External Innovation Ecosystem Analysis

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How Institutions and Communities Work Together to Launch Innovation

In a quest to find ways for the University of Tennessee (UT) and Oak Ridge National Laboratory (ORNL) to better work together to accelerate the launch of innovation, UT faculty visited and interviewed people in successful institutions and communities to learn what works and what doesn't. This document reports the findings of this benchmarking activity.

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EXECUTIVE SUMMARY

"When we studied why Silicon Valley works for spurring innovation, it came down to two things: (1) entrepreneurs, and (2) a culture of accepting failure."

− *Sue Siegel, General Partner, Mohr Davidow Ventures, at the 2012 TN Governor's Conference*

Purpose

This report summarizes the benchmarking activity conducted in late 2011 and early 2012 as part of the contract between the University of Tennessee (UT) and Oak Ridge National Laboratory (ORNL). Appendix A contains the proposed scope of work[1], and this report summarizes the results of Phase 1, which was focused solely on benchmarking successful communities and institutions that work together to launch innovation. The ultimate goal of the research is to determine how the organizations can better work together so that the region can be more successful in commercializing technologies. Phase 2 (a review and analysis of the local ecosystem) and Phase 3 (final report and recommendations) will continue through May of 2013.

Methodology

A preliminary literature review was conducted to identify best-in-class institutions and communities, which were proposed to an advisory board set up for this project that included members from both UT and ORNL. These targets were selected based on either their reputation for tech-based entrepreneurial ventures and/or because of co-location of both a university and a national laboratory. Advisory board members made adjustments to the list, and the list was reviewed with Dan Berglund, President and CEO of the State Science and Technology Institute (SSTI), who made further suggestions. The targeted organizations and communities were researched to identify the appropriate contacts, and cold calls were made where advisory board members could not facilitate personal introductions. Contacts are listed in Appendix B.

Visits or conference calls were held with most of the identified participants. Some visits were set up in conjunction with conferences that were focused on this subject (SSTI 2011 Annual Conference in Columbus, OH, and 2012 University Startups Conference in Washington, D.C.). Some of the identified organizations did not respond to the request.

A standard set of topics was used as a guide for discussions (see Appendix C). These discussions led us to new organizations and contacts, which we pursued where appropriate.

Key Findings

There were three messages heard consistently throughout our visits:

1. Our focus should be on improving the rate of innovation, *not* how to improve tech transfer.
2. Innovation requires deeper engagement with industry and entrepreneurs in the very early stages of research so that the research is focused on solving a problem.
3. This is a long-term commitment that must stay consistent across both organizational and state administrations.

[1] Note: Scope of Work has been changed for Phase 2, which will be reflected in the next written report.

Our research suggests innovation (and entrepreneurship as a way to launch that innovation) is becoming more important to universities and public research laboratories for many reasons, including:

- Federal granting agencies are starting to require commercialization plans and even evidence of a commercialization track record in grant proposals (e.g., NSF iCorps, EDA i6 Challenge, NSF Partners for Innovation, etc.).
- To the extent which industry is turning to research universities and laboratories for research, the work must be done with an eye toward applied research and application development.
- Universities and laboratories are recognizing that they must have a robust entrepreneurial ecosystem to recruit good students, researchers, and faculty.

However, it is not just laboratories and universities that are required to work together to spur innovation. There were five key requirements that emerged from our research:

1. A **collaborative culture** is required for launching innovation, and it requires champions. Although industry champions were the primary drivers, it also requires champions from labs, universities, state and local government, and the media to drive the culture both internally within their organizations and collectively as a region. This culture change requires a long-term commitment to make it happen, therefore emphasizing the need to have industry champions who remain consistent throughout changing administrations in publicly funded institutions.
2. Resources for building and maintaining a **supportive ecosystem** must be integrated throughout the entire value chain (from idea generation to venture launch and growth), with special emphasis on industry involvement at the idea generation stage. It also requires constant communication and cooperation between all ecosystem players. Many areas focus on core competencies (clusters).
3. Various pools of **capital** are necessary throughout the different stages of the lifecycle and should be implemented in small amounts with short time frames and milestones geared toward commercialization. This capital pool is critical for attracting venture funding.
4. A region must develop its own **entrepreneurial talent** because it is too difficult and expensive to attract talent, especially if the culture, ecosystem, and capital resources are not yet robust. The educational effort should start as early as the K-12 school system, and the entire ecosystem should be included. Mentor networks are especially important.
5. Tech transfer offices must find ways to make it easier to access **intellectual property** (IP)

None of these are short-term endeavors. All of them require a long-term investment/commitment before rewards can materialize.

Each of these topics is explored in separate sections of this report. Each section starts with a quote from either an interviewee or a speaker at one of the conferences, as well as a summary of best practices. More detailed information on specific examples is either included in sidebars or as special sub-topics within each section.

Next Steps

Phase 2 begins now with a revised work plan for reviewing and analyzing the local ecosystem. This will include focus groups of participants in the regional ecosystem to assess perspectives. Phase 3 will combine all of what we have learned into a set of recommendations for how to adapt best practices in our region, and identify levers to move toward increasing our rate of innovation.

DEVELOP A COLLABORATIVE CULTURE

"Developing a culture of innovation isn't a job for the faint-hearted. Moving from a short-term transaction-based culture to one based on long-term returns takes 5 – 10 years."
– *Jack Brittain, University of Utah*

Best Practices Summary:

- Identify and recruit state and local champions, both industrial *and* political, who lead collaborative efforts at the state, local, and institutional levels.
- Take a long-term approach to tech transfer -- basic research is at the front end of what is typically a 5 – 10 year commercialization process.
- Create programs designed to increase engagement of researchers with industry and the venture capital community very early in scientific research. Focus research on solving problems that exist in the market.
- Establish a high level administration position in the university to develop a culture of innovation within the institution (across colleges and departments) and develop relationships outside of the institutions.
- Focus on getting technologies into the market vs. just financial returns – it's about "shots on goal."
- Break down silos -- both within institutions and across regional ecosystem players, to develop an entrepreneurial culture and ultimately achieve economic success.

Increasing innovation is only one element of a broader plan that must encompass all aspects of creating a regional environment that will attract the resources necessary to increase innovation. One of the messages heard repeatedly throughout our interviews was that the goal of this research effort should be how to establish a collaborative culture of innovation, *not* how to simply increase tech transfer. The difference between the two lies partially within the institutions, and partially within the surrounding ecosystem.

Silo-Busting and Collaborative Cultures

The common denominator is that breaking down of silos is paramount, whether internally, locally, regionally, or statewide. Silos are broken down when there is:

- Engagement of leaders from all organizations, both private and public, as well as local media
- Networking between leaders as well as at execution levels
- Open and frequent communications between participants and stakeholders
- Willingness to work together, even if there is not an immediately obvious short-term return
- Targeted and specific outreach to the external community
- Reinforcement of collaborative norms via success stories in local media outlets

The Columbus (Ohio) Partnership : Collaboration Across a Region's Institutions

The Columbus Partnership offers one of the most interesting examples of developing a collaborative culture across a region's institutions. This is a non-profit, membership-based CEO organization of 43 CEOs from Columbus' leading businesses and institutions. Its purpose is to strategically consider how to better position their community for the future. The Partnership does this by convening leaders from its member organizations and other community groups to thoughtfully discuss the economic issues facing Columbus and the needs that will positively impact the entire region.

About two years ago, the Columbus region started the journey to transform the way it addresses economic development of its11-county region. The Partnership commissioned an assessment that benchmarked the region against peer communities throughout the U.S. They engaged more than 1,500 individuals representing big business, small business, government officials, young professionals, and other civic organizations in this process.

This community-wide collaboration resulted in the creation of an aggressive new economic development strategy for the region called Columbus2020! This is a regional, public-private partnership leveraging central Ohio's research and academic institutions and diverse industries to position Columbus to become a national leader in economic development and establish the region as one of the nation's fastest growing economies. They have specific, measurable goals:

- Add 150,000 net new jobs by 2020
- Increase personal per capita income by 30%
- Add $8 billion of capital investment to the region

They plan to achieve these goals by:

- Retaining and expanding existing companies and industries in the region
- Attracting major employers to establish operations in the region
- Creating new commercial enterprises by leveraging the region's research assets and entrepreneurs
- Improving the civic infrastructure and political conditions that enhance the economic development environment

The third point in this list is the one most relevant to our research. The Columbus Partnership is working very closely with the state, private industry, and research institutions to create a very large open innovation center (details to be announced soon).

In New Mexico, the networking between all of the groups is key to their success in both moving technologies into the market as well as attracting venture capital to the region. The ecosystem includes LANL, Sandia, their three research universities, Tech Ventures Corporation (economic development organization similar to Tech 20/20), New Mexico Angels, University of New Mexico's STC (Science & Technology Corporation, similar to UTRF), local venture capitalists and entrepreneurs. They all meet with new entrepreneurs and investors and link them to appropriate resources. They have built a relationship of trust, work together and do not compete with each other for any particular opportunity -- they funnel opportunities to the resources that are best positioned to turn the opportunity into a success.

In Colorado, David Hiller of NREL stated that the Colorado Collaboratory and ultimately it's CREED initiative (see details in "Build a Collaborative Ecosystem" section) was instrumental in breaking down silos. As a result, they have developed strong, trusting relationships that allow them to work together toward a common objective. His specific quote was that they are "becoming great now that they've pooled their forces together." They have created an entrepreneurial environment in their lab which is starting to produce more and more innovation.

Within the institution, it requires both a dedicated commitment (in talk and actions) to developing a collaborative culture. The most successful innovation typically involves people from multiple disciplines with complementary skill sets that work together and build on each other's ideas, so breaking down silos is paramount. Collaboration is also required *outside* of the institution, specifically with industry, entrepreneurs, and the venture capital community. Traditionally, neither internal nor external collaboration has been easy, natural, or required of either scientific researchers or institutional leaders.

Our research shows that increasing the rate of innovation hinges upon changes that go beyond

the research function or institution. Specifically, we found that a culture of innovation is typically driven by passionate champions across multiple entities throughout the community and the state. In the communities we benchmarked, we found it was often driven by leadership from industry. Regardless of where the champions were based, they garnered support from local and state politicians, the local media, entrepreneurs, the capital community, and university and laboratory leadership. We believe industrial champions are often the key drivers because they have consistency of leadership over time, the financial resources, and the political influence needed to implement and support broad change as described in the following section.

