Innovation & Technology in Hawaii:

A Framework for Developing a Statewide Innovation Plan

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Forward

In the last decade, it has become abundantly clear that the U.S. economy is undergoing a major transformation to a new kind of economy—it can be called a knowledge-based economy, a technology-based economy, an innovation-based economy or any number of other monikers that emphasize that science and technology is now the driving factor for economic development. Thomas Friedman has described the world as being flat, and while there can be discussion about exactly how flat the world is, the simple fact is that the U.S. as whole and individual states are now competing with countries across the globe. There are a myriad of reasons for this, including the explosion of the information technology revolution, the success and spread of capitalism accompanied with the collapse of communism, and trade agreements that opened new markets and new sources of labor.

Unlike much of the U.S. that has suffered as part of this transition to a new economy, Hawaii is in a position to greatly benefit. With cultural ties to Asia, Hawaii could serve as one of the important gateways between the U.S. and rapidly rising economies. Additionally, the state through its support of the High Technology Development Corporation, the Hawaii Strategic Development Corporation, the Experimental Program to Stimulate Competitive Research (EPSCoR) and alternative energies has helped lay the foundation for an economy that could thrive in the 21st century.

Yet, Hawaii is not alone in trying to determine how to adapt and thrive in this changing economy. States across the U.S. as varied as Massachusetts, Maine, Kentucky, Arizona, and Ohio have been making multi-year investments in supporting the elements that are required for a tech-based economy. As outlined in this report, a variety of groups have done fine work in examining the state's economy, which leads to an understanding of the state's strengths, weaknesses, opportunities, and threats. Together these reports have made a variety of recommendations to strengthen the state's economy and take advantage of the changing world.

Those states that are investing heavily now to improve their chances in this changing economy came to the conclusion that they had two choices; they could either operate as if nothing has changed in the world and watch their position in the world decline, or they could make tough decisions on investing for the long-term and commit themselves to a strategy that will require sustained investments over several decades.

Where to make those investments and at what scale requires careful consideration by all actors—the governor, the legislature, the private sector, the education community from pre-K through post-graduate, economic development organizations, and the people of Hawaii. Fortunately, a variety of groups in Hawaii have done some excellent work that the state can use to chart a course. This report should serve as a means by which to facilitate that.

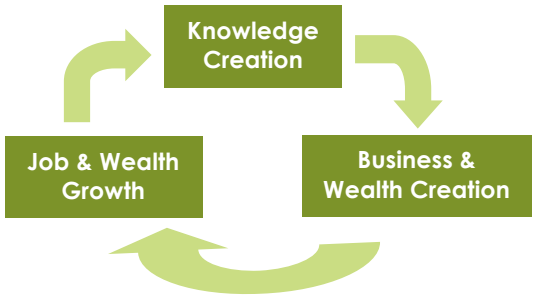
Dan Berglund,
President & CEO
State Science & Technology Institute (SSTI)

Executive Summary

We live in an economy with increasing global dependence. The ability of a region to innovate has become a key determinant for the standard of living of its citizens. **Hawaii has made critical strides in developing many of the building blocks for an innovation economy**. The recently released 2008 State New Economy Index indicates Hawaii moved from an overall ranking of 41 in 2007 to 35 in 2008, the largest jump of any state.

As a result, the state has achieved notoriety in several research areas, and has new pockets of emerging industries that are driven by innovation. A recent report on technology and innovation in Hawaii called for a statewide innovation plan that would bring together the array of current efforts and address remaining gaps.

A statewide plan and resulting policies can enhance the ability to create new knowledge and discoveries, turn discoveries into products and businesses, and grow those businesses with new jobs and wealth. In addition, an innovation plan would target specific capital, talent, research capacity, and governance issues that are needed to be competitive in today's economy.



Hawaii's foundation for innovation is built on its international position, both geographically and culturally, combined with a strong university R&D capacity, a military presence with private sector collaboration, top tier research in ocean sciences, astronomy, tropical medicine and clean energy, and a robust broadband infrastructure. To be more competitive, however, the state will need to address key innovation gaps such as low rates of commercializing university research, poor industry R&D investment, a lack of risk capital, and limited talent in both top management and technical occupations.

> *If states are going to meet the economic challenges of the future, they will need to make the promotion of innovation a larger part of their economic development policy framework.*
>
> *2008 State New Economy Index*

There are immediate opportunities as well as long-term investments to be made. As an example, Hawaii's technology companies tend to be smaller than average, yet the exhaustive time and investment of developing technologies and starting a new enterprise has already been made. An innovation strategy could help these existing companies tap into resources for immediate job and revenue growth. Another prime opportunity could be created by accelerating the commercialization of university research.

With a downturn in the economy, technology-based economic development may be an even more important strategy for diversifying the economy. Moving forward, the state will need to solidify public and private leadership around innovation, and significantly increase its level of cooperation among organizations. Hawaii will also need to creatively use its own assets and reach out to mainland resources when necessary.

Even with growing budget concerns, it will be prudent for Hawaii to make targeted investments in innovation. Such investments will need to be focused on industries and research where Hawaii has a competitive advantage and can build hard-to-replicate excellence.

A Framework for a Comprehensive Innovation Plan

The time is right for the development of a statewide innovation plan. Basic data and research on innovation assets have been completed, and industry opportunities have been identified. The next step is to convene an industry-led coalition of private and public sector partners to take this work to date and develop action-oriented strategies that can leverage state, private and federal resources to significantly grow Hawaii's innovation economy. **Hawaii's numerous innovation studies and reports point to a common set of goals and recommendations that can form a strong basis for developing a statewide innovation plan**.

Innovation Goals

- Significantly strengthen the state's overall capacity for innovation,
- Rapidly commercialize research and build strong competitive advantages,
- Enhance the entrepreneurial climate and the ability to successfully grow high-impact, high-technology companies, and
- Increase the ability of existing industries to continually innovate and compete in global markets.

Recommendations for an Innovation Plan	
Access to Risk Capital	◆ **Increase funding that helps to commercialize R&D concepts** ◆ **Increase stage-specific capital including early stage and growth capital**
Active Entrepreneurial Climate	◆ **Provide In-depth mentoring, commercialization and launch services for entrepreneurs** ◆ **Promote networks for and a culture of tech-based entrepreneurship**
Enhanced R&D Capacity & Commercialization	◆ **Increase the technology transfer and commercialization of university research** ◆ **Encourage industry and university partnerships to develop and commercialize new technologies** ◆ **Increase industry R&D efforts, especially in targeted clusters**
Adequate Science & Technology Workforce	◆ **Actively promote STEM careers and enhance access to and affordability of these programs** ◆ **Enhance incumbent workforce efforts to increase the availability of qualified technology workers** ◆ **Continue to fund and support efforts to enhance STEM programs for students and teachers**
Growth of Targeted Technology Clusters	◆ **Promote sector-specific partnerships that enhance research, start-ups, and growth of targeted industry clusters**

At the end of the day, an innovation plan will need to turn words on paper into actions on the ground. Best practices from other states suggest that innovation plans start from the perspective that this is a **highly collaborative process** where no one sector or organization can solve the problem. The plan will need to be **outcome based**, rather than prescriptive, and focus on "hard-to-duplicate" assets and industries. Other states have clearly demonstrated the importance of prioritizing efforts and providing those efforts the **pace and scale of investment** needed to be competitive.

Purpose of This Report

The objective of this report is to provide a summary of key information for the purposes of developing a statewide innovation plan, and to help inform the ongoing work of organizations such as the Hawaii Innovation Council, Hawaii Science & Technology Council, and the High Technology Development Corporation.

An array of studies and strategies has been developed by state agencies, business groups and educational institutions. Each of these studies (listed in Appendix A) provides insights, assessments and recommendations for the state in general and for specific sectors or geographic regions. The report summarizes, in one location, the key findings and recommendations of these previous studies and reports under topic areas that could easily be used as a foundation for a statewide plan: capital formation, entrepreneurial development, R&D infrastructure, education and workforce, and industry clusters.

Innovation:

The process by which new ideas enter the economy and change what is produced, how it is produced, and the way production is organized.

National Governors Association

Section I describes how the work to date could be used as a foundation for creating a more targeted statewide innovation plan. Section II illustrates how other states are addressing specific recommendations that have been identified as key needs for Hawaii. The Appendix represents an inventory of previous studies which highlights data and findings of over a dozen innovation reports.

It is also important to note what this project does not do. Since a major study on Hawaii's innovation and technology sector was recently completed, this project does not attempt to assess gaps or opportunities not previously identified. While the report contains highlights from other states, it does not determine to what extent similar programs exist in Hawaii, nor does it assess the scale or quality of Hawaii's programs. It uses other state examples to highlight various options for addressing the array of recommendations defined by Hawaii's innovation leadership. Finally, this report does not include a section on government incentives or tax policy. Government policies and incentives are typically developed as a way to accelerate the outcome of another key strategy (e.g. a tax incentive for increasing the rate of capital formation). Since these specific strategies have yet to be defined, it is difficult to determine key government challenges.

Section I: A Framework For A State Innovation Plan

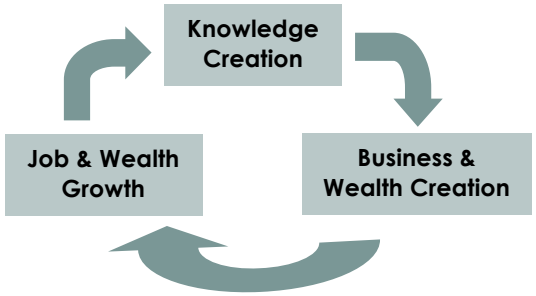
Over the past several years, Hawaii has explored and invested in various efforts to build R&D capacity and grow the technology and innovation industries in the state. These investments have had positive results as illustrated by **national reports that show an increase in Hawaii's innovation ranking among all states**. Despite improvements, the state still performs below average on many innovation issues. So while much has been launched, more is still needed.

"You have to have a plan in place, but not one so rigid that you don't take detours. The A-ha's are in the detours."

Terry Eggar, publisher of the St. Louis Post-Dispatch

While many of the elements needed to grow science and technology are similar among states (e.g. capital, research centers, a skilled workforce, etc.), **each state has its own blend of assets that defines its winning combination for an innovation economy**. Previous reports have identified the array of strengths, gaps, opportunities and recommendations that serve as the foundation for Hawaii's innovation economy. Now it has been recommended that industry, government and education collectively develop a statewide innovation plan[1] that builds on the array of efforts and information already in place, and defines Hawaii's own recipe for innovation.

Building on an Innovation Framework



One of the first steps in developing a statewide plan is defining a framework that describes what is included. Many state plans are based on three interconnected stages commonly used to describe an innovation economy: **the ability to create new knowledge, the ability to turn discoveries into new products and businesses, and the ability to grow those businesses to create quality jobs and wealth**. Within each of these stages, there are key elements of capital, talent, research and development (R&D), and public policies and leadership that contribute to a region's overall capacity to grow and sustain its innovation economy.

Combining these four elements with each stage of innovation can be described as an innovation ecosystem or framework by which more specific efforts can be develop, organized and implemented.

[1] Recommendation from the October 2008 report, *Innovation and Technology in Hawaii*

Table A: Typical Components in the Innovation Framework

Innovation Elements	Knowledge Creation	Business & Wealth Creation	Job & Wealth Growth
Capital	Research and pre-seed capital (federal grants, loans, state funds, university funding)	Seed and start-up capital (state funds, Angels, some early VC)	Growth stage risk capital
Talent: Entrepreneurial & Workforce Development	Top-tier researchers (university and industry) Graduate level S&E students Connections between researchers and entrepreneurs	Experienced and savvy entrepreneurs and start-up talent Connections between entrepreneurs and business resources (capital, facilities, mentors)	STEM workforce Ongoing business networks, mentoring and assistance
Technology: Public & Private R&D Infrastructure	Translational research centers/labs Streamlined technology transfer system	Incubators/accelerators Resources for existing industry R&D	Growth space Industry reinvestment in R&D
Leadership & Government	Incentives for translational and commercialized research - universities and industry R&D Access to federal funding	Regulatory environment for start-ups Incentives for tech start-ups & investments Infrastructure support (including broadband, transportation, etc.)	Incentives and regulatory environment for growth of high impact industries Infrastructure support (including broadband, transportation, etc.)

Building on Previous Recommendations

Another key step in developing a statewide plan is to understand what has already been recommended and compare those recommendations with current data that can help refine and prioritize needs specific to Hawaii. **The state's array of innovation reports clearly point to a set of similar recommendations that can be summarized in five groupings: capital, entrepreneurial climate, R&D infrastructure, education & workforce, and industry clusters**. Some of these recommendations are currently being implemented, some are in planning stages, and others remain undeveloped.

Table B: Previous Recommendations for Building an Innovation Economy

	Recommendations from Innovation & Technology In Hawaii Report (2008)	***Recommendations from other reports (2001-2008)***
Access to Risk Capital	Assist with the formation of risk capital at all levels and continued private-sector investment in technology & innovation.	Increase pre-seed and seed funding for entrepreneurs and small businesses. Increase access to growth capital.
Active Entrepreneurial Climate	*none*	More actively promote and recognize successful entrepreneurs and technology businesses. Provide well coordinated entrepreneurial mentoring, technical assistance and connections to risk capital.

	Recommendations from Innovation & Technology In Hawaii Report (2008)	*Recommendations from other reports (2001-2008)*
Enhanced R&D Capacity & Commercialization	Diversify the state's technology base by encouraging private investment in non-defense activities and by increasing local commercialization of technology developed with DOD Funding.	Increase the amount of proof of concept and pre-seed funding. Streamline technology transfer processes and foster an entrepreneurial culture at universities. Invest in targeted research centers that build on the state's unique strengths. Greatly enhance the amount of private sector industry R&D.
Adequate Science & Technology Workforce	Design a comprehensive technology workforce retention strategy to reduce turnover and keep talent in Hawaii. Enhance workforce programs designed to both increase internships with technology companies and provide information about STEM careers. Systematically examine how two-year and four-year degree programs at UH and the private universities can better meet industry needs and expand or develop new programs to meet those needs.	Enhance the number of STEM teachers and teacher preparation. Increase STEM learning opportunities and academic standards for students. Foster interest in STEM careers for students and adults. Enhance the connections between education and business to ensure degree and certificate programs meet industry needs. Increase the alignment and articulation of STEM related programs between high schools and post-secondary institutions.
Growth of Targeted Technology Clusters	Support existing trade and professional group efforts to develop cluster networks that support the key technology segments	Develop centers of excellence and signature research centers around specific industry clusters Provide incentives that promote industry-university partnerships

Understanding Hawaii's Current Innovation Environment

Acting on these recommendations means understanding the state's strengths and weaknesses as well as Hawaii's relative position among other states. While a detailed inventory of these issues are found in the Appendix, highlights of innovation data indicate that Hawaii is gaining ground relative to its performance when compared to other states.

According to the 2008 *State Technology & Science Index* which measures over 77 innovation indicators, **Hawaii posted the largest jump of all states in overall rankings—eleven spots to 28th** overall. The increase was attributed in part to efforts to attract specific types of life sciences and clean energy, STEM education in pre-college, and investment in dual-use technologies with the military.

Analysis from the recently released 2008 *State New Economy Index* points out that Hawaii has made significant progress in the past decade, yet still remains in the lower half of states in most innovation measures. The following table highlights Hawaii's state ranking in key innovation measures compared to other selected states.

Table C: Comparison of Key Innovation Measures with Selected States

	HI	AZ	ME	NV	OR	UT
Managerial, Professional & Technical Jobs	43	19	30	50	24	22
Education of Workforce	11	30	22	43	17	12
Direct Foreign Investment	14	38	21	34	42	35
Gazelle Jobs	48	33	45	13	28	14
Entrepreneurial Activity	29	23	7	46	6	27
Patents	40	12	31	20	6	16
Broadband/Telecommunications	15	22	28	6	17	23
High Tech Jobs	41	19	32	37	14	11
Industry R&D	45	18	38	50	11	20
Venture Capital	45	19	43	39	34	6

Source: 2008 State New Economy Index, Kauffman Foundation and ITIF

Hawaii's Technology & Innovation Profile

More specific research about the state's innovation economy also point to a growing base of jobs and businesses. According to the 2008 *Innovation and Technology in Hawaii Report*, the state's technology economy was described as:

The greatest danger for most of us is not that our aim is too high and we miss it, but that it is too low and we reach it." Michelangelo

- Having **31,106 jobs and 1,964 establishments**; 23,985 technology jobs, or 77% of the total, were found in private sector companies.
- **Growing by 4,158 jobs or 2.9% between 2002 and 2007**; a rate slightly higher than Hawaii's overall economy of 2.5% for the same time period.
- Having 4,784 science and technology jobs located on the Neighbor Islands, or 17% of total tech employment.
- Paying an **average annual salary of nearly $69,000**, which is 50% more than the average worker in the state. Accordingly, this generates higher tax revenues for the state.
- Accounting for 3.6 percent of the state's total employment, yet **generating 5.4 percent of Hawaii's total worker earnings** ($2.1 billion).
- **Projected to grow nearly 50 percent faster than the rest of Hawaii's economy** over the next decade.

According to earlier studies, the state has experienced strong growth in specific sectors of the tech economy. Particularly noteworthy (between 2000 and 2003) was the 19.2% increase in employment in life, physical, and social science occupations (which only increased by 7.2% nationally over the same period), and the 12% increase in architecture and engineering occupations (which shrank by 7.7% nationally, creating an almost 20 point differential in growth rates between Hawaii and the U.S.).

A Summary of Previously Defined Strengths and Weaknesses

The collection of reports evaluated for this project consistently points to a set of strengths and weaknesses for growing the state's innovation economy. Existing reports also note key opportunities and threats that face state efforts for developing innovation strategies. While detailed information for each topic area is contained in the Appendix, a summary is described below.

Table D: Current Strengths & Weaknesses

Overall Strengths	Overall Weaknesses
Significant university R&D expenditures	The lack of technology transfer and commercialization of university R&D
Military presence and private sector collaboration with the military (e.g., dual use technologies)	The lack of entrepreneurial talent with experience in commercializing research and launching/growing high impact companies
Growing reputation and employment for specific life and physical sciences (especially ocean sciences, tropical medicine, and astronomy), and renewable and clean energy	The lack of risk capital to commercialize research, and lack of growth capital after business launch
The attraction of high wealth individuals and angel investors	Lack of industry investment in R&D
International position, both geographically and culturally	Lack of adequate facilities with labs and other infrastructure conducive to science and technology companies
Efforts to increase pre-college science and technology skills (although modestly funded)	Overall skill level of existing workforce that will need to be retrained to meet projected job demands
Competitive broadband infrastructure and adequate growth capacity (e.g. dark fiber)	Lower than average wages in many science and technology sectors, combined with an overall higher cost of living
	Industry perception that the costs of starting a new business are very high and that the process is complicated or time intensive

Building on Identified Goals and Objectives

Work to date points to a set of goals and objectives that were often repeated throughout various innovation studies and efforts that **can provide a platform by which specific recommendations are developed and prioritized**. As state leaders move forward with developing a comprehensive innovation plan, they might review and refine these previously stated goals and objectives:

Goals:

- Significantly increase the state's overall capacity for innovation (overall R&D, industry R&D).
- Rapidly commercialize research and build strong competitive advantages.
- Enhance the entrepreneurial climate and the ability to successfully grow high-impact, high-technology companies.
- Increase the ability of existing traded industries to continually innovate and compete in global markets.

Strategic Objectives:

- Increase the competitiveness of existing high impact industries while building a base of new, emerging science and technology industries.
- Attract capital investment (from federal grants to private equity) that supports product development, business start-ups, and business expansion.
- Provide an environment that supports the success of entrepreneurs and builds an economic culture that rewards entrepreneurial behavior.

- Enhance human capital, ranging from world-class researchers and executive talent to budding scientists and engineers in our K–12 system.
- Foster state and local governments that are champions of innovation in terms of elected leadership, public policies, and agency operations.
- Systematically evaluate progress and enable policies and programs to be adapted to changing environments.

Refining Recommendations

It is clear that Hawaii has put in place some critical building blocks for an innovation economy. It is also clear that more can be done. Hawaii's lower than average ranking compared with other states' innovation performance points to the need to think about scale (the amount occurring) and pace (the rate at which it is occurring) in regard to effort and investment. **Previous recommendations were combined with the latest innovation data to create a set of targeted recommendations that further define key needs of an innovation plan**. For each of these recommendations, Section II details what other states are doing to address similar efforts.

Table E: Targeted Recommendations for An Innovation Plan

Topic Area	Targeted Recommendations
Access to Risk Capital	◆ **Increase funding that helps to commercialize R&D concepts** ◆ **Increase stage-specific capital including early stage and growth capital**
Active Entrepreneurial Climate	◆ **Provide In-depth commercialization, mentoring and launch services for entrepreneurs** ◆ **Promote networks for and a culture of tech-based entrepreneurship**
Enhanced R&D Capacity & Commercialization	◆ **Increase the technology transfer and commercialization of university research** ◆ **Encourage industry and university partnerships to develop and commercialize new technologies** ◆ **Increase industry R&D efforts, especially in targeted clusters**
Adequate Science & Technology Workforce	◆ **Actively promote STEM careers and enhance access and affordability of these programs** ◆ **Enhance incumbent workforce efforts to increase the availability of qualified technology workers** ◆ **Continue to fund and support efforts to enhance STEM programs for students and teachers**
Growth of Targeted Technology Clusters	◆ **Promote sector-specific partnerships that enhance research, start-ups, and growth of targeted industry clusters**

Moving Forward

As global economic pressures increase including the nation's own economic recession, investment in innovation may be an even more important strategy for diversifying areas that have significant impact on the state's economic recovery and future. There appears to be considerable momentum for building a statewide innovation framework—momentum which is easier to keep going than it is to restart.

Moving forward will require intense collaboration of public and private leadership. In most other states while an array of organizations and industries are involved in setting an innovation agenda, typically one organization leads the planning effort. In Hawaii, key partners are currently viewed as fragmented and lacking coordination and trust. The lack of collaboration means there is no single entity that is recognized by both the public and private sectors as the "go-to" organization that would naturally lead such an effort.

"Beware of the tyranny of making small changes to small things. Rather, make big changes to big things."

Roger Enrico, former chairman, Pepsico

Given the clear need for an innovation plan, a new statewide effort may offer the opportunity to re-establish a more robust coalition or alliance of public and private leaders. This alliance could be the much needed neutral body to convene existing efforts and act as the final review committee that puts an objective "seal of approval" on the innovation strategic plan. Such a planning group would not replace existing efforts--it would act as the much needed glue to pull agendas together.

Lessons from other states can be used to help guide the process and focus for developing an innovation plan for Hawaii. Insights from other efforts include:

Having Strong Private Sector Leadership: While the planning process may be administered or managed by a state agency or nonprofit, **a planning alliance needs to deeply engage and be lead by business leaders** representing various industry clusters. These business leaders should be top in their field; well recognized and respected among Hawaii's private sector. If the structure and process is well organized, even the busiest CEO can find selected time to participate.

Initial Staffing and Resources for managing this planning coalition could come from key government and industry organizations (HTDC, HSTC, EPSCoR, and the university system). These groups need to agree to allocate some small amount of initial funding and staff resources to start this planning process prior to the end of this legislative session. **Innovation efforts are likely to get more legislative support if they can show both progress and cooperation prior to requests for funding or legislation.** To ensure consistent expectations among partners, a memorandum of understanding can be used, or one organization can be chosen as the fiscal agent for the planning process.

Working with Existing Structures: There needs to be commitment from the state's private and nonprofit organizations to follow through on the recent momentum. If the process depend on only funding from the legislature to continue, people's passion and ideas might die a slow death. **Given the fact that the Science & Technology Council has completed the study of the state's tech economy, and the Governor's Innovation Council has established committees, the planning process can really hit the ground running**. Members of the newly formed coalition/alliance can be added to existing committees and structures to form a seamless interface among various efforts. Recent reports and this summary document can serve as the foundation of information. Since data and asset evaluation is typically half the budget and time of a strategic planning process, this already puts Hawaii in a good spot to continue.

An example: The bootstrap effort in Oregon. In Oregon, the Council for Knowledge & Economic Development (the predecessor to the Oregon Innovation Council) was funded through dollars and staff of three government agencies (economic development, the university system, and community colleges/workforce development) and in-kind contributions from several industry groups. The entire planning budget was approximately $75,000 for the first year.

A person outside the government agencies was contracted to manage the process and complete the background data and policy research, while each agency provided staff for a working committee (the economic development agency staffed the capital committee; the university system staffed the R&D committee; and community colleges staffed the workforce group). Industry leaders chaired the various committees. Everyone had clear roles and it worked well for a limited budget. This process not only provided state leadership with living proof that industry, education and government were serious about addressing this challenge, it accelerated the momentum among the partners themselves. The result was a legislative bill and funding passed in a year of budget cuts.

Making the Planning Process Short & Sweet: If key partners agree to start the process without additional funding from the legislature, then a planning process could easily begin in early 2009 and be completed no later than six to seven months later, especially considering the background information is complete, committee structures are in place, etc. **The pace and sense of urgency for innovation needs to be accelerated** in Hawaii, and the recent economic downturn should only provide a greater sense of urgency.

Developing Strategic Partnerships: As an island economy, Hawaii has a history of creatively using its own assets and reaching out to mainland resources when necessary. This is especially critical for the innovation economy. The time and investment to adequately grow innovation resources (especially areas like later stage risk capital) to a competitive scale may either be too great or just not feasible. Lessons from other small states have shown that strategic partnerships have paid off. **It is important to understand what resources need to be place-based and what resources can be virtual**.

Keeping it Focused: One lesson learned from other states is that while a plan may have a list of many recommendations, there needs to be a very limited number (typically three) on which everyone agrees. Recent work in Hawaii has created a set of broad recommendations that at this point need to be more specific. Hawaii is playing relatively late in the game, so they have two choices: put a large infusion of money into innovation, or strategically choose advantages and work like mad on them. Given state budgets of late, the likelihood of a $100+m infusion of state dollars is unlikely. **Given resource constraints, there will need to be agreement on what top actions receive the first infusion of resources with priorities based on need and desired outcomes**, rather than the peanut butter method of giving each key organization an equal amount of money.

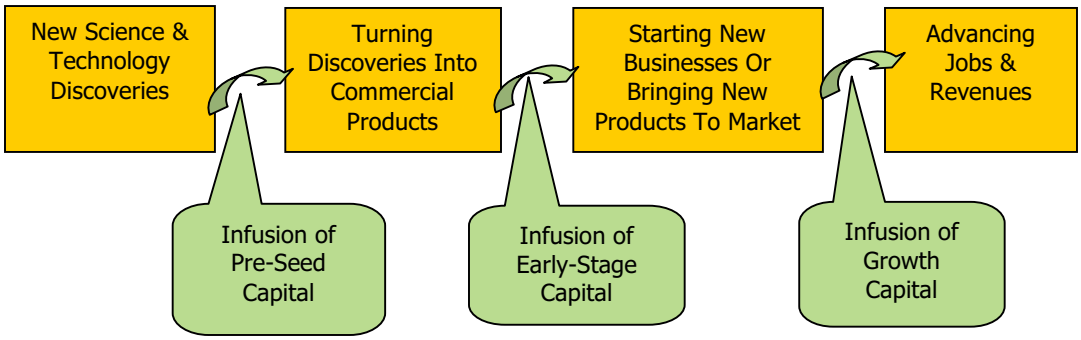
Thinking Scale and Pace: A threat that many smaller states face is the level of investment required to build an innovation economy. Innovation investments must not only be adequate to ***reach the scale of change needed*** to compete at national and global levels, but sustained **for a long enough period to make the change stick**. With limited budgets, there is also a need to ***focus investments*** **on select areas that offer the state the highest economic and social returns on investments**—avoiding political pressures to spread investments across an array of initiatives, which dilutes efforts to build excellence. Smaller states leading the innovation charge have chosen to make targeted investments with their limited budgets.

Section II: Examples From Other States

This section takes the recommendations of Table E in Section I and examines how other states are addressing similar challenges. Examples from other states are meant to highlight an array of models. This project did not assess the current status of practices or programs in Hawaii—therefore, examples from other states may be similar to existing programs in Hawaii, which only underscores the importance of current efforts.

Risk Capital

A key challenge facing Hawaii and other smaller states is the lack of risk capital for product development and business growth. As the following diagram shows, there are several critical stages of business development where access to capital plays an important role in the success of a new product or business. Hawaii recognizes the need for connecting this continuum of funding and has developed a set of recommendations to address this issue.



Risk or venture capital is very concentrated in only a few states and the lessons from smaller states can also provide valuable insights for Hawaii.

Examining venture capital programs is often overshadowed by the sheer volume of dollars invested in California and Massachusetts (almost 60% of all venture capital). However, other states have increased the number of financed deals and the amount of venture capital into their states.

SSTI analyzed the data on per capita venture capital dollars and deals at different stages of company development. Adjusting for population and focusing on seed- and early-stage capital revealed that several states, including Minnesota, Utah, Maryland and North Carolina are seeing impressive increases in capital opportunities for early-stage entrepreneurs. States like Kentucky experienced sharp gains in 2007, along with Oregon and New Hampshire which both doubled 2006 investment levels per capita. Vermont led the country in deal growth with 6.43 more deals per million people in 2007, though it did not appear in the top ranks for dollars due to the smaller size of these deals. New Mexico and Maine were also in the top 10 states in 2007 in terms of increases in deals.

Hawaii's Recommendations for Risk Capital

	Recommendations from Innovation & Technology In Hawaii Report (2008)	Recommendations from other reports	**Combined Recommendations**
Access to Risk Capital	Assist with the formation of risk capital at all levels and continued private-sector investment in technology & innovation	Increase pre-seed and seed funding for entrepreneurs and small businesses Increase access to growth capital	**1. Increase pre-seed and seed funding that helps to commercialize R&D concepts** **2. Increase stage-specific capital including early stage and growth capital**

Lessons from Other States: Risk Capital

Recommendation #1: Increase pre-seed and seed funding that helps to commercialize R&D concepts.

Examples From Other States: University-focused pre-seed funds

The Kentucky Commercialization Fund Program (KCF)
The Kentucky Commercialization Fund Program (KCF) supports efforts made by faculty in the Commonwealth of Kentucky to commercialize a technology, product or process that they have developed but not yet licensed. The fund has a maximum of $75,000 per award and a total of $500,000 per round of funding. The KCF mission is to commercialize the technologies developed in any of the state's five identified research focus areas:

- Biosciences
- Environmental and Energy Technologies
- Human Health and Development
- Information Technology and Communications
- Materials Science and Advanced Manufacturing

The Kentucky Science and Engineering Foundation (KSEF) staff manages the KCF program. KSEF was created to invest in research and development activity to promote innovation and build a pipeline of new ideas and technologies that will add value to the growth in the Commonwealth. Created under the Kentucky Innovation Act of 2000, the mission of KSEF is to build science and engineering capacity and excellence by investing in ideas, technologies, human resource development and technological innovations in Kentucky. http://ksef.kstc.com/?36

Purdue University Emerging Innovations Fund
Purdue University has recently created the Emerging Innovations Fund. This is a philanthropic initiative supported by University alumni and private donors. It is designed to provide financial support for startup companies that work with University technologies so that the discoveries and technologies can be moved to commercialization. Initial capitalization is $1.5 million, expected to grow to $5 million. Initially the fund is expected to support 5-7 grants annually ranging from $20,000 to $200,000. Purdue faculty, staff, students and Purdue Research Park-based

companies, including all Indiana incubator and satellite campuses, are eligible to apply to the program. Funds can be used for:

- Intellectual property enhancement
- Prototype development and testing
- Market research and commercial assessment
- Feasibility studies for production
- Determination of regulatory, reimbursement pathways
- Preliminary business plans

The program is designed to be financially self-sustaining. Money will be invested in technology equities and startup companies benefiting from the fund will provide a payback into the program as part of the technology commercialization process.
www.prf.org/otc/index.asp

Oregon University Venture Fund
The University Venture Fund provides a 60 percent income tax credit to Oregon taxpayers who contribute to a new program designed to fast-track commercialization of research discoveries at Oregon's eight public universities. With limited state budget resources, Oregon is tapping the philanthropic wealth of residents to create a proof of concept fund for universities. The fund has three goals: 1) to accelerate the commercialization of university research, 2) to enhance the opportunities for undergraduate and graduate students to gain experience in applying research to commercial activities and gaining vital entrepreneurial experience, and 3) spur more partnerships among universities and industry.

Under the legislation:

- $14 million in tax credits are allotted to the participating public universities
- Tax credit certificates will be issued to donors on a first-come, first-served basis
- Both individuals and corporations are eligible to make unrestricted donations to the venture fund, which the university will use exclusively to pave the way to commercialization of OSU-based research

The fund has an "evergreen" clause which requires universities to repay the state for claimed tax credits with income from royalties and licensing fees generated from fund investments. The state will issue additional tax credits as the initial ones are repaid, allowing a cycle of reinvestment in university-derived innovation.
Enabling legislation www.leg.state.or.us/05reg/measpdf/sb0800.dir/sb0853.en.pdf

Examples From Other States: Pre-seed/seed funds for businesses/entrepreneurs

Oklahoma's Technology Business Finance Program (TBFP)
The TBFP is a state-funded loan program designed for advanced technology companies in the State of Oklahoma. Eligible firms must be technology-based, sufficiently innovative to provide a competitive advantage in the marketplace, and have the potential for significant, high performance growth. They must also exhibit significant potential for high sales per employee, substantial value added per employee, wage levels 35-40% higher than average, and other indicators related to the generation of wealth for Oklahoma's economy. Firms applying for assistance under this program must be classified as a small business (less than 500 employees) and located in, or must have relocated to and be primarily domiciled in Oklahoma.

The fund provides approximately ten awards per year (total of approximately $1,000,000). Awards can be up to $100,000 with payments allocated according to an agreed set of milestones with each company. Eligible firms are primarily in a development stage prior to full production. This is further defined as any stage from idea conceptualization up to, and prior to, established and steady market sales. This, for the most part, suggests firms in the development, proof of

concept, and prototype stages of their life cycle. Firms needing "pre-seed" capital are also eligible, with funding allowed for prototype development, completion of business plans, executive recruiting, and detailed market analysis needs.

Firms are required to have a 1:1 cash match and agree to a repayment provision of two times the original amount funded by the Program (there is no required payback provision for companies that fail). The amount of the repayment shall be determined in part by the degree of perceived risk and the anticipated length of time for payback for the project under application. The repayment amount may be prorated if repaid prior to five years. The program is run by i2E, a nonprofit organization that provides technical and business assistance to technology companies. http://www.i2e.org/DesktopDefault.aspx?T0=4539&T1=4745&T2=4771&TM=18

Maryland Technology Development Corporation (TEDCO) Technology Transfer Fund
TEDCO provides funding to support the transfer of technology from universities and federal research laboratories to private companies. The program funds awards up to $75,000 and the funds can be used for early stage feasibility testing. To date, 114 companies have received funding through MTTF and completed their projects. According to TEDCO, "with an investment of $6,812,113 by TEDCO since its start, companies have gone on to receive downstream funding from angel and venture investors, federal awards and other resources nearing $205 million. This is a leverage of the state's investment through TEDCO of $30.07 to $1[2]".
www.marylandtedco.org

Michigan Pre-Seed Capital Fund
The Michigan Pre-Seed Capital Fund supports high-tech start-up companies as they near commercial viability by providing access to early-stage capital to accelerate company development. Supported by a consortium of Michigan SmartZones, these funds will extend the personal investment of entrepreneurs during the critical stage when they are developing their businesses to the point of readiness for outside investment.

Eligible companies will need to be past the concept development and analysis phase, and have specific milestones identified for achieving commercialization suitable to a matching investing partner of the Pre-Seed Fund.

These needs might include hiring key management executives or specialized consultants, regulatory review, contract manufacturing agreements, marketing strategies and sales plans, etc. At this stage, the Pre-Seed Fund will be able to fund $50,000 to $250,000 per company alongside their investment partner who will provide a minimum dollar for dollar match.

The goal of the Pre-Seed Fund is to position these companies for follow-on investment. The concept of identifying early, matching investment partners with each company provides the company with a level of professional direction it would otherwise not have at this stage. These professional investors will also know how to garner the attention of the Venture Capital community at the appropriate time and facilitate the next level of investment for a win-win situation. http://www.annarborspark.org/start-ups/pre-seed-fund/

Maine Small Enterprise Growth Fund:
An $8 million fund that invests $150-350,000 in a company with an expectation to realize returns in 5-7 years. Purchase of company preferred stock, and will also consider convertible debt. An evergreen fund seeded through a combination of state bond proceeds and direct appropriation.
www.segfmaine.com

[2] TEDCO Press Release October 15, 2008 *TEDCO Honored with 2008 Excellence in Technology-Based Economic Development Award.*

Recommendation #2: Increase stage-specific capital including early-stage and growth capital.

In the past decade various fund of funds models have been developed by states to encourage more investment. The results of these funds have varied. While most provide good returns to their investors, not all models have returned the broader economic development objectives of more and better enterprises in their state. There are two common paths states have taken

> Tax Credit Programs: Several types of tax credit programs exist. Certified Capital Company (CAPCO) programs are those where the state provides tax credits to insurance companies that invest in CAPCOs, which in turn invest venture capital into qualifying businesses. These programs had mixed results and have, for the most part, fallen out of favor.
>
> Equity Investment Vehicles: Models such as venture capital limited partnerships and fund of funds provide venture capital level investment in businesses. While some states made direct equity investment, most current programs are managed by a private, professional fund manager. Some state-sponsored equity funds are evergreen, in which returns are designed to be invested back into the fund rather than distributed to investors. The two most common ways that states provide capital to these investment programs are through state pension funds and contingent tax credits. Both models are illustrated below.

Oklahoma Capital Investment Board (OCIB)
OCIB was funded in 1993 and has been a leading example of using contingent tax credits for venture fund of funds. OCIB is authorized to borrow up to $100 million from banks, which in turn invests for a minority interest in privately managed VC funds that have a willingness to invest in Oklahoma businesses. The borrowed money plus a rate of return (based on Libor + additional basis points) is guaranteed by OCIB which is authorized to sell state tax credits in the event that it is called on its guarantee. As of a 2006 study, the model increased the number of VC funds investing in Oklahoma from three to fifteen; a $60 million commitment ($40 million draw) has generated over $130 million of investment in Oklahoma companies. While other states like Utah, Ohio, Michigan, Arkansas, etc. have introduced similar programs, Oklahoma obtains a full equity interest for its investment risks. http://www.ocib.org/

Michigan 21st Century Investment Fund
The Michigan 21st Century Investment Fund, L.P. is part of the overall 21st Century Jobs Fund initiative that was first announced in November 2005. Under this 10-year initiative, the State government decided to allocate up to $1.0 billion of proceeds from Tobacco Settlement monies to strengthen and diversify Michigan's economic base by focusing resources in three areas. Up to 40% ($400 million) of the amount allocated to the 21st Century Jobs Fund may be invested through the Capital Investment Program over the life of the 10-year initiative of which the Michigan 21st Century Investment Fund, L.P. is a part.
http://www.michigan21stcenturyinvestmentfund.com/about_21stCentFund.htm

The three components of the 21st Century Jobs Fund include:

- A Capital Investment Program that seeks to make investments in qualified private equity, mezzanine and venture capital funds as well as potential co-investments alongside these funds.
- A Competitive-Edge Commercialization Program that seeks to invest in the commercialization of products, processes and services as well as basic and applied research.
- A Commercial Lending Program, which seeks to stimulate additional lending by financial institutions across the state by creating commercial loan enhancement programs.

Oregon Investment Fund (OIF)
The OIF is a $100 million fund of funds investment using the Oregon Public Employee Retirement Fund and the State Accident Insurance Fund and is managed by Credit Suisse. The OIF enabling legislation notes that it will seek to build an overall portfolio with:

- "Investments that are mainly in Oregon or Pacific Northwest-based companies,
- Investments that are mainly placed through Oregon/Pacific Northwest focused and based private equity funds,
- Investments that are mainly made in funds that intend to invest in venture capital, growth capital or later-stage buyout companies, and
- Funds that intend to make investments that could ultimately benefit start-up companies coming out of Oregon universities and colleges."

While the intention of the legislation was on target with many economic goals, the execution of this fund has shown different results. The OIC's statutory mandate is to achieve the highest rate of return on its investment and, therefore, much of its investment tends to be distributed toward later stage VC funds. While investments to funds were intended to be made to VC firms located in Oregon and the Northwest with a goal of obtaining more outside investment for Oregon companies, to date investments have been made in only one Oregon-based VC fund with seven investments in VC funds in Seattle, Los Angeles, San Francisco, and Massachusetts. Due to the mandate of highest return, funds invest in the best "deals" which may not always be in Oregon. In summary, as an investment for return of public funds it is meeting its goal; as an economic development tool for more VC funding in Oregon, the verdict is still out.
www.oregoninvestmentfund.com

Oregon Growth Account
The Oregon Growth Account was founded in 1995 and is a fund of funds that has made $91 million in commitments to 19 general partners, primarily in Oregon and Washington. Funded through proceeds from the state lottery, with oversight from a state appointment board of Oregon business and financial professionals, the fund tends to invest in a variety of funding stages and industries that are targeted to Oregon's economy.
http://www.ost.state.or.us/divisions/investment/index.htm

National and Other State Reports on Risk Capital

Seed and Venture Capital: State Experiences and Options, National Association of Seed and Venture Funds, May 2006

Investing in our Competitive Future: Approaches to increase early stage capital in Washington State. A report of the Technology Alliance Seed Funding Committee, January 2007 [Appendix of more than 100 state funding initiatives]

Florida's Innovation Benchmark Study, Prepared for the Florida High Tech Corridor by Boyette Levy, June 2008 [Highlights of other state programs]

Entrepreneurial Development

Entrepreneurs are the change agents of an economy: taking risks and pursuing economic dreams. Although all new and small businesses are important to a state's economy, it is a small percentage of high-growth, high-performance companies (often called "gazelles") that add the majority of new jobs and wealth to the economy. These entrepreneurial and highly innovative companies often require a different type of business assistance in their growth.

"The ability to innovate is only as good as how one can accept changes and take risks."

Franco Paolo Liu Eisma

From various studies on entrepreneurship, we know entrepreneurs do not work in isolation—they thrive in environments with open ideas and information flow, and where there is a dynamic structure for connecting entrepreneurs to each other, and to the technology, talent and capital resources they need to take their concept to market. Studies also indicate that strong peer and mentoring networks are among the most effective way to build tech savvy entrepreneurs.

States across the nation have developed an array of in-depth and coordination programs to enhance the entrepreneurial climate. It has been identified in various state reports that Hawaii has many of the pieces to support entrepreneurial development, yet the overall coordination and scale of these efforts may not be as strong as possible.

Entrepreneurial strategies are not just about starting companies, they are also about growing companies. Hawaii's technology companies tend to be smaller than the mainland counterparts and may offer significant opportunity for the state. For many technology sectors, a huge chunk of time and resources are spent developing technologies and launching the business. Once a company is "on its feet" growth strategies can have significant return on investment in terms of growing jobs, revenues and wages.

Hawaii's Recommendations for Entrepreneurial Development

	Recommendations from Innovation & Technology In Hawaii Report (2008)	Recommendations from other reports	**Combined Recommendations**
Active Entrepreneurial Climate	*none*	More actively promote and recognize successful entrepreneurs and technology businesses. Provide well coordinated entrepreneurial mentoring, technical assistance and connections to risk capital.	**1. Provide In-depth commercialization, mentoring and launch services for entrepreneurs** **2. Promote networks for and a culture of tech-based entrepreneurship**

Lessons From Other States: Entrepreneurial Development

Recommendation #1: Provide In-depth commercialization, mentoring and launch services for entrepreneurs.

In smaller states or metro regions there are nonprofit organizations that offer in-depth, customized services to entrepreneurs that can assist with technology development, business plan development and enterprise launch, and get them investment ready. Many of these programs also run state pre-seed funds to help those clients that reach specific milestones apply for small grants or loans that will provide capital for early stage development of their companies. This

integrated set of services has resulted in businesses with more than double the average survival rate, and often with job growth that is two to four times the state's average.

These programs not only offer entrepreneur academies or boot camps, their core offering is a customized service that assesses each company's expertise and stage of development, and then provides one-on-one business expertise, coaching and referrals based on these needs. Services include technical feasibility and IP assessments, market research, risk assessment, business modeling, capital formation strategies, team building, and exit strategies. Staff is typically comprised of executives with start-up experience and investors. The programs have very tight connections to university tech transfer and research offices, angel and venture groups, and state and regional economic development programs—not just providing a referral contact, but bringing parties together to help broker how each partner can add value to the client company.

Examples of these programs include:

i2E (ideas to enterprise), Oklahoma
i2E offers one-on-one customized assistance through their commercialization services, including a referral service. i2E also manages a state supported technology grant program for start-ups and a newly established seed fund. They have two programs to build the long-term pipeline of entrepreneurs: the Governor's cup business plan competition and an intern program focused on business students getting hands-on experience in start-up companies. www.i2e.org

Innovation Works, Southwest Pennsylvania
Innovation Works offers entrepreneurial academies, one-on-one customized services, and a referral service. Innovation Works also manages three state pre-seed and seed funds: University Innovation Grant Fund, Innovation Investment Fund, and Innovation Adoption Grant Fund. The group hosts a business plan competition, and an entrepreneurial intern program between tech start-ups and Carnegie Mellon and the University of Pittsburgh.
www.innovationworks.org

Oregon Entrepreneurial Network and Seed, Angel and Venture Forums
The Oregon Entrepreneurial Network (OEN) is the state's nonprofit membership organization with a mission of promoting the start-up and growth of high value companies in Oregon. OEN helps improve the flow of ideas, services, and capital to entrepreneurs and helps connect companies to expertise and other resources they need to grow their businesses. Together, the nearly 2,500 members strive to aid the growth and development of a healthy, diversified Oregon economy with a new generation of entrepreneurial leaders. Privately funded, this organization began holding a venture forum in 1996 to connect companies with investors. Today, the organization has three forums that systematically connect each level of funding: a seed, angel and venture forum.
www.oen.org

> *OEN's Venture Northwest (formerly Venture Oregon)* is the premier forum for new and emerging investment opportunities in exciting companies from Oregon, Washington, and throughout the Pacific Northwest. This annual conference draws institutional investors and investment bankers from across the western U.S. who are interested in the emerging companies that the Northwest has to offer. Companies that have presented at Venture Oregon have raised over $1.3 billion in venture capital since 1996 and over $68 million in angel investment. More than 50 investors from 35 venture capital firms attended the conference in 2007.
>
> *OEN's Angel Oregon* brings together Oregon and Southwest Washington's brightest entrepreneurial talent with qualified angel investors. Seven companies were showcased in 2008 at the conference.
>
> *Seed Oregon* is a unique competition for Oregon and Southwest Washington seed-stage companies who are seeking capital within the range of $100,000 to $2,000,000. One

winner from each preliminary round will move on to a championship round, where nine finalists will earn a coveted presenting opportunity at OEN's Angel Oregon. Coaching is provided to finalists.

Invest Southwest
Invest Southwest is the premier capital conference in Arizona and the Southwest. This event connects the region's most promising ventures with knowledgeable investors. Presenting companies have received more than a quarter billion in investment dollars since inception of the conference in 1992. http://investsouthwest.net/

Recommendation #2: Promote networks for and a culture of tech-based entrepreneurship.

Other regions with a healthy or growing entrepreneurial climate appear to have, among other things, three assets: a strong coalition-based network, high profile events and competitions, and programs that connect start-ups to markets outside the state. Below are just a few examples of these.

Coalition Building Organizations
All states have an array of programs to serve both technology and non-technology entrepreneurs. Yet states with growing innovation sectors tend to have a very coordinated entrepreneurial community with a shared set of goals. For decades, programs like the **MIT Enterprise Forum http://enterpriseforum.mit.edu/** have provided models for state and regional technology sectors to connect private, education and government resources. These organizations serve as both a broker and convener for entrepreneurial resources as well as provide specific services not covered elsewhere in their region.

High Profile Competitions
High profile events can help to connect entrepreneurs to needed resources and build awareness of the tech sector's impact on the overall economy. Almost every state and region have resources to help entrepreneurs develop business plans and pitches, yet some states have taken these resources and developed premier events that take the competition to a higher level.

Georgia Business Launch Competition: The Georgia Research Alliance (GRA) and the Technology Association of Georgia (TAG) joined forces to support the creation and growth of new companies that will strengthen and expand Georgia's strategic high-tech clusters. The Business Launch Competition is an event designed to motivate and support entrepreneurs in creating new high-tech businesses in Georgia that will support and expand existing strategic clusters, and create greater awareness within the investment community that Georgia is a great place to launch and grow high-tech businesses.

The contest winner receives a $100,000 cash award courtesy of the GRA and a diverse array of services valued at an additional $200,000. This comprehensive $300,000+ prize is GRA and TAG's way to reward high-tech entrepreneurship and assure a deserving Georgia start-up company has everything in place to be successful. Entrants must legally reside in the State of Georgia. All awards are conditioned on the company launching and/or maintaining its operations in Georgia. If the winning company moves a majority of the business outside Georgia within 3 years, the winning company must repay TAG for the $100K cash prize plus 8% annual interest.

The competition is aimed at "new" businesses; however, the time and effort necessary to launch a successful business in the targeted areas may require that an entrepreneur form

a company and begin certain limited functions before any meaningful business operations occur. These functions could include prototype or Intellectual Property development and for these or similar reasons, up to $500,000 in external funding may be allowed. Market trials may also be required, and for this or a similar reason some limited revenue may be allowed. Entrants have an option to request a mentor in further developing and refining their proposal. A group of Georgia's most successful high-tech entrepreneurs has agreed to serve as mentors. A preeminent panel of judges consisting of business leaders, entrepreneurs and a venture capitalist has been recruited. In addition, a group of local investors will attend the final event and receive copies of the business plans of the finalists. www.tagonline.org/businesslaunch.php

Expanding horizons (and markets) for technology companies
A common gap reported by various studies on Hawaii's tech sector is their lack of connections to broader markets, despite a central location between continents. In addition to providing business assistance within their geographic region, other organizations are taking their technology companies to global markets.

> **Automation Alley** is a 501(c)6 non-profit organization in Michigan that drives growth and economic development through a collaborative culture that focuses on workforce and business development initiatives. Automation Alley's business accelerator brings together businesses, educators and government to help entrepreneurs accelerate the commercialization of new technologies and services. Assistance includes limited pre-seed and commercialization funding, business plan and strategy development support as well as a powerful network of experts and mentors. *Automation Alley has conducted trade missions to Mexico, China, Germany, India, Central and Eastern Europe and to date has garnered more than $130 million in signed contracts for participants.* www.automationalley.com

R&D Infrastructure

> *"Innovation is the fuel for growth. When a company runs out of innovation, it runs out of growth."*
>
> *Gary Hamel and Gary Getz, in 'Funding Growth in an Age of Austerity'*

The primary goal of a strong R&D infrastructure is to have the ability to innovate not once, but over and over again. R&D infrastructure is more than just "facilities with labs." It requires people who have experienced taking research ideas to market, effective collaboration between businesses and research institutions, and an ongoing environment that rewards reinvestment in research.

Among the most cited R&D needs are three issues that are relevant to Hawaii. **The capacity of universities to conduct translational research and develop commercial applications of research is essential.** Technology transfer between universities and the private sector can come in various forms: discoveries and technologies that are patented or licensed, and products or services with no proprietary intellectual property. The culture of the university's administration and research faculty, endowed chairs with technology transfer experience, and fair and expedient licensing agreements all contribute to this capacity.

Research partnerships between education and industry effectively build critical mass. These partnerships can leverage the resources and expertise necessary to build the critical mass that any one partner alone can not accomplish. **The capacity of existing businesses to conduct research (industry R&D) is necessary for ongoing success.** Over the past several decades industry R&D has surpassed the amount of government sponsored research. And of all

the research conducted by industry, less than 15% comes from federal funds[3]. This private reinvestment into the research infrastructure is essential, especially when government funds are at risk.

Data indicates that Hawaii's university research is very competitive. With this foundation in place, the state now has the ability to grow the commercial application of university research by licensing technologies to Hawaii's entrepreneurs and businesses and spinning off companies. This is not just a university effort—it will take public and private involvement and investment to make this happen. Funding for eminent scholars and graduate programs, proof of concept funding, more sponsored research by industry, etc. are all part of the equation.

Hawaii's Recommendations for R&D Infrastructure

	Recommendations from Innovation & Technology In Hawaii Report (2008)	Recommendations from other reports	**Combined Recommendations**
Enhanced R&D Capacity & Commercialization	Diversify the state's technology base by encouraging private investment in non-defense activities and by increasing local commercialization of technology developed with DOD Funding.	Increase the amount of proof of concept and pre-seed funding. Streamline technology transfer processes and foster an entrepreneurial culture at universities. Invest in targeted research centers that build on the state's unique strengths. Greatly enhance the amount of private sector industry R&D	**1. Increase the technology transfer and commercialization of university research** **2. Encourage industry and university partnerships to develop and commercialize new technologies** **3. Increase industry R&D efforts, especially in targeted clusters**

Examples from Other States: R & D Infrastructure

Recommendation #1: Increase the technology transfer and commercialization of university research.

Technology Transfer

A fair and streamlined technology transfer system allows university research to be commercialized while protecting the interests of the educational institution. Many of Hawaii's existing reports on innovation note the lack of a leading-edge tech transfer process.
So, what can be learned from other states? In a 2007 article appearing in the *Journal of the Association of University Technology Managers* based on state experiences the authors offer guiding principles for a establishing a technology transfer process[4]. These principles are:

[3] National Science Foundation, U.S. Business R&D Expenditures, August 2008
[4] *A New Technology Transfer Paradigm: How State Universities Can Collaborate with Industry* Catherine S. Renault, PhD, Jeff Cope, MSM, Molly Dix, MIP, and Karen Hersey, JD; Journal of the Association of University Technology Managers, Volume XIX 2007.

- Universities should reserve the right to practice licensed inventions and to find ways for other nonprofit and state and regional public interest organizations to benefit.
- Exclusive licenses should be structured in a manner that encourages technology development, use, and regional impact.
- State universities should anticipate and help to manage technology transfer-related conflicts and be prepared to help local and regional actors overcome them.
- Ensure broad access to research tools and strive to provide a bridge to regional users with access and training.
- Consider including licensing provisions that address unmet needs, such as those of a state's neglected patient populations or geographic areas, giving particular attention to improved therapeutics, diagnostics, and agricultural technologies for regional benefit and the developing world.

Additionally, for technology transfer to continue to occur over time research institutes must embrace the role of economic development within their mission and culture. Recent research indicates that an important factor in the occurrence of technology transfer is the understanding and acceptance of economic development as a key role of the university[5].

Universities can do two things to improve the culture surrounding their role as economic development agents and the occurrence of technology transfer. First they can work to communicate the importance of that role on a clear and consistent basis among the university community and the public. Second they can consider the likelihood that a candidate will fit the role of economic development agent when selecting new hires.

Finally, effective technology transfer requires resources to manage operations, administer policies, and facilitate communication and networking with businesses and faculty. In addition to state funds some universities are supplementing efforts with funds created by alumni and donors.

Creating A Culture of Technology Transfer Within the University

Industry Technology Transfer, State of Oklahoma
In 1998, Oklahoma passed two initiatives: State Questions 680 and 681 that removed legal prohibitions against state employees (e.g., faculty members at public universities) and state institutions participating in start-up companies based on faculty inventions and in using campus facilities to foster these activities. Passage led to the adoption of model policies for universities and research institutions within the state[6]. Some recent examples have shown that technology transfer need not be limited to universities and can occur at the community college level as well.

Ontario Partnership for Innovation and Commercialization (OPIC)
Smaller universities and research institutions often lack the resources to provide fully staffed technology transfer offices. Universities and colleges in the Ontario Canada region resolved this problem by creating a virtual technology transfer network known as the Ontario Partnership for Innovation and Commercialization (OPIC). OPIC is a partnership among Lakehead University, Laurentian University, Nipissing University, Brock University, the University of Ontario Institute of Technology, Trent University, and Ryerson University. Through the network, the member

[5] *Academic Capitalism and University Incentives for Faculty Entrepreneurship,* Catherine Searle Renault, Journal of Technology Transfer, 31, 227–239, 2006.

[6] *Building State Economies By Promoting University-Industry Technology Transfer:* Louis G. Tornatzky, Ph.D.; National Governors' Association, 2000

institutions enhance technology transfer capacity by sharing expertise and educational resources, and partnering with clients. OPIC also provides a Collaboration Travel Program in which faculty can be reimbursed for travel to business for technology transfer related work.
http://www.opic-ontario.ca/

University of Wisconsin-Madison - First Look Investor Forums
Through its Office of Corporate Relations, the University of Wisconsin-Madison sponsors bi-monthly forums for investors specifically focused on early-stage opportunities. The forums allow University faculty, researchers, and entