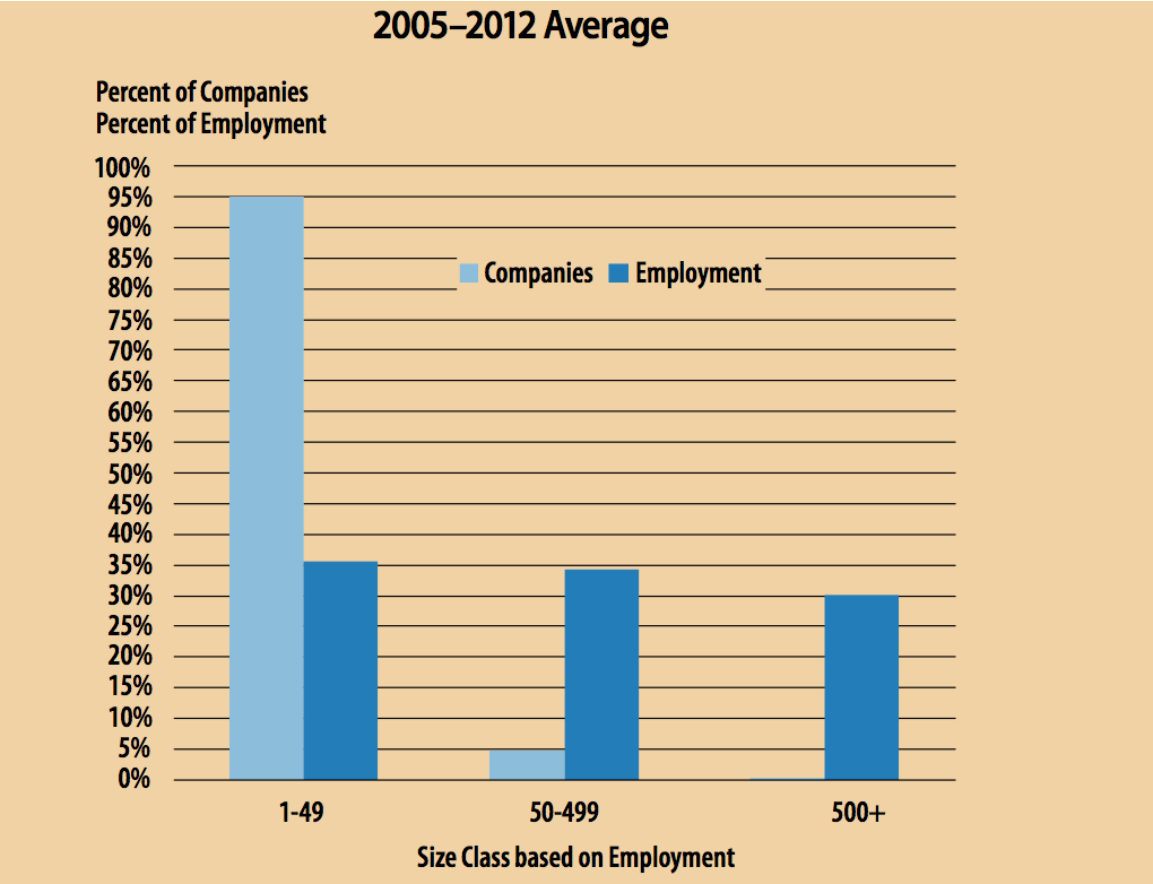
Impact Metrics from Other States

In thinking about metrics and the anticipated impact of state technology commercialization and research capacity building programs, it's important to remember the objectives and scale of these programs in the broader economic context. Utah is a $141 billion economy measured by GDP. As highlighted in a previous section of this report, Utah's private sector performs approximately $2 billion of R&D each year, and Utah universities perform approximately $600 million of R&D annually. USTAR is currently funded at $20 million per year—3% of total university R&D expenditures or 1% of total private R&D expenditures.

Second, compare the original expectations of the scalability of Utah technology startups with the actual scale of employment in the vast majority of Utah companies. The vast majority (95%) of Utah's 65,000 private sector companies today are small companies with fewer than 50 employees. Within this category of small companies, the average size of companies is very small—fewer than five employees. By contrast, large companies (those with 500-plus employees)—like Intermountain Healthcare—represent less than 1% of Utah companies, but employ a third of Utah workers. Medium-sized

companies (those with 50-499 employees) represent fewer than 5% of Utah companies and employ another third, and all small companies combined employ the final third.[31]

Figure 8 Share of Utah Companies by Employment and Share of Private Sector Employment by Size of Company



Source: Utah Department of Workforce Services

Therefore, it's important to temper state technology commercialization program employment metrics with:

- The amount of state money being invested relative to the size of the economy;
- The actual size of the vast majority of companies in the state, and
- An understanding of the time required to commercialize products and to grow companies based on expanding sales.

[31] U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages data presented in, Knold, Mark (2012), "The Influence of Company Size on the Utah Economy," Utah Insights: An economic and labor market analysis of the State of Utah, https://jobs.utah.gov/wi/pubs/localinsights/winter2012/localinsightsstatewide.pdf

The 2005 USTAR Prospectus estimated the creation of 123,406 jobs over 30 years. While this job creation number is within the realm of possibility, one must consider the small business-dominated makeup of the state's companies. A benchmark calculation of the number of spinoff companies from university-based technologies required to achieve this job creation target ranges from 25,000 companies (if they have an average of five employees) to 2,500 companies (if they have an average of 50 employees). University of Utah and USU would have to license over 80 technologies a year to startup companies.

Table 9 Projected USTAR Economic Impacts by Year (2005 Prospectus)

Projected USTAR Economic Impacts by Year (2005 Prospectus)					
Program Year	Cumulative State Funding (Millions)	Annual State Funding (Millions)	Utah Jobs	Employment Earnings (Millions)	State Taxes (Millions)
5 (FY 2010)	$107.0	$26.5	3,036	$56.7	$5.4
10 (FY 2015)	$247.9	$29.3	6,761	$179.2	$14.4
20 (FY 2025)	$575.0	$35.7	35,071	$1,816.9	$145.4
30 (FY 2035)	$973.8	$43.5	123,406	$9,357.9	$748.8

When looking at the experiences of other state technology programs, SRI finds that the 2005 USTAR Prospectus overestimates impact by a factor of two to three comparing the total number of expected jobs after 10 years.

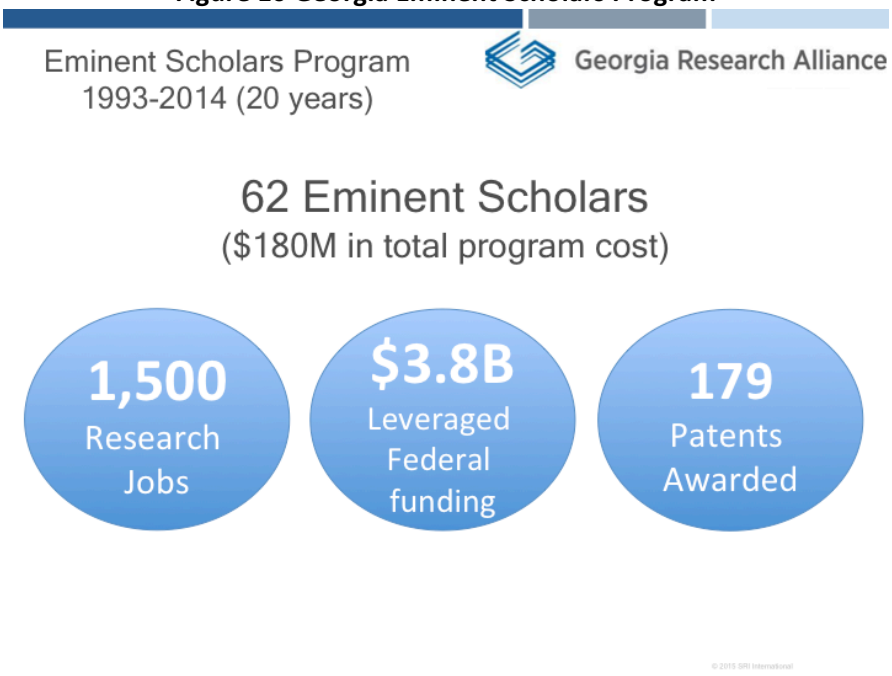
When analyzing the impact of their pre-seed investment program, the Ohio Third Frontier only looked at impacts on companies with very high level of engagement with the program – those companies that had received at least $100,000 in pre-seed investments and at least 40 hours of programmatic support since 2006. In those high-engagement companies, Ohio Third Frontier focuses on three impact metrics: new jobs created, follow-on equity, and product sales/revenue.

Of the 900 companies that utilized ESP center services since 2006, roughly half (446 companies) received some pre-seed investments, but OTF measured the impact on only those 287 companies that received at least $100,000 of investment and 40 hours of programmatic support. These 287 companies that received $134 million in total investments from the program, created 2,130 new jobs, received $1.3 billion in follow-on equity and generated $833 million in product sales from 2006 to 2014. Most of those impacts came at the tail end of that time period, as program evaluators saw a significant delay between early stage development (when companies need pre-seed funding) and growth in terms of jobs and product sales. Of the 287 high-engagement companies, nearly 80% have either exited (15) or were still reporting (213) in 2014.

Figure 9 Ohio Entrepreneurial Signature Program

GRA Eminent Scholars Program, which has funded endowed chairs at Georgia research universities since 1993, looks at thee main impacts for its program: leveraged research funding, patents awarded, and research jobs (on the research teams led by GRA endowed chairs).

Figure 10 Georgia Eminent Scholars Program



The program, which receives about 10 percent of the GRA annual budget or $1.7 million per year, funds 62 GRA eminent scholars. The program generated $3.8 billion in cumulative external investment (primarily federal) and funded research leading to 1,042 invention disclosures, 1,207 patent applications, and 179 issued patents from 1993 to 2012. GRA scholars also led research teams that employed 1,500 people in 2012.

Appendix

Appendix 1 – Ohio Third Frontier Entrepreneurial Signature Program

ESP Center Review Process

The non-profit organizations submitting proposals for ESP funding must describe:

- Their regional economic strengths, assets, opportunities, and challenges,
- Sources of technology-based company deal flow, and
- Key industry sectors for client company recruitment.

Applicants must discuss the gaps in their regional entrepreneurial systems and their approach for addressing these gaps, including:

- Talent (managerial, technical, sales, etc.),
- Underrepresentation of women and minority entrepreneurs and outreach to rural areas,
- Access to capital,
- Access to customers, and
- Mentorship networks.

ESP proposals are reviewed by external evaluators with technical and entrepreneurial experience, and rated on a set of criteria designed to support the mission of the Ohio Third Frontier. ESP applicants are assessed on their likelihood of advancing their regional entrepreneurial systems, the soundness of their approaches for addressing gaps in these systems, potential for attracting venture capital resources, and their track record of advancing companies and creating economic impacts, among other factors.[32] In addition to this holistic evaluation, each proposed service activity for client companies (e.g., market validation assistance) is judged according to its relevance in advancing regional entrepreneurial activity and likelihood of significant impacts.

The external evaluators provide funding recommendations to the Ohio Third Frontier Commission at a public meeting; OTF program staff, who perform an initial compliance review of proposals, may also offer recommendations at the request of Commission members. The Commission is the 11-member governing body of the OTF, comprised of state government, public university, and economic development organization officials, along with six regional business representatives and one public-at large representative appointed by the governor. The Commission makes final funding decisions by majority vote.[33]

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[32] For the full list of evaluation criteria, see http://development.ohio.gov/files/otf/Entrepreneurial%20Signature%20Program%20RFP.pdf, 20.

[33] See http://development.ohio.gov/files/otf/Appendix%20A%20-%20RFP%20Process,%20Awards%20Process%20and%20Mandatory%20Compliance.docx.

Funding of ESPs

The Ohio Development Services Agency projects awarding up to $50 million through the ESP in calendar years 2015 and 2016.[34] Distributed among six regional centers, this level of funding represents an average funding level of $4.2 million per ESP per year. ESPs are required to match their state funding with external funds, as the program carries a cost share commitment of at least one dollar in external funding for every dollar requested from OTF. Up to 25% of the cost share may come in the form of donated professional services, such as legal, tax, accounting, and marketing services.

Reporting Requirements and Metrics

The ESP requires that funded intermediary organizations create detailed client management plans that describe their approaches for conducting outreach, selecting client companies, and methods for tracking and evaluating client progress through OTF's Technology Commercialization Framework. Centers report on the following metrics:

- Clients: number of clients that are active, have ceased operations, left Ohio, been attracted to Ohio, and are research institution spinouts
- Jobs: new permanent, full-time jobs in Ohio
- Capital: total third-party investment raised by clients, total third-party investment attracted into Ohio, number of clients that raised at least $250,000 and at least $1,000,000 in third-party investment capital
- Other Leverage: product sales, federal grants, licensing incoming and other revenue
- Client Progress: number of clients transitioned into market entry, number of clients transitioned into growth and sustainability.

[34] http://development.ohio.gov/files/otf/Entrepreneurial%20Signature%20Program%20RFP.pdf, 7.

Appendix 2 – The Maryland Industrial Partnerships Program

Identification of Faculty Partners

MIPS personnel offer assistance to companies in matching them with faculty researchers with the right expertise for the companies' projects. MIPS predominantly operates on a "demand pull" basis, identifying faculty with relevant expertise to industry needs, rather than a "technology push" model of searching for companies aligned to faculty interests. MIPs staff occasionally refer several faculty members to interested companies, who choose the most appropriate university partner.

Review Process

Applicants to the MIPS program must provide a technical proposal describing the scope of the research project and the anticipated results, as well as a business proposal with a plan for commercialization of the research results. MIPS proposals undergo several stages of review, and are awarded on a competitive basis. Each proposal is first screened by a MIPS staff member to ensure completeness and clarity, and the staff member may work with the proposal team to correct any issues at this stage.

Proposals are then assessed on their technical and economic merits by small expert review teams.[35] Several MIPS and Mtech staff members act at as technical coordinators for proposals, and recruit reviewers from the USM and nationwide based on their area of expertise. Technical reviewers, typically active researchers at federal laboratories and universities, evaluate the technical feasibility of the project. The proposing company or faculty investigator may suggest technical reviewers for their proposals. Economic reviewers with experience in early-stage technology commercialization evaluate the business, financial, and economic development components of the project.

A separate MIPS Evaluation Board composed of representatives from state economic development organizations and university technology transfer offices makes final funding recommendations based on the ratings and comments of the technical and economic reviewers. Above all, the primary considerations of the MIPS program in funding commercialization research projects are their likelihood of success from a technical perspective, and their potential to make a positive impact on Maryland's state economy.[36]

Funding

MIPS provides matching funds to university-industry collaborative R&D projects focused on the commercialization of new products and processes. MIPS does not fund companies directly; instead, the program applies matching funding to industry-supported research projects at Maryland public

[35] For the complete evaluation forms, see http://mips.umd.edu/forms/MIPS_evaluation_forms.pdf.
[36] http://www.mips.umd.edu/applying.html#selection_process_criteria.

universities. The level of MIPS matching funding varies according to the size of the participating company. For example, large firms must contribute a minimum of 50% of the R&D project's funding (up to a 1:1 MIPS match), while startup firms must provide a minimum of 10% of funding (up to a 9:1 MIPS match).[37] In addition to funding a portion of the R&D project, companies are required to make an in-kind contribution of work on the project in the form of salaries of corporate researchers, materials and equipment, travel or other related expenses.

MIPS contributes up to $100,000 per year per project (up to $90,000 for projects with startup firms) for both one-year and two-year projects. Two-year projects receive funding for the first year if selected, and second-year funding is awarded on a renewal basis, contingent upon satisfactory progress of the project in its first year.

Reporting Requirements and Metrics

In order to help track and quantify the impact of the program, MIPS requires that companies report on several metrics as part of the funding agreements. Starting one year after project completion, companies are required to submit annual reports on the commercial impacts of their projects for five successive years. The data collected include the number of jobs at the company supported by the MIPS-funded technology, product sales, and follow-on investments. Although the greatest economic impacts of MIPS projects may occur after the five-year reporting period, high-growth MIPS-funded companies that become public provide relevant information in their annual reports.

[37] MIPS defines a large firm as one with more than 1,000 full-time employees. A startup firm has no more than 20 full-time employees, and must meet additional qualifications. For full details on company definitions and funding requirements, see http://mips.umd.edu/applying.html#funding_requirements.

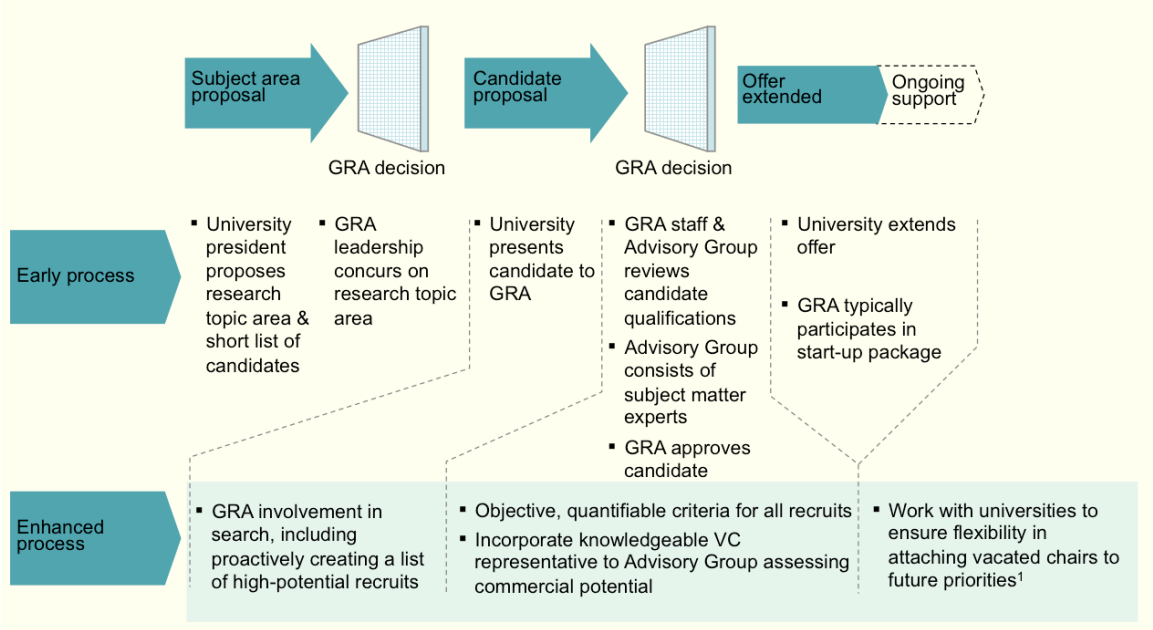
Appendix 3 – Georgia Research Alliance Eminent Scholars Program

Faculty Recruitment Process

The program's faculty recruitment process has evolved over time, with GRA taking on a more active role in recruiting, screening, and hiring of candidate researchers in recent years.

After a subject/research area has been selected, the university proposes candidates to a group of 4 to 6 external peer reviewers, usually senior scientists with similar technical backgrounds to the candidates. The panel reviews and scores candidates based on an established set of qualitative and quantitative criteria and provide recommendations to GRA staff, who then decide whether to make an offer the candidates. Venture capitalists may also be invited to serve as peer reviewers on the commercial potential of candidates' research.

Figure 11 GRA Eminent Scholars Recruitment Process



Source: Georgia Research Alliance

Candidate researchers are scored on both qualitative and quantitative criteria. Quantitative criteria include: grant funding productivity; research alignment with GRA priorities; patents, publications and disclosures; licenses; startups created; publications; connections in academia, industry, and government; research team management history; and academic awards. Candidates are also scored on the commercial potential of their research with inputs from the Georgia VC community. Qualitative criteria are often judged during the interview process, where interviewers ask questions about the candidate's vision, how often they collaborate, their leadership ability, etc.

From the beginning stages of the Alliance, GRA has sought alignment with the specific technical competences/research areas for GRA-sponsored faculty and existing research and industrial competencies in the Georgia region. For this reason, every candidate for an Eminent Scholar position is scored on their research's alignment with GRA priority research areas.

Figure 12 Scoring Criteria for GRA Eminent Scholar Candidates

Scholar scoring sheet

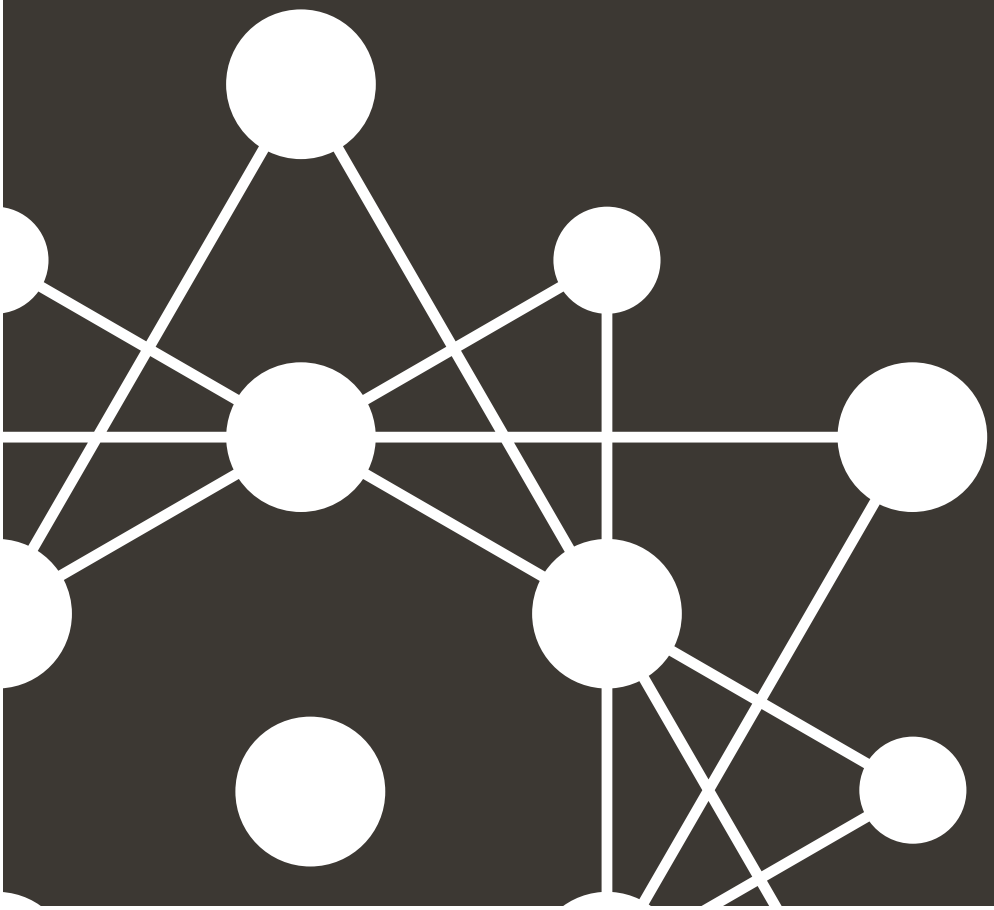
	Rating (Low 1 – High 5)				
	1	2	3	4	5
R&D grant performance					
1. Funding productivity				X	
Sector attractiveness					
1. Priority sector for federal R&D funds over next 5 years				X	
2. Research deemed by investors to be of near-term commercial relevance			X		
3. Research sector aligned with GRA priorities					X
Individual commercial potential					
1. Disclosures/patent applications			X		
2. Start-ups	X				
3. Licenses				X	
4. Industry relationships in GA				X	
Academic leadership and excellence					
1. Research center leadership potential				X	
2. Create a sustainable R&D enterprise with multiple collaborations			X		
3. Broadly cited and published in highest-impact journals					X
High-level external profile					
1. Academic awards and recognitions			X		
2. Industry/investor networks			X		
3. Government networks			X		

R&D grant performance criteria
1. Less than 1M per year
2. $1-3M per year
3. $3-5M per year
4. $5-10M per year
5. $10M+ per year

Sector attractiveness criteria (VC input)
1. No business opportunity
2. Likely cannot be market-ready within 5 years
3. Likely licensing opportunities within 5 years
4. Likely start-up opportunities within 5 years
5. Technology is presently start-up ready

Publishing criteria
1. No publications in top-5 journals within last 5 years
2. 1-4 publications in top-5 journals within last 5 years
3. 5+ publications in top-5 journals within last 5 years
4. 5+ publications in top-5 journals within last 5 years; at least one considered "required reading"
5. 5+ publications in top-5 journals within last 5 years; multiple considered "required reading"

Source: Georgia Research Alliance



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