The Role of Leadership in Developing Culture

All of the constituents interviewed, regardless of their affiliation (venture capital, industry, institutions, etc.), independently provided input that consistently echoed certain themes:

- Finding ways to increase innovation is only one element of an effort to create a regional environment that will attract the resources (capital and people) needed for successful commercialization of new technologies.
- Champions for collaboration are required throughout the ecosystem. In many instances, it is industry leaders who drive the culture shift because of their need for new innovation to sustain their businesses. Their stature as leaders of tax-generating businesses is also important for developing local and statewide political champions, who then are able to develop programs and initiatives at the state level.
- The most successful ecosystems have clear financial and other resource commitments from leaders at multiple institutions. The leaders come from:

    - Large, profitable businesses (sales over $100M annually)
    - Successful entrepreneurs and venture capitalists
    - Universities
    - Research institutions
    - Media outlets
    - Economic development organizations
    - State and local governments

- The leaders "walk the talk". They state their vision and implement programs, either internally or across the partnership, that are specifically designed to foster an innovative culture.
- Beyond working individually as leaders, they typically either create a separate organization to coordinate their efforts, or institute a formalized meeting/communication process to ensure coordination across their region to maximize effectiveness.

Strategic Focus on Long -Term Outcomes

Developing a culture of innovation requires a long-term perspective. In the sidebar on the next page, Dan Berglund, President and CEO of State Science and Technology Institute (SSTI), presents Research Triangle Park in North Carolina as an example of the long-term perspective required for success in developing a region's innovation economy. The RTP story illustrates why industry champions are so critical to the long-term commitment essential to develop a culture of collaboration:

- Their businesses provide a motive for long-term commitment to the region.
- Their businesses need innovation for growth, so they invest in research projects and institutions.

- For success, they need to attract and retain qualified employees, which motivates them to invest in education at all levels.
- They have the power to influence political decisions that affect their progress and their message remains consistent across administrations.

Research Triangle Park : Long Term Commitment

In the mid-1950's, the backbone of Raleigh's economy was low-wage, low-skill enterprises, such as farming, textiles and furniture. With the region ranked near the bottom for per capita income, college graduates were leaving for out-of-state opportunities. A group of passionate and visionary champions (including a construction company owner, the governor, and a bank chairman) realized that the research institutions could be the basis for attracting modern industry and embarked on creating Research Triangle Park. They also realized that the quality of education needed improvement before new industry would relocate, so complementary efforts began to strengthen their educational system. About 15 years later (1970), IBM completed its facility andthe floodgates opened for companies to populate the park. According to Berglund, it took a total of *30 years* to accelerate and widen the gap between North Carolina and states starting at a similar point, such as Kentucky.

Mr. Berglund also observed that the three major issues for stifling Tennessee's economic growth stem from:

1. Inconsistency due to changing priorities and administrations,
2. Inconsistent private sector commitment, and
3. Inconsistent state investment in science and technology.

We found that the best research institutions took a long-term perspective on fostering innovation and collaboration. None of the top research institutions we studied take a short-term view of their objectives and measurement criteria. While the precise ranking varied by institution, the top two objectives for each were getting technologies in the market (increasing innovation) and supporting research and/or education missions. Financial returns were a distant third. Erik Stenehjem at Lawrence Livermore National Laboratory (LLNL) stated, "It's not about the money, it's about shots on goal." Following is a sampling of objectives by organization, along with their priority:

Objectives	**University of Utah**	**Lawrence Berkeley Nat. Lab.**	**Oregon Health & Science Univ.**	**Pacific Northwest Nat. Lab.**
Getting technologies into the market	2	1	1	3
Educate next generation entrepreneurs	1			2
Connection into universities & ecosystem				1
Support research mission		2		
Financial returns	3	3		4

Building a Collaborative Culture in Research Institutions

Speaking at the 2012 University Startups Conference in Washington, D.C., on the importance of collaboration to foster innovation success at universities, Steven Merrill, Executive Director of Science, Technology and Economic Policy at The National Academies, said the following:

> *"Tech transfer and entrepreneurial activities will never be successful until there is a shared vision communicated to and supported by upper administration, across all colleges and departments."*

This comment was echoed by several venture capitalists having experience with university start-ups. Their collective comments suggest that not only is it necessary to have buy-in and commitment at the very top of the institution, but tangible support for these activities in the form of resources, tools, education, and training, should be provided to both faculty and students. But beyond providing the resources, a leader's personal commitment and actions are critical. That is what Julie Goonewardene,

Associate Chancellor for Innovation and Entrepreneurship at Kansas University illustrates when she confides that she will "flip my schedule on a dime to accommodate a start-up."

Coulter Foundation Translational Partners Program

The Coulter Foundation has established the Translational Partnership Program to advance and promote translational biomedical engineering research at universities and medical schools in North America. With this award, the Coulter Foundation forms a working partnership with the Biomedical Engineering Department to promote translational research, which is defined as research that has some or all of the following characteristics:

- It is driven primarily by **considerations of use** and **practical application** of the research results, as opposed to basic research, which is driven primarily by a quest for knowledge.
- It envisions the development of a practical solution that addresses a particular clinical problem or unmet clinical need.
- The research results generally include protectable intellectual property.
- It involves clinical application as a goal, and therefore requires a translation of the research from a research laboratory to the clinic – from bench to bedside.
- It often envisions a particular product as the endpoint of development.
- It involves commercialization as a goal and therefore requires a transfer of technology from the academic institution to a commercial entity for final product development, manufacturing, marketing and sales.

In this program, the Biomedical Engineering Department Chair is the principle investigator of the award. Each school establishes an Oversight Committee, consisting of stakeholders in the translational process. It includes the BME Department Chair, representatives from the medical school, the Office of Technology Transfer, entrepreneurs, local venture capital, and the business school. Additionally, the grant provides funding for a Coulter Project Director to oversee the daily operations of the award. The award provides $580,000 each year for a period of five years.

The goals are to increase the number and effectiveness of collaborations between biomedical engineers and clinicians, support the movement of promising technologies to clinical application, and develop sustainable processes. The awardees work closely with the Coulter Foundation to promote, develop and realize the clinical potential of translational research. Ultimately, the purpose is to focus on outcomes which will save, extend, and improve patient lives suffering from any disease or condition, in any size market, in any discipline, in any country around the world.

In keeping with this position, here are some of the trends in research institutions:

- High-level administrative positions for fostering innovation cross-institution are being created.
- Industrial relationship development is evolving from ad hoc efforts scattered across research departments to more consistently managed commercialization offices.
- Commercialization is now being included in faculty evaluations at some universities (i.e., Texas A&M, Cornell University, Texas Tech) and in performance appraisal systems at federal laboratories (e.g., National Renewable Energy Laboratory).
- Research institutions are involving industry in early stages of research (see full discussion in the "Building and Supporting a Supportive Ecosystem" section).
- Institutions are focusing on core competencies and technology strengths to more effectively attract industry participation and involvement in research (see the Cluster Strategies discussion in the "Building a Collaborative Ecosystem" section).

Dedicated Leadership

Several of the institutions visited have implemented high level administrative positions (*with* budget) to put a focus on innovation. In fact, the Coulter Foundation Translational Partnerships program *requires* the establishment of a pan-university innovation officer as part of their granting program (see more about the Coulter Program in the sidebar).

The University of Utah has Jack Brittain, Vice President, Technology Venture Development, who is responsible for the tech transfer office, their entrepreneurial center, *and* their commercial sponsored research. Another example is Julie Goonewardene, Associate Chancellor for Innovation and Entrepreneurship and President of the Kansas University Center for Technology Commercialization. She was given the resources

to provide tools to researchers that encouraged them to work on translational research. According to the chancellor (Bernadette Gray-Little), this commitment to innovation made by the university increased industry collaborations. Additionally, VPs and Vice Chancellors of Research are now being selected, trained, and/or are having goals established for developing and supporting a culture of innovation.

These leaders are critical for:

- Changing the research philosophy from basic scientific research to one where researchers identify the problems that exist and find experts that can help them understand and solve the problems (more fully discussed in the "Developing a Collaborative Ecosystem" section).
- Developing rallying points that all members of the institution can embrace.
- Developing student, researcher, and industry champions.
- Ensuring consistency across administration/leadership changes.

Voice of the Venture Capitalists

Venture capitalists have a lot to say about building a collaborative culture at universities and research institutions. These are the key messages they put forth:

- Institutions must find ways to purposely fund research for solving problems. This requires working with them and/or industry to set objectives for funded programs that have potential commercial value.
- They want easier access to our talent. This includes:
    - Educating our researchers on commercialization activities as part of their research programs. This will increase viable market opportunities.
    - Finding ways to manage the researchers to deliver on the commercialization objectives.
    - Facilitating faster and easier contracting/licensing mechanisms.
    - Stop fighting over the IP rights: the goal should be to get technologies into the market vs. extracting the highest possible financial return to the institution.
- Institutions need to support incoming capital resources with:
    - Connections to the local community
    - Places/spaces to work
    - Identification of first customers
    - Technology access
    - Student collaboration and support
    - Managing expectations at both the researcher and administration levels

Community involvement from all ecosystem players is critical for building a culture supportive of innovation.

The Special Role of Tech Transfer Offices in Fostering Collaboration

Within the tech transfer offices at each institution, these key messages emerged:

- Developing and maintaining faculty and/or researcher relationships is essential to increase the amount of new ideas and innovative technologies.
- Close proximity of the tech transfer office to the researchers is essential. The greater the distance between the two, the more difficult it is to build the relationships needed to generate innovation.

- Stability of the personnel in the tech transfer office is essential for relationship building inside the university and with outside industrial partners, as well as continuity of technology development. These are all long-term processes that require consistency and stability for building trust and good working relationships.
- In additional to the quality and market applicability of the technology being generated within the institution, tech transfer offices have to prove their offices are collaborative, efficient, and flexible before venture capitalists will establish satellite offices nearby (more fully described in the "Attract Capital to Spur Innovation" section)..
- It is essential to have a business advisor network of entrepreneurs, angels, venture capitalists and industry experts to validate researcher concepts and value propositions (some are given equity in exchange for fixed time commitments). This helps both guiding the direction of the research toward commercial outcomes and builds in potential commercialization avenues early in the process.
- Successful institutions are finding ways to address conflict of interest quickly. Luis Proenza, President of University of Akron, said this at the University Start-Ups Conference: "Conflict of interest becomes *no* interest, which becomes no commitment."

Ohio State University Community Initiative

Ohio State University's tech transfer office works with community and industry leaders to host "Wake Up Start-Up," an entrepreneur-driven movement to bring together people committed to creating, building and growing high growth companies. It is a monthly morning event where founders pitch their companies to a group of entrepreneurs, investors, students, faculty, and the community. The event is designed to bridge the gap between the university and the community by foster new startup ventures, and providing education and awareness for the startup community.

It takes time to change a culture, but success stories will beget other successes. As researchers see others become successful (both professionally and financially), they become more willing to consider including commercialization elements in their work. They also become willing to teach their colleagues about the process and how to overcome fear of trying. The tech transfer offices must focus on the most innovative people, identify obstacles that must be removed to help them, and then use them as mentors to encourage others to follow similar paths.

University of Utah found that their culture was energized on campus by implementing "spin- ins" (vs. spin-outs). Once they built their entrepreneurial infrastructure, outside inventors saw the benefit of the research, student involvement, and entrepreneurial programs, and actually approached the university to take their technology under their venture umbrella. Spin-ins are given the same financial terms (revenue sharing) as the faculty. The success with the spin-ins encouraged more participation from their faculty.

BUILD AND OPERATE A SUPPORTIVE ECOSYSTEM

"The Collaboratory helped break down silos between organizations, and now the people involved have developed trusting relationships that are accelerating our growth."
– David Hiller, National Renewable Energy Laboratory (NREL)

Best Practices Summary:

- Identify and recruit industry champions to drive the ecosystem. Typically, these leaders are self-selected and unite for the common good of the community. Industry involvement draws in other support (i.e., local media, politicians), which helps break down silos between and among organizations.
- Integrate otherwise independent elements of the support systems across the entire value chain (from idea generation to business start-up to product launch to growth).
- Focus on core technology competencies (clusters), which create critical mass and attract more industry involvement.
- Engage industry early in the research process to influence the direction of research towards solutions that solve market needs.
- Establish key point people within ecosystem organizations. These people must communicate and cooperate in coordinating their efforts for the ecosystem to operate effectively.

Without exception, the most successful communities we studied have built supportive entrepreneurial/ economic development ecosystems where multiple players from different organizations (e.g., state and local politicians, industry leaders, universities, economic development entities, investors, entrepreneurs, etc.) put personal and organizational agendas aside, and work together for the benefit of the ecosystem as a whole. The vast majority of initiatives are focused on specific industry clusters (tied around core competencies in the regions and institutions) and have been primarily driven by industry leaders in those clusters. In this section, we will describe examples of industry-driven collaborations as well as universities with collaborative programs that support the entrepreneurial ecosystem.

Ecosystem Development: Born of Necessity and Crisis

Tennessee has three distinct economic development regions, based on both geography and industry concentrations. West Tennessee is known for its medical devices and logistics; Middle Tennessee is known for music and health care services, and East Tennessee is known for Oak Ridge National Laboratory (ORNL) and the University of Tennessee (UT). Until the last decade, East Tennessee did not have strength in any specific industry sector. Instead, it had some progress in a variety of sectors. This diversity has probably contributed to economic stability in the region. The significance of publicly funded institutions in the region (UT, ORNL, TVA, Y-12 National Security Complex) also protects the region in economic downturns. While this makes it an attractive place to live, it also creates impediments for progress: we have yet to experience a crisis that could spur change.

In some of the cases that we studied, the development of the ecosystem was specifically born out of a crisis. For example, Ohio was adversely affected by the dotcom crash. Industry leaders in the private sector, in conjunction with political leadership from the state, realized that they needed to take control of their own destiny. The result was the Ohio Third Frontier (http://thirdfrontier.com/), a $700M investment in 2002 to create new technology-based products, companies, industries, and jobs. It was so successful that it was renewed in 2010 (through 2015). This initiative, now approaching $2.3 billion in investment, provides funding for open innovation, entrepreneurial support, value chain development, and expansion of a skilled talent pool that can support technology-based economic growth. According to their website,

the Ohio Third Frontier's strategic intent is to create an "innovation ecosystem" that supports the efficient and seamless transition of great ideas from the laboratory to the marketplace.

Successful Ecosystems Require Champions

Regardless of what factors triggered creation of the ecosystem, its success depends on strong champions. For example, in Ohio, it was the private sector partners that broke down the silos to create the Third Frontier initiative. Specifically, it was the CEOs of the top companies and the publisher of the prominent newspaper in Columbus who were able to influence the political leaders to take bold actions to assert economic leadership through technology-based economic development. The universities then followed.

In Colorado, it started with an influential senator, who formed an alliance with the head of the National Renewable Energy Laboratory (NREL) to begin work on the Colorado Renewable Energy Collaboratory, a research partnership between NREL and Colorado universities. This Collaboratory ultimately led to the creation of Colorado Renewable Energy Economic Development (to be discussed later in this section).

Role of Universities in Ecosystems

Universities are the primary idea generation engines for launching innovation and play a critical role in the ecosystem. In addition to champions, support systems are essential to advance innovation, especially for start-ups. Although economic development-type support systems (similar to Tech 20/20) are in the successful communities, the more entrepreneurially-focused universities have created programs to support start-ups, as well. Two interesting programs were at the University of Southern California (USC) and the University of Utah (UU). Both of these universities have elevated innovation and entrepreneurship to the highest levels of university administration with a focus on cross-college and community implementation.

USC Stevens Institute

The USC Stevens Institute for Innovation is a university-wide resource for USC innovators in the office of the Provost. It was specifically launched to develop a new model for innovation and is designed to harness and advance the creative thinking and breakthrough research at USC for societal impact, beyond traditional academic means. It, like UU, focuses on education and development of entrepreneurial talent.

Also like UU Technology Ventures, the Institute manages USC's intellectual property and is the focal point for entrepreneurship across the university. They have several programs, both internally at the university as well as externally with industry and the venture capital community, to move innovation to the market. Like UU and many other universities, they have internships and business competitions, but they also have some unique programs:

- USC Student Innovator Showcase: Student innovators from all disciplines -- from cinematic arts, music and social sciences to information technology, engineering and life sciences – gives parents and students an interactive glimpse into the imaginations of student innovators, and a sneak peak at tomorrow's world. The innovators are judged on criteria such as potential for societal impact, novelty, and understanding of the market. Judges select ten finalists to give a two-minute "fast pitch" presentation about their ideas. The showcase is hosted each year during the opening day of parent's weekend and is followed by an awards reception n
- First Look LA: USC, Caltech and UCLA join forces with Entretech, a non-profit organization formed by the City of Pasadena and CalTech to establish and develop high-tech businesses in the Pasadena area, to present First Look LA. It is an invitation-only event, where venture capital investors take a sneak peak at some of the most promising research and emerging startup opportunities from LA's premier research institutions.

- Meet Tech Coast Angels – Screening Sessions: The Tech Coast Angels (TCA) brings screening sessions to USC where USC innovators and students are allowed to attend and observe how angel investors interact with entrepreneurs who are looking for funding.
- The Innovator Mentoring Program: Geared to support innovation and entrepreneurial activity throughout the USC community, the Innovator Mentoring Program matches the most promising innovators and prospective entrepreneurs with volunteer mentors.
- USC Stevens Institute Legal Office Hours Program: This program provides strategic legal guidance on a complementary basis to USC innovators and start-up companies. USC innovators participating in the program have access to corporate and intellectual property attorneys that provide invaluable assistance by acting as sounding boards for both business and legal issues.

University of Utah Technology Venture Development

UU's Technology Venture Development (Tech Ventures) is the economic driver for the State of Utah, and accomplishes this through commercializing university inventions, creating diverse partnerships, supporting entrepreneurship, and sparking a culture of innovation. Tech Ventures reports directly to the President of the university and implements many of the traditional programs found at other entrepreneurially-minded universities (e.g., several business competitions, internships, etc.).

Tech Ventures is one of the leading creators of start-up companies (based on data from the Association of University Technology Managers). They launch start-ups either through licensing their technology to spin-out companies or spinning-in start-up companies that have attractive technology and management teams. It supports these companies through a program called Venture Bench, an accelerator that provides support services for start-ups. Specifically, Venture Bench provides help for:

- Pursuit of grant funding
- Finding investment funding
- Attracting management
- Establishing a company's corporate structure
- Market assessment
- Business plan development
- Logo/brand creation
- Web hosting and development
- Accounting services
- Access to research facilities and labs

They also have a series of staged maturation funding and seed money programs to support innovation. These funds range from $5K proof-of-concept funds all the way through $50K maturation grants with specific commercialization milestones (see more on this topic in the "Attracting Capital to Spur Innovation" section). All amounts are given with specific goals required over the course of short-time frames (three months). The goal is to move technologies through their development stages quickly and require both market validation and tangible results before additional amounts of funding are invested. Student interns are involved to help researchers with market validation and commercialization elements.

Cluster Strategies

In the regions we studied, it was evident that focusing on clusters of core competencies was critical for successful ecosystem development.

One of the more successful cluster strategies is in Utah. Started in 2005, the state identified the major companies in the state, and industry clusters of core competencies naturally emerged. The state then

approached the leaders of the top three companies in each cluster who formed industry networking groups to identify needs (educational, technology, workforce, etc.) and worked with the state to develop strategies for solving those needs. These groups are still active and driven by industry, and the state also has hired experienced, cluster "insiders" that are the liaisons between the state and the national/ international industry networking groups. This provides these networks a single point of contact in the state, which helps facilitate communication and makes it easier for both parties to engage with each other. These liaisons participate in traditional economic development through industry recruiting as well as technology-based economic development through start-ups.

One of the results of Utah's cluster strategy is the USTAR/BioInnovations Gateway, which focuses on the life sciences cluster. USTAR is the technology commercialization initiative for state universities to engage with industry, and the BioInnovations Gateway (BiG) is an outcome of that collaboration. This is a new high-technology business incubation facility designed to develop Utah's life sciences workforce (at both the high school and college levels) *and* incubate life sciences companies. Industry helps develop curriculum; entrepreneurs have their own labs to protect their IP, and they all share expensive equipment needed to advance their research. More can be found in the "Develop Entrepreneurial Talent" section or at http://www.innovationutah.com/BiG.html.

Industry Involvement

One of the key findings throughout this project was the need to develop closer relationships with industry (both large and mid-sized) as early as possible in the innovation process for a number of reasons:

1. Research (and the resulting innovation) is often being done in an academic vacuum, which decreases its attractiveness to and effectiveness for industry. Early and deep industrial relationships are critical to help drive the innovation towards solving market needs from inception, and it allows industry to see where technology is headed.
2. Corporations are increasingly looking at universities as sources of strategic technology acquisition and equity investment, so having solutions tied to their needs is paramount.
3. Partnerships with industry are instrumental for hiring graduates from the university.

The most progressive communities have active industry engagement from a variety of segments. For example, the Columbus Partnership (Ohio) is industry driven. Not only do they have champions from large corporations participating in the entrepreneurial ecosystem, they also have an active banking community that recognizes that these new businesses will be the source of their next big customers. These private sector partners have driven the breaking down of silos between organizations, and this effort has been supported by local media outlets and both state and local political leaders.

Continuity of relationships with industry is also essential for transforming research into licensing opportunities. This isn't a short-term prospect. Oregon Health and Science University said that it took three years to get their industry business development process up and running. They spent this time identifying companies appropriate for their areas of research while simultaneously vetting the faculty members before they would actually bring the companies to campus. This process is part of their tech transfer function, but they are co-located with pre- and post-award research functions to facilitate knowledge transfer and resolve issues.

Some examples of the creative ways that labs and universities engage industry include:

- Lawrence Berkeley National Laboratory (LBNL)/UC Berkeley bring industry representatives on campus to hear about and provide input to the research being performed.

- University of Utah/USTAR has engaged industry to develop curriculum for the shared USTAR incubator facility/educational program.
- NREL and the universities tied to it through the Colorado Renewable Energy Collaboratory hold an Industry Growth Forum every year, where they bring in investors and companies to increase NREL and university interaction with industry. This helps guide both their research and development efforts, and helps the lab and university identify (and pursue) new research to help meet potential investor needs.

Colorado Renewable Energy Collaboratory

The Collaboratory is a research partnership among NREL and Colorado's research universities — Colorado State University, the University of Colorado at Boulder, and the Colorado School of Mines. It works with industry partners, public agencies, and other universities and colleges to:

- create and speed the commercialization of renewable energy technologies, energy management systems, and energy efficiency,
- support economic growth in Colorado and the nation with renewable energy industries, and
- educate energy researchers, technicians, and workforce.

The research centers unite world-class researchers with industry leaders under a single administrative structure, with one institution serving as the administrative lead. Research can be conducted on any of the four Collaboratory campuses, depending on the location of the principal investigator, key researchers, and appropriate laboratories.

Each center pursues both shared (public) and sponsored (proprietary) research. In the shared research program, each participating member makes an annual contribution, matched with state funds, and jointly they outline the topics of interest to the members. RFPs are then sent out to researchers to address the need. Seed grants are approximately $50K for six months for early stage projects, and all members share patent costs in exchange for non-exclusive licenses in all fields. If companies identify avenues for more substantive research, they can do privately sponsored research in exchange for exclusive IP rights.

Colorado Renewable Energy Economic Development (CREED)

CREED was a natural extension from the Collaboratory. CREED brings together stakeholders and service providers to support the creation and growth of cleantech companies in Colorado, contributing to economic development in the state. CREED provides a unique facility where organizations, industry, researchers, scientists, and engineers can interact and discuss important technical, business, market, and policy issues with entrepreneurs, investors, analysts, and policy makers. The state committed $1 million per year for 10 years to help support this program.

CREED has established a structured process for moving innovations from the state's clean energy research institutions into the hands of the cleantech industry. They provide hands-on management and coaching to entrepreneurs, and help them find capital sources. However, CREED goes well beyond mentoring to include:

- Stakeholder collaboration to ensure the availability of a skilled workforce for cleantech startup companies in the state,
- Analysis and promotion of the impacts of clean energy policy for the benefit of the cleantech industry, and

- Facilities to help startup companies and entrepreneurs test and demonstrate their clean energy products for the marketplace.

CREED's director is employed by NREL and is the bridge between NREL's tech transfer office and the Boulder Innovation Center, their local entrepreneurial support organization. The director is a single focal point of contact for all of the stakeholders for both programs, which has proven very helpful to industry.

University of Maryland Proof of Concept Alliance with the Army Research Laboratory

Another highly successful collaboration program is the University of Maryland Proof of Concept Alliance with the Army Research Laboratory. This was funded ($5.1 million over 2 years) by a Department of Defense appropriation that was spearheaded by a passionate senator. The goal is to address the Army's current and future needs through technology commercialization, which includes research, development, prototyping and testing. Like the Collaboratory, RFPs are issued and interdisciplinary teams (engineering, business, law, etc.) are required to work on the project. Because entrepreneurship and job creation are critical elements for the center, MBAs must be included to validate the market opportunity and develop the commercialization strategy. The university owns 2% of any resulting spin-out company.

Managing and Organizing the Ecosystem

Collaborative ecosystems connecting industry, national laboratories and universities drive more and more innovation into the market. The structure and management of the ecosystems varies widely, but regardless of the implementation, there were three elements that repeated themselves across the different institutions and communities that we benchmarked:

1. Each institution had a point person that all stakeholders used as a funnel into the organization.
2. Regularly established communication vehicles and activities were used to keep everyone apprised of developments and needs.
3. Networking was critical, especially in the entrepreneurial community, to support each other and ensure timely access to any required resources in the community.

In New Mexico, both Los Alamos and Sandia National Laboratories, as well as the University of New Mexico, have identified primary contacts that act as conduits for external players to engage inside the institutions. For example, one of the methods they use to stay engaged with the external community is the Coronado Venture Forum, which is an educational forum for investors and entrepreneurs. Although it includes traditional company showcases to accelerate deal flow, it provides information on an array of topics, including the state of entrepreneurship, angel, and venture capital in New Mexico, and trends in industry segments that are tied to their clusters. In addition to regular informal communication with one another, these primary contacts actively participate on the boards of local economic development organizations, further ensuring broad awareness of local happenings and support for each other's efforts.

The Entrepreneur-to-Entrepreneur Ecosystem

Finally, while it was not the focus of our research, we came across evidence for the important of an informal, entrepreneur-centered ecosystem. For example, speakers at the annual National Council for Entrepreneurial Tech Transfer Start-Up Conference agreed that a common physical space and/or event (educational, networking, etc.) allows entrepreneurs to come together to present their issues and learn from each other. These gatherings are optimal places for regional educational events, networking programs, and providing access to support resources.

ATTRACT CAPITAL TO SPUR INNOVATION

"Start-ups have to be where the investors are."
– Brian Kirk, Sun Mountain Capital

Best Practices Summary:

- Establish early proof-of-concept funds to validate the business model:
  - Micro-grants ($5K)
  - Use outside advisors and industry experts in the evaluation process
  - Limit the number of times to provide these investments
- Implement technology maturation funds in short, fast bursts:
  - Small amounts ($10 -25K)
  - Limit to 4 months
  - Require milestones tied to commercialization activities
  - Limit the number of times these investments are provided
  - Make fast decisions with little regulation
- Look for co-investment from outside companies to de-risk the investment.
- Establish a regional angel investment fund.
- Provide a STTR/SBIR matching program.

Progressive states view innovation as both a statewide mandate and a comprehensive program that goes beyond providing capital or maturation funds. There must be commitment from the state, universities and research institutions to create a capital pool before large investors can be attracted to a region or a state. Capital consists of several different types of funds, from maturation to capital investment funds, as well as capital to help develop businesses beyond the start-up phase.

An example is the Ohio Third Frontier. Started in 2002 and recently renewed through 2015, this $2.3 billion bond initiative provides funding for open innovation, entrepreneurial support, value chain development, and expansion of a skilled talent pool that can support technology-based economic growth. The strategic intent is to create an "innovation ecosystem" that supports the efficient and seamless transition of great ideas from the laboratory to the marketplace. This program is successfully building an innovation economy and has a commitment to:

- Produce economic return for the state in quality jobs, company growth, and wealth creation
- Attract companies, talent and capital to the state
- Create sustainable economic development engines in key technology and industry areas
- Reduce the risk of pursuing entrepreneurial, innovation and development activities
- Sustain best practices and relationships that lead to efficient commercialization
- Increase the visibility and reputation of Ohio as an innovation and entrepreneurial destination

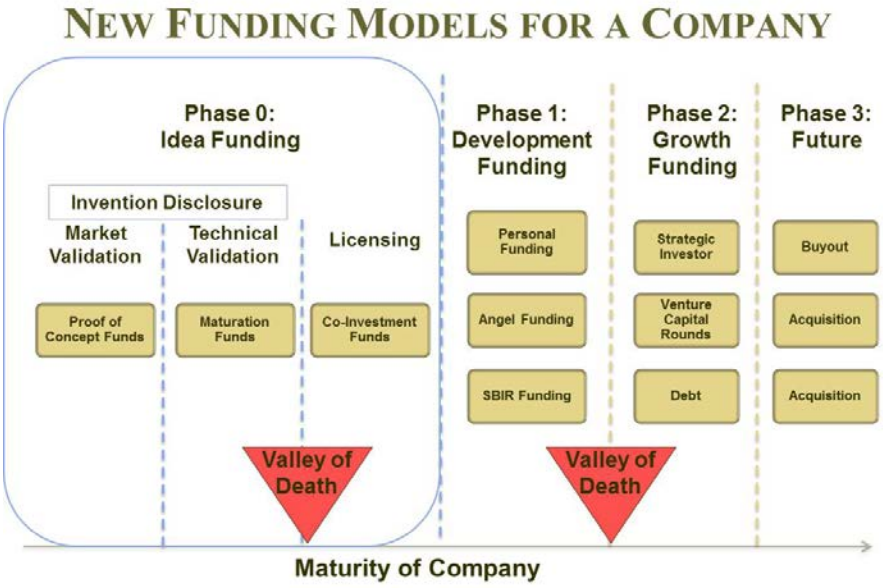
Details on this program can be viewed at http://thirdfrontier.com/ProgramDescriptions.htm.

The culture, industry presence, and tax base of Ohio puts it in a unique position for such a large-scale program. While we looked at Ohio's mega-program, we focused on how communities without these types of state programs have been able to prosper and grow. We found that successful communities rich in technology resources have implemented grass roots efforts to provide very early access to capital, and the trend is to tie those early funds to commercialization milestones. By focusing on commercialization

early in the process, they have been more successful at both launching new companies and attracting outside investment.

Importance of Early Capital

Regardless of the context in which it is discussed, capital is always described as a critical element for spurring innovation. In most cases, different sources of capital are discussed as elements required during the development (Phase 1) and growth (Phase 2) of a start-up company as depicted in the accompanying figure. This discussion usually includes warnings about the cash flow "valley of death" that many fledgling companies encounter when they attempt to commercialize their technologies, typically between Phases 1 and 2. If this valley is not crossed, the start-up fails, and crossing it often requires capital specifically designed for that purpose.



Our benchmarking of innovative communities found that there are actually *two* valleys of death in the funding cycle, one which occurs much earlier in the process, that we call Phase 0: Idea Funding. The importance of this early capital is to get key risks, either market or technical, out of the company early in the process using small amounts of money with a tightly defined milestone and timing schedule.

Because research coming out of universities and laboratories is typically basic science or very early in development, it is unlikely to attract significant levels of investment by angel or venture capital: the timelines are too long and the risk is too great. In fact, one of the panels at the Association of University Technology Managers (AUTM) western conference indicated that early-stage technology that is further along in its development is forcing universities and labs to fund more research internally. That's where state- or university-based funds become an important element for getting the technology ready to hand over to a development partner from the private sector.

Proof-of-concept funds are usually in the $5K range, where the technical idea is validated from a market perspective: does a pain point exist that this solution can solve? Is the market large enough, and is there a business model that will allow it to be profitable? These funds often include advisors and industry experts in the evaluation process, and are used to quickly determine whether the idea has market potential. "Fail fast and fail often" was a common mantra – the idea is to fill the pipeline with promising technologies as quickly as possible and avoid large investments in technologies that aren't market viable. A panel at the State Science and Technology Institute (SSTI) annual conference in November 2011 indicated that more successful universities are putting together proof-of-concept funds to help with pre-revenue funding that blends advisors into the process.

Technology maturation funds are the next step in this funding process (discussed further below). Here, larger amounts are given in traunches that are milestone-based with short timeframes, typically at around

three-month intervals. The goal of the funds should be to solve a problem (which often can be matched and leveraged with private funds). The trend is to require researchers to establish a start-up company to receive the funds and tie the milestones around commercialization activities. This eliminates the tendency for researchers to use the funding for additional basic research.

Co-investment funds from external organizations can leverage internal funds for accelerating innovation and reduce investment risk. Often, external organizations interested in specific technologies are willing to co-invest in technologies that are beyond the basic research stage and that can be applied to their specific needs, typically with a match of 2:1 or 3:1. These types of funds are becoming more important as research institutions are realizing that they have to attract industry research funds to compensate for declining federal research funding. To effectively compete with other research institutions, they have to attract industry and address industry needs during the earliest stages of basic research (to be discussed in depth in the 'Develop an Ecosystem' section).

We found that these earlier funding mechanisms, most of which were funded internally or by state governments, were instrumental for communities to achieve a continuum of funding sources across the life of a start-up company. It was especially critical when there was a lack of government funding or established venture capital -- these funds helped them get innovations to market faster, which actually *attracted* venture capital.

An example is New Mexico, a state of only 2 million people but with a federally-funded research base of just over $5 billion. They have no state government funding to support commercialization efforts. Together, Los Alamos National Laboratory and University of New Mexico invest $450,000 annually in maturation funding. They have developed a strong network of investors that provide input to their organizations on a monthly basis regarding the technology being developed, and they launch about 10 start-ups per year. As a result, they have attracted venture capital offices (e.g., Sun Mountain Capital) and people from firms outside of their region that have placed focus on New Mexico (e.g., Cottonwood Technology Fund and Village Ventures Fund II). Additionally, New Mexico Community Capital is a group of approximately 70 angel investors organized within the last five years that also invest in their technologies. Using this process, New Mexico estimates that they have attracted $6.70 of outside investment for every dollar invested in maturation funds.

Technology Maturation Funds

Regardless of institution or location, technology maturations funds were consistently pointed out as absolutely necessary for launching innovations into the market. They should be directed toward solving specific problems. More and more organizations are implementing maturation funding in smaller amounts with very short timeframes for execution, and with milestones tied to commercialization elements. In fact, the University of Utah is no longer giving maturation funds to professors – they require that the funds go into a company to ensure that the research is applied rather than basic science.

Sources of funding for technology maturation vary:

- Governments allocate state funds to some IP-generating institutions (Utah, Ohio, Colorado).
- Some institutions allocate a small percentage of overhead from every research grant into a pool of funds (University of Utah, University of New Mexico, Los Alamos National Laboratory).
- One uses unrestricted funds from alumni donations (Oregon Health and Science).
- Funds are allocated through returns generated as part of state economic development initiatives, such as tax increment financing programs or taxes on natural resources (e.g., taxes on shale oil).

Following is a table of different states or organizations and the structure of their technology maturation funding programs (shaded boxes indicate that the information was not provided):

Organization	Annual Research	Annual Maturation Funds	Average Investment	Source of Funds	Conditions
State of Utah	Not applicable	$2.7M	$40K	State	Funds must go to a company with technology licensed from a university; max of two awards
Univ. of Utah	$250M	$500K	$5K proof of concept/ $35K/$50K	"Tax" on research funding; royalties	Funds go into a company with short, fast, timeframes and commercialization milestones
U. of New Mexico/ Los Alamos NL Venture Accelerator Fund (joint)	$2.6B	$400K	$50 - $150K	Mgmt fee	Look at total portfolio (VC invested vs. small companies)
Los Alamos NL	$2.3B	$500K	$50-100K		Commercialization managers make the decision
Jet Propulsion Lab	$2.0B	$425K	$50-75K		
Lawrence Livermore		$500K	$50K		Use funds to de-risk technology. Entrepreneur has to take an option for $1K before LLNL will invest maturation funds built to LLNL's specifications.
Lawrence Berkeley	<$100M	$300K	Not yet available	Royalties	Have just started this program
Oregon Health & Science University	$380M		$7K proof of concept/ $120-150K	Unrestricted donations	
Colorado Center for Renewable Energy Economic Devel.	Not applicable		$50K		
Pacific NW NL	$1.1B	$2.5M		Royalties and OH	

Angel Investors

Typically, the first investors following maturation funding are angel investors. The successful communities we investigated had a thriving, organized angel network involved with their technology institutions. Interviews with angels revealed the following for attracting investors:

- High volume, high quality deal flow
- Tech transfer offices with a history of providing easy access to technology, support, connections to the local community (for first customers), and a place to work
- Available and easily accessible technologies
- Entrepreneurial support system
- Cost of living
- Lifestyle

In most areas of the country, angels become self-organizing because they know that they can leverage their funds -- syndication of investments reduces risk. University angel funds are becoming more prevalent across the country, and the nature of these varies widely. Setting an objective for the fund

(Educational mission? Return on investment? Economic development?) determines how it should be funded (philanthropically through donations or investments expecting a financial return) and managed.

SBIR/STTR Funding

Best practices show that state matching programs for SBIR/STTR awards increases both the success rate of new technology-based businesses and attracts more external investment. The University of Utah has a grant proposal writer on staff to help companies apply for SBIR/STTR proposals. Several institutions told us that an experienced grant writer can have a 40% hit rate on Phase 1 and 2 SBIR awards, which creates a much larger economic impact for the state and the region. Where SBIRs have become important sources of funding, the institutions involved have taken proactive steps to structure, staff and support the effort.

DEVELOP ENTREPRENEURIAL TALENT

"You don't want to turn lab people into entrepreneurs – you want the community to provide the entrepreneurs, so you have to educate the community."
– *Richard Adams, Colorado Renewable Energy Economic Development*

Best Practices Summary:

- Begin entrepreneurial education in K – 12 school systems.
- Establish interdisciplinary university programs to enhance the success of commercial outcomes. This requires commitment from, and coordination across, multiple colleges.
- More tightly integrating tech transfer offices, commercial-sponsored research, and entrepreneurship education programs.
- Tap into university alumni, either through mentoring programs or angel networks.
- Develop formal technology evaluation programs utilizing students and providing student access to technologies for business competitions.
- Jointly educate and engage the entrepreneurial ecosystem to move innovations to the market.

Interviewees at the institutions and communities we visited consistently repeated that the shortage of management talent is one of the primary constraints for launching start-ups. In successful communities, education of entrepreneurs is embraced by everyone, including the local school systems. It starts as early as elementary school, continues through college, and permeates the private sector with continuing education for existing and aspiring entrepreneurs. This requires both state commitment and community support.

Opportunities from Kindergarten to Post-Docs

Although education of entrepreneurs is primarily focused at the college level, educators are realizing that the entrepreneurial spirit must be ingrained in students early in their lives. What makes this difficult is the long-term perspective required to make it successful (see related discussion on Strategic Focus for Long-Term Outcomes in the "Developing a Collaborative Culture" section). Per the Kauffman Foundation, young people's curiosity about the world around them, natural creativity, willingness to take risks, and unbridled enthusiasm add up to the characteristics of great entrepreneurs. But after they close down their lemonade stands, lawn mowing businesses or outgrow babysitting services, they often lose their entrepreneurial instincts. Kauffman's long-term view is that entrepreneurial education should begin early, both in building up innate entrepreneurial skills as well as improving science, technology, engineering, and math skills (which are the primary foundations for spurring innovation).

While no one we interviewed disagreed, most were focused on the more immediate returns found with high school, college, and graduate or post-doctoral students at research institutions. The most innovative high school and college program we found was Utah's BioInnovation Gateway, described in the sidebar on the following page.

BioInnovations Gateway (Utah)

The BioInnovations Gateway (BiG) is an incubator for emerging biotech and medical device companies, a high-tech training facility for the next generation of bio-innovators, and a contract research resource for Utah's life science industry. Located within the Granite Technical Institute (GTI) in Salt Lake City, BiG supports up to seven resident companies, providing access to state-of-the-art biotech, biomanufacturing, engineering design and prototyping equipment for start-up teams. But what distinguishes BiG is how it integrates education into the incubator.

Students work side-by-side with company staff using shared facilities (the companies also have individual labs to protect their intellectual property). High school students participate in the morning, and college students participate in the afternoon. Students develop creative thinking and biotech work skills in a product-driven environment. Students earn high school and college degree credit, and learn first-hand what an entrepreneur sees, hears, and lives every day in a start-up company.

Funding for the facility comes from multiple sources:

- U.S. Department of Labor Community Based Job Training Grant
- U.S. Department of Labor Workforce Innovation and Regional Economic Development (WIRED) grant.
- Granite School District
- Utah Science Technology and Research initiative (USTAR) -- a long-term, state-funded initiative that invests in Utah university-based innovation teams and research facilities to create novel technologies that are can be commercialized through new business ventures.

As part of this program, BiG has also launched a student-run contract research organization called BioInnovate. BioInnovate provides a mechanism to mutually benefit research-based training, biotech and biodevice businesses, and educational activities through the use of shared facilities, equipment, technical resources, and talent. BioInnovate contracts with Utah-based companies to perform project work in biotechnology, nutrition and natural products, and medical device businesses while teaching students both technical skills and business practices involved in delivering quality, documentable results on time and within budget.

There are limits to undergraduate involvement in technology-based innovation. A number of institutions we visited place a high emphasis on post-doctoral students from engineering or science. Post-docs hold the most promise for being trained on how to start significant new technology businesses for several reasons:

- They are early in their careers and often don't have financial and family commitments that would prohibit them from starting a business.
- They have intimate knowledge of technologies and often want to see the technologies have an impact on the market.
- They are open to working with people experienced in commercialization and launching new businesses.

While some post-docs have a strong interest and aptitude for start-ups, it is fair to say that most do not. The schools most successful in finding the needles in the haystacks, like CalTech, use a broad range of informal methods, such as looking for leads by reviewing material transfer agreements and industry-sponsored research proposals, as well as developing strong relationships with lab managers who might spot a future entrepreneur.

Integrating Alumni in Developing the Next Generation

University alumni are largely an untapped resource, but several universities are finding ways to engage their alumni in entrepreneurial education. These efforts tend to fall into two categories:

- Formation of alumni mentor groups primarily for student- or alumni-based start-ups.
- Formation of alumni angel networks to fund and mentor student-based start-ups.

An example of an alumni mentoring program is Columbia University in New York. They have an Engineering Entrepreneurship program and are now providing practical assistance and guidance for Columbia engineering entrepreneurs who want to launch a start-up venture. They have a nationwide network of over 45 business-savvy, engineering alumni mentors who meet regularly with young entrepreneurs from across the university.

An angel network is a great way for alumni to give back to the university. In addition to investing funds, the angel member can also invest time and expertise in deals that come out of the university. There are several examples of alumni angel networks, including private institutions like Harvard and Wharton, along with several public institutions, including Baylor and University of Texas. Each has differing objectives, but they primarily target student education. To be successful, Hall Martin of the Texas Entrepreneur Network says there are three important elements for starting an alumni angel network:

- Get sponsorship by a well-respected faculty member.
- Get two to five alumni backing the idea and promoting it.
- Get buy-in from the university legal department and foundation.

Seamless Interaction Between Students and Researchers

At the successful universities we visited, the business, science, and engineering colleges were critical and integrated partners for advancing innovation education and talent development. A venture capitalist at the University Start-Ups Conference confirmed the importance of this by saying, "The quality of research is high everywhere – it is the quality of the interdisciplinary teams that make the difference."

To achieve this integration, typically there were formalized programs between the research arms within universities and government laboratories. Business students are integrated into the process to provide market analysis and business plan development for emerging technologies. Interestingly, all government research institutions we studied believe that business plan competitions, especially those comprised of interdisciplinary teams, are an important component for helping them evaluate and launch new businesses based on technology emerging from their labs.

Of the universities we visited, the University of Utah has the most comprehensive set of efforts to educate and develop entrepreneurs.

Best Practice: Technology Venture Development Office at the University of Utah

The Technology Venture Development Office ("Tech Ventures") at the University of Utah is dedicated to technology commercialization and driving economic development for the state. They accomplish this by licensing faculty inventions, building partnerships, supporting the community, and educating students. This center is headed by Jack Brittain, who leads commercialization activities across the campus, including the Pierre Lassonde Entrepreneur Center, the Technology Commercialization Office (TCO), and all commercial-sponsored research (see further discussion about the importance of Brittain's role in the "Build a Collaborative Culture" section).

The Technology Commercialization Office (TCO) is a recognized leader in transforming new ideas into practical, commercially viable products and services. The TCO provides process support services to university spin-outs and outside company "spin-ins" to help them successfully commercialize their intellectual property. They believe that providing these services will facilitate the growth of resources and deals in such a way that it will create a hub of creative commercialization for the city, state and region. Their programs include:

- Venture Bench – an accelerator that provides a suite of services for the university's technology-based companies, including grant and investment funding, entrepreneur-in-residence program, establishing a corporate structure, market assessment, business plan development, logo/brand

creation, web hosting and development, and accounting services. It also helps provide access to research labs and office space.

- TCO Accelerator: a rapid prototyping facility, focused on accelerating product development and market launch for early stage medical and life science companies and technologies. This facility provides the infrastructure, resources and services for startups and existing companies looking to relocate.
- Software Development Center: formed to create a clear distribution channel for university software projects, developing state of the art entrepreneurial applications, and training students to become professional software developers.
- Energy Commercialization Center: formed to address the problem of discoverability of energy commercialization resources and engage their partner network to drive research energy technologies to the next stage of validation via rapid prototyping, pilot development or commercial-scale deployment.
- Start-Up Center for Students (StaC): helps students execute on their business ideas by assisting with strategy, funding, implementation and mentoring. StaC's expertise is building companies around ideas that are scalable and have an intellectual property component.
- Entrepreneur Faculty Scholars: provides help identifying funding to explore new ideas, protecting intellectual property, applying for a patent, creating a business plan, or determining if fundamental research is, or should be, on the commercialization path.

The TCO also has responsibility for commercially-sponsored research. They build alliances with companies to develop new technologies by matching the companies' research interests with the university research capabilities. They have dedicated staff who provide industry sectors with a single point of access to the university research enterprise. This not only has served to increase the amount of commercial-sponsored research, but it also helps university researchers with their research direction and ensures that an appropriate mechanism for commercialization is in place once the research is complete.

The Pierre Lassonde Entrepreneur Center's goal is to provide unique educational opportunity through real world business experiences and to help young entrepreneurs be better prepared to understand and assume the risks of business ownership and management. They are separate from, but integrated into, the business school, and make a concerted effort to pair business, technical and law students together to create the interdisciplinary teams that are most effective at analyzing and launching new businesses. Their programs are:

- Business competitions that range from idea validation to full business planning:
    - Utah Entrepreneur Challenge — Competitors from across Utah write a full business plan for a chance to win $40,000.
    - Opportunity Quest — A business summary competition for students across the state. Winners advance to the Utah Entrepreneur Challenge.
    - techTITANS — An idea competition for students from all disciplines. Winners get cash prizes and free business advice.
- Student Entrepreneur Conference — An introductory conference for aspiring entrepreneurs.
- Lassonde New Venture Development Center — assists researchers with breakthrough technologies and determines the commercialization potential of those ideas while providing students a unique educational experience in new business development. It is composed of graduate students from engineering, science, and business, and is run by an accomplished local entrepreneur, with an advisory board made up of venture capitalists and inventor/entrepreneurs. During a year-long process, students receive weekly mentoring and teaching from both the executive director and local professionals. Students are trained in the various disciplines involved with early stage business development, from intellectual property to market analysis and strategy

to writing a business plan. While receiving this training, students work in team to evaluate and develop business opportunities based on real technologies coming out of their labs.

- The Foundry — A program sponsored by the David Eccles School of Business that teaches entrepreneurship to students, graduates and the community. Similar to a traditional accelerator, they run 20 companies through a structured program that is held three times a year. It provides infrastructure (but no expenses) to help entrepreneurs quickly determine if the company has legs, and if it doesn't, to "fail fast and inexpensively."[2]
- Bench to Bedside Medical Device Competition – a year-long program that provides a competitive opportunity for medical students, engineering students and business students to develop a medical device concept or make a novel improvement to a current medical device.

Jack Brittain firmly believes the University of Utah is successful at technology commercialization because they put education *first*. They select technologies primarily based on their educational value – they specifically look at maturity of the technology, value that can be added by students, and the characteristics of the researcher -- they do *not* look at whether the technology is a licensing vs. start-up candidate. Students then develop commercialization plans for the technologies. Students are provided a $25K scholarship to do this (without class credit).

While there is a clear emphasis on education at the University of Utah, they also insist that the educational investments produce tangible results in the form of new start-ups. For example, maturation funding and grant programs are an essential element for their success, but the funding is no longer being given to researchers, who tended to use it for continuing their basic research. Instead, it is given to companies in small quantities with short durations and targeted commercialization milestones to ensure that the funding is applied to commercially viable projects.

Educational Role of National Research Institutions

National labs are building their local entrepreneurial ecosystems by educating their researchers and post-doctoral researchers in technology commercialization. This typically entails working with entrepreneurs, investors, and industry experts to provide input to their research activities, and working with universities to develop entrepreneurial talent. Most labs are actively involved in work with their local universities' business schools, including providing them with technologies and access to their researchers for participation in business plan competitions.

For example, the primary objective of Pacific Northwest National Laboratory's (PNNL) tech transfer office is to educate the next generation of entrepreneurs as that is Battelle's mandate (through Gordon Battelle's will). PNNL has their University Technology Entrepreneurship Program that matches students with their technologies. Their TTO and economic development department leaders look through a list of opportunities and work with their commercialization managers to identify technologies that they can use for business plan development and competitions by graduate students.

Lawrence Livermore National Laboratory (LLNL), while not having education as their primary objective, said that student development is an attraction, not a *dis*traction, for them because students actually help educate their researchers on commercialization. They built upon ORNL's former Global Venture Challenge concept and use the Idea to Product (I2P) model developed at University of Texas for their Commercialization Plan Competition. They also have an Entrepreneurship Academy underwritten by a local charitable organization. This is a summer bootcamp where four teams of four students (two

[2] Oregon Health & Science University has a similar program called Springboard that provides $7 - $20K of seed money to get incorporated, set up a financial infrastructure, hire a consultant for a feasibility study, and develop a business plan.

technical, two business) are given $4,000 and paired with two faculty members (one business, one engineering, both given a $14K stipend) who are then paired with an entrepreneur in residence. Over the course of eight weeks, they follow the I2P program and investigate three technologies, pare them down to one, and then use that to compete in the Commercialization Plan Competition.

At National Renewable Energy Laboratory (NREL), they want members of their science and technology organization to understand what it takes to get innovation to the market. But, they do not necessarily want to turn their researchers into entrepreneurs – they want their community to work with their researchers to bring innovations to the market. Through programs at the Collaboratory and CREED (more detail about these efforts is in the "Develop an Entrepreneurial Ecosystem" section), they engage with both their researchers and their local entrepreneurs. They have three educational programs specifically targeted to newly hired researchers, although the programs are open to anyone:

- The nuts and bolts of commercialization
- E-learning video program for idea to product, where it focuses on what happens in the lab for commercialization along with what happens when it is transitioned to a company.
- Quarterly panel series where companies send representatives to dialogue with researchers about the challenges of working together and what *has* been working.

Externally, they hold a series of just-in-time training sessions on entrepreneurial topics, and they host/sponsor regular networking events so that entrepreneurs can learn how to access their resources and engage with each other.

CREATE AND MANAGE INTELLECTUAL PROPERTY

"Our objective is to get technology into the market – it's NOT about making money."
– *Jack Brittain, University of Utah*

Best Practices Summary:

- Provide standardized and simplified licensing terms to potential licensees.
- Involve industry experts in assessing market opportunity of technologies.
- Involve industry early in the research process to generate new IP that satisfies market needs.
- Focus objectives on service and education.
- Re-evaluate policies to accelerate the tech transfer function as well as encourage the involvement of inventors in start-up activities.
- Have a long-term focus on technology transfer office staffing and results.

The development and nurturing of intellectual property (IP) is a critical component for all of the institutions surveyed, but the more successful institutions recognize and embrace it as a way to improve society, and serve as the basis for technology-based economic development. Additionally, there is a shift being made inside institutions to engage industry and potential investor involvement in IP development earlier in the research process to help guide direction of the research to meet industry needs.

Trends

Both state and federal governments are placing more and more emphasis on technology-based commercialization, and these efforts are being supported by industry. At the November 2011 State Science and Technology Institute (SSTI) Annual Conference, a session on "Accelerating the Commercialization of Research" described the following trends in university technology commercialization:

- Industrial relationships are moving from the research offices into technology commercialization offices (similar to what exists in national laboratories). This is because corporations are looking at universities as strategic sources of technology and are often willing to provide equity investment.
- Commercialization is increasingly being included in faculty promotion and tenure track discussions.
- Tech transfer offices are developing and relying on a business advisor network to validate researchers' concepts and validate the value propositions.
- More and more universities are creating alumni networks of mentors and investors to help validate, facilitate, and fund start-ups.

Another session at the same conference focused on the "Trends in Tech-Based Economic Development," and reported these findings:

- Universities and hospitals are recognizing that to recruit good students, researchers and faculty, there must be a robust entrepreneurial ecosystem available to receive the fruits of their efforts.
- Federal agencies are increasingly requiring commercialization elements in grants.
- New approaches are being considered for economic development, including business accelerators and crowdfunding.

- New financing approaches are also being considered, including bond issues, tax increment financing, and taxes on natural resources (i.e., shale oil in Texas).

These sessions were validated by the interviewed institutions. All of them realize the need for, and are taking steps to acquire, objective, market-based input (from industry and investors) to successfully launch new innovation. This is something that takes time -- Oregon Health and Science University found that it took three years to get their industrial business development program up and running.

Importance of Objective Setting and Metrics

Every institution we studied gave the following as their top two objectives, although the order depended upon the institution:

- Service -- getting technologies into the market, supporting the research mission of the institution, increasing the stature of the institution in the eyes of the community and/or nation
- Education -- primarily geared towards the next generation of entrepreneurs, it also included education of students as potential employees for more innovative industry and government

If making money was listed as an objective, it was either listed as the third priority or as a positive by-product of the first two objectives.

Metrics used to measure success tended to reflect these priorities. They include:

- Number of disclosures
- Number of companies started
- Number of jobs created
- Average salaries of new jobs
- Number of competitions won by students in business plan competitions
- Dollars won in student business plan competitions
- Level of follow-on investment in companies (equity, SBIR, etc.)
- Revenues and/or royalties to the institution
- Press coverage for the institution

Generating and Protecting IP

Although different institutions had their own philosophies on how they generate and protect IP (as well as different financial resources for doing so), it is high on all of their priority lists. They all agree that it is about "shots on goal" and maximizing the potential for deal flow. An example is Lawrence Livermore National Laboratory, which has a "Fast 50" program where they pay every inventor $50 for every disclosure. Protection approaches ranged from "instant and everything" to careful consideration before investment:

- Jet Propulsion Laboratory (JPL)/Cal Tech (a combined commercialization office) does a cover sheet provisional on every idea (handled by internal staff vs. outside counsel) to encourage their faculty to both continue to invent and to use the subsequent year to develop data needed to convert it to a utility patent. They stress building trust and relationships with their faculty, and the faculty appreciate adding the patent applications to their curriculum vitae.
- Oregon Health and Science University will file a more in-depth provisional if prior art searches are clean and if the faculty provides data that enable claims.

- University of Southern California will file patents if the disclosure is enabling, claims are enforceable, and there is commercial interest.

Regardless of approach, there was consensus around the following:

- No office believed they can predict what will work and what won't – it is important to patent whether or not there is a licensee in place.
- Start-ups usually don't have the funds to support patent expenses, so the institutions support patent expenses until the start-ups have the ability to pay.
- It is important to monitor and enforce patent protection once the patents are issued.

The biggest challenge faced by national labs is their need to reserve rights for future development partners – this often delays or terminates potential licensing deals.

Marketing the IP Portfolio

There were diverse approaches to marketing the IP portfolio, but there was consensus on the following:

- Untapped technologies generally are not the critical issue – someone (venture capitalists, angels, entrepreneurs, industry) are always tracking them.
- There are two critical issues surrounding successfully tapping technologies:
    - A solid market opportunity assessment must be performed and validated by industry
    - The entire ecosystem must be in place to support moving technologies into the market.
- Institutions must focus on solving problems in the market vs. pushing technologies that are on the shelf. Market pull is more effective than market push, and there are several ways that this is accomplished:
    - LLNL has 70 entrepreneurs looking at their technologies at any given time to provide them with feedback on market and technology issues. Entrepreneurs (vs. venture capitalists) are entrenched in the market on a daily basis and can provide real-time feedback.
    - Business school students are used extensively in all organizations to evaluate technologies. The University of Utah actually uses an interdisciplinary team approach to look at business, technical and legal issues for their technologies. In their case, they pre-select the technologies that they believe have educational value, so that there is both a practical and academic learning experience for the students.
    - Lawrence Livermore National Laboratory (LLNL) also has a relationship with the Keiretsu Forum, the world's largest angel investor network, where they present technologies for discussion and potential investment.[3] Forum members collaborate in the due diligence, but make individual investment decisions, with rounds in the range of $250K - $2M.
- Institutions MUST make it easy for prospective licensees to engage with them. This includes:
    - Ready to sign licensing agreements with standard terms and fixed pricing (LLNL)
    - Fast licensing deals – simplified deals and agreements (JPL claims that they can do an option agreement in a half hour)
    - Automatic option for follow-on work by the inventor using the same terms and conditions of the original licensing deal (University of Utah)
    - Lab space rental agreement for start-ups (Utah has addressed and managed conflict of interest issues)

[3] LLNL has offered to present either an ORNL or UT technology at one of their future meetings.

    - Taking technologies to auction (e.g., LLNL licenses older technologies to Ocean Tomo and Intellectual Ventures)
- Everyone had an online portal into their technologies primarily for public relations purposes (most deal flow came from personal contacts or targeted outreach). The more functional sites allowed searches by keywords and automatic population from their technology databases.

One interesting best practice that came up in multiple conversations was the Coulter Foundation Translational Partnership grant for speeding the technology transfer process. Geared towards biomedical applications, this grant increases both the number and effectiveness of collaborations between biomedical engineers and clinicians, supports the movement of promising technologies to clinical application, and develops sustainable processes. Each university recipient establishes an oversight committee consisting of stakeholders in the translational research process, which includes the biomedical engineering department chair, representatives from the medical school, the tech transfer office, entrepreneurs, local venture capital, and the business school. The grant provides almost $600K per year for five years, which includes a director to oversee the daily operations of the award.

Policies

All of the organizations have recognized that standard approaches for transitioning innovation into the market place are no longer viable, so they are experimenting with policy adjustments and flexible ways to make it easier to get technologies into the market. Here are some examples:

- For universities that co-own intellectual property with national labs, the tech transfer offices meet monthly to decide which organization should take the lead in marketing/licensing IP. University of California-Davis and LLNL have an arrangement where the lead organization, if successful, takes 15% of revenues off the top, and then the remainder is split 50/50 between the two organizations.
- University of Utah puts forth the following standard requirements/stipulations for students or faculty to execute an option agreement for a start-up company:
    - A business plan must be written and approved by the technology transfer office (TTO)
    - The company will require at least $500K in funding
    - The option fee is $1000
    - Patent costs are deferred for 2 years
    - The TTO takes 5% equity

Despite these actions, many (especially national labs) are hindered by some policies that can't be changed or can't easily be changed, especially with regard to start-ups. These include:

- Fairness of opportunity issues (exclusive licenses become a challenge with this policy)
- Consulting limitations (1 day/week)
- A lack of flexibility on sponsored research projects
- Must link technology-based economic development to a work package so that the researcher can get paid for it
- Entrepreneurial leave policies (e.g., giving up benefits, conflict of interest issues)

Organization and Staffing

A familiar refrain in the TTO community is that "tech transfer is a contact sport." The TTO must have strong personal relationships with both faculty and industry, which requires an investment in people. Although each office had different organizational structures, the following were key recurring themes:

- TTOs must be staffed at an appropriate level to move innovations into the market. The most effective offices have one licensing associate for every 20 – 25 disclosures, and there must be adequate staff to support them.
- The TTO staffing has to be stable with minimal turnover because (1) most innovations require several years to materialize, which requires a high level of sustained, institutional knowledge, and (2) it takes time to establish and maintain industry relationships required to translate the discoveries into product. This requires a long-term perspective from university administrators who tend to look at short-term results.
- Staff should be paid competitively – because TTOs have a narrow career path, promotions and growth typically come by moving to another TTO, which adversely affects turnover. Competitive pay can minimize that turnover.

Most universities and labs continue to use a traditional structure for tech transfer. One interesting organizational structure existed at University of New Mexico. They created four teams to address:

- IP management, which included technology licensing and legal staff
- New ventures, which included licensing and business development staff
- Finance and operations, which included accounting and support staff
- Public relations, which included marketing and communications staff

Many of the organizations had patent agents and paralegals on staff to minimize (*not* eliminate) the costs of outside counsel. Additionally, LLNL has an Entrepreneur in Readiness program where entrepreneurs meet with them quarterly to get a first look at emerging technologies. The participants have launched and sold at least two companies – these people have the interest, knowledge and focus to successfully work with the inventors to commercialize technology.

The trend at more progressive universities, however, is to create a program that better integrates the tech transfer function with research across all campuses and institutes. Oregon Health and Science University co-locates their tech transfer office with the pre- and post-award research functions to resolve issues quickly. A more transformational example is the Coulter Foundation Translational Partnership Program (see "Marketing IP" section), which was instrumental at the University of Virginia for completely re-engineering their tech transfer business model. They established a new pan-university innovation officer (similar to Jack Brittain's position at the University of Utah) whose job it was to increase partnering external to the university. They created a "plug and play" translational research program that has attracted new partners (and subsequently new funding) to the university.

APPENDIX A: SCOPE OF WORK (7-5-11)

Objective:

- Determine how the two organizations can better work together so that the region can be more successful in commercializing technologies

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Strategies:

- Secondary research (literature review) to identify best-in-class institutions
- Identify models of how technology transfer organizations in communities/regions interact and leverage each other to successfully move technologies into the market
- Benchmark best-in-class technology transfer institutions and their surrounding ecosystems, looking specifically at:
    - Technology transfer policies and processes
    - Industrial partnerships
    - Incubation processes
    - Programs
    - Community involvement/support
    - State and local government participation/support
- Interviews with people involved in successful and unsuccessful commercialization efforts from UT and ORNL
- Evaluate our region relative to desired characteristics/programs
- Recommend actions to improve our success rate

DELIVERABLES

PHASE 1: EXTERNAL ECOSYSTEM REVIEW/ANALYSIS

Phase 1A (June 1, 2011 – July 30, 2011):

- Document potential benchmarks identified by both literature review and recommendations by individuals in the industry (e.g., SSTI, AUTM, etc.). Other community benchmarking targets suggested at prior advisory board meeting:
    - San Francisco area (Stanford, UC Davis) - suggest phone interview
    - Chicago (Argonne) - suggest phone interview
    - Salt Lake City (U of Utah, BYU)
    - New Mexico (Sandia, Lawrence Livermore)
    - Boulder (NREL)
    - Pittsburgh (U of Penn, Carnegie Mellon)
    - Columbus (Battelle, Ohio State)
- Develop questionnaire for benchmarking
- Meeting (or conference call) with advisory team to agree on benchmark targets and questionnaire

Phase 1B (August 1, 2011 – January 30, 2012):

- Completion of visits/phone calls with benchmarking targets

Phase 1C (February 1, 2012 – May 30, 2012):

- Report that summarizes benchmarking results (analyzing the successful models of collaborative tech transfer efforts) and identifies common elements/attributes/ programs for successful commercialization in the following areas:
    - People

- Process
- Technology
- Programs
- Business incubation
- Surrounding ecosystem
- Unique circumstances

PHASE 2: UT/ORNL/LOCAL ECOSYSTEM REVIEW/ANALYSIS
(June 1, 2012 – December 31, 2012)

- Documentation from each technology transfer office that identifies names of participants and contact information for those involved in three successful and three unsuccessful commercialization efforts.
- Development of a questionnaire to use with identified participants.
- Complete and document interviews conducted with participants.
- Identify common threads that had impact on the outcomes.
- Identification of participants in the regional ecosystem that are/have been involved in technology transfer.
- Development of a questionnaire to use with these participants to assess their perceptions.
- Interviews conducted with ecosystem participants.

PHASE 3: FINAL REPORT/RECOMMENDATIONS
(December 1, 2012 – May 31, 2013)

- Document that:
  - Recommends best collaboration practices from other regional ecosystems that can be adapted for use in the UT/ORNL regional ecosystem.
  - Identifies levers to move toward successful technology transfer outcomes
    - Best ways for organizations to work together
    - Barriers that need to be removed
    - Processes that should be revisited, eliminated, or established
    - Assets needed
    - Recommended training

APPENDIX B: CONTACTS

Name	Title	Organization	Date	Venue
Brittain, Jack	President, Tech. Venture Development	University of Utah	8/31/11	UU, Salt Lake City
Miles, Zachary	Interim Director, Tech. Commercialization Office	University of Utah	8/31/11	UU, Salt Lake City
McNally, Dave	President and CEO	Domain Surgical	9/1/11	UU, Salt Lake City
Hamilton, Jack	Director, Energy Commercialization Center	University of Utah	9/1/11	UU, Salt Lake City
Williams, Charity	Chief Business Officer & In-house Counsel	Catheter Connections	9/1/11	UU, Salt Lake City
Taylor, James	Bus. Devel. Mgr., Tech. Commercialization Office	University of Utah	9/1/11	UU, Salt Lake City
Kulkarni, Rajiv	Associate Director, Tech. Commercialization Office	University of Utah	9/1/11	UU, Salt Lake City
Weiss, Ronald	Professor; Faculty Outreach	University of Utah	8/31/11	UU, Salt Lake City
Parks, Thomas	VP for Research	University of Utah	8/31/11	UU, Salt Lake City
D'Ambrosio, Tony	Director, Pierre Lassonde Entrepreneur Center	University of Utah	8/31/11	UU, Salt Lake City
McAleer, Ted	Executive Director	USTAR	8/31/11	Salt Lake City, UT
Cox, Sharon	Program Coordinator	Governor's Office of Economic Devel.	8/31/11	Salt Lake City, UT
Colosimo, Beth	Business Development Manager	Economic Development Corp. Utah	8/31/11	Salt Lake City, UT
Derr, Zachary	Project Manager	Governor's Office of Economic Devel.	8/31/11	Salt Lake City, UT
Wright, Marshall	Director, Business Development	Governor's Office of Economic Devel.	8/31/11	Salt Lake City, UT
Brightwell, Todd	VP Business Development	Economic Development Corp. Utah	8/31/11	Salt Lake City, UT
Goetz, Tami	State Science Advisor	Governor's Office of Economic Devel.	8/31/11	Salt Lake City, UT
Winters, Suzanne	Director	BioInnovations	8/31/11	Salt Lake City, UT
Jaeger, Fred	CEO	Wastewater Compliance, Inc.	9/1/11	UU, Salt Lake City
Freisinger, John	President & CEO	Technology Ventures Corporation	9/20/11	Albuquerque, NM
Fulgham, Julia	VP for Research	University of New Mexico	9/20/11	Albuquerque, NM
Allen, Mark	Manager, Corporate IP and Licensing	Sandia National Laboratory	9/20/11	Albuquerque, NM
Chavez, John	President	New Mexico Angels	9/20/11	Albuquerque, NM
Padilla, Belinda	Program Mgr., Development Office, Tech Tsfr. Div.	Los Alamos National Laboratory	9/20/11	Albuquerque, NM
Kuutila, Lisa	President & CEO	Science & Tech. Corporation (U of NM)	9/20/11	Albuquerque, NM
Kirk, Brian	Managing Partner	Sun Mountain Capital	9/19/11	AUTM West Conf.
Brazil, Barbara	Deputy Secretary	New Mexico Economic Devel. Dept.	9/21/11	Albuquerque, NM
Morgan, Hal	Sr. Mgr., Industrial Partnerships & Strategy	Sandia National Laboratory	9/21/11	Albuquerque, NM
Salazar, Andrew	Director, Proj. Devel. & Bus. Assistance	Technology Ventures Corporation	9/20/11	Albuquerque, NM
Hoeft, Michelle	Founder and CEO	High Desert Discovery District	9/20/11	Albuquerque, NM
Edmonds, Karina	Technology Transfer Coordinator	US Department of Energy	9/19/11	AUTM West Conf.
Shum, Ida	Business Development Executive	Lawrence Livermore National Laboratory	9/19/11	AUTM West Conf.
Fischer, Alex	President & CE?O	Columbus Partnerships	11/7/11	Columbus, OH
Bosley, Brett	VP Tech. Commercialization	Battelle	11/8/11	SSTI Conference
Bond, Drew	VP Public Policy	Battelle	11/8/11	SSTI Conference
Cummings, Brian	VP Tech. Commercialization & Knowledge Transfer	Ohio State University	11/9/11	SSTI Conference
Murcia, Michelle	CFO	TechColumbus	11/8/11	SSTI Conference
Stenehjem, Erik	Director, Industrial Partnerships	Lawrence Livermore National Laboratory	11/30/11	LLNL, Livermore
Smith, Ray	University Interactions	Lawrence Livermore National Laboratory	11/30/11	LLNL, Livermore
Werne, Roger	Deputy Director	Lawrence Livermore National Laboratory	11/30/11	LLNL, Livermore
Fragiadakis, Cheryl	Director, Technology Transfer	Lawrence Berkely National Laboratory	11/30/11	LBNL, Berkeley
Shelander, Bill	Business Development	Lawrence Berkely National Laboratory	11/30/11	LBNL, Berkeley
Pradhan, Arun	Assoc. VP, Tech Transfer & Business Development	Oregon Health & Science University	12/1/11	Conference Call
Rencher, Kristin	Director of Technology Development	Oregon Health & Science University	12/1/11	Conference Call
Hiller, David	Executive Director	National Renewable Energy Laboratory	12/15/11	Conference Call
Cejka, Cheryl	Director of Technology Commercialization	Pacific Northwest National Laboratory	1/5/12	Conference Call
Spanner, Gary	Economic Development Office	Pacific Northwest National Laboratory	1/5/12	Conference Call
Adams, Richard	Mgr. for Innovation & Entrepreneurship Center	National Renewable Energy Laboratory	1/10/12	Conference Call
Holly, Kristina	Director of Technology Transfer	University of Southern California	11/29/11	USC, Los Angeles
Kerr, Karen	Sr. Director for New Ventures & Alliances	USC Stevens Insitute for Innovation	11/28/11	USC, Los Angeles
Rimalovski, Frank	Managing Director	NYU Innovation Fund	1/19/12	Univ. Startups Conf.
Crowell, Mark	Executive Director of Innovation Partnerships	University of Virginia	1/19/12	Univ. Startups Conf.
Gansler, Jacques	Dir., Center for Public Policy & Private Enterprise	University of Maryland	1/20/12	Univ. Startups Conf.
Warren, Tracy	General Partner	Battelle Ventures	12/6/11	ORNL
Kasdin, Kef	General Partner	Battelle Ventures	12/6/11	ORNL
Farina, Fred	Chief Innovation Officer	California Insitute of Technology (JPL)	11/28/11	Cal Tech, Los Angeles
Broderick, Daniel	Associate Director, Tech. Commercialization Office	California Insitute of Technology (JPL)	11/28/11	Cal Tech, Los Angeles
Cortese, Case	Assistant Director	California Insitute of Technology (JPL)	11/28/11	Cal Tech, Los Angeles
Dvorak, Hannah	Assistant Director	California Insitute of Technology (JPL)	11/28/11	Cal Tech, Los Angeles
Vieregg, Craig	Licensing Associate	California Insitute of Technology (JPL)	11/28/11	Cal Tech, Los Angeles
Berglund, Dan	President and CEO	State Science and Technology Institute	7/11/11	Conference Call

APPENDIX C: TOPICS EXPORED

- What kind of formal relationships and programs are in place between the lab and the local universities for accelerating tech transfer?
- What are the objectives of the programs?
- What/who was the driving force behind establishing these relationships and programs?
- What hurdles had to be overcome to establish them, and how were the hurdles overcome?
- What mechanisms seem to work and what don't?
- How are you measuring success, and what are the results?
- What elements are in place (funds, culture, infrastructure, etc.) that help you succeed?
- What has been the involvement of local and state economic development organizations, and how have they helped?
- How has the local investment community been involved?
- What have been your challenges working together and how have they been resolved?
- What would you have done differently?
- We are seeing more and more universities merging their tech transfer functions with their entrepreneurial centers:
    - We'd like to know your comments on this trend and how you see it unfolding in the future.
    - How have the effective universities made this happen?
    - How have metrics improved (or not) with universities that have done so?
    - What are the challenges being faced?
- What would you like to see happen to increase the rate of technology commercialization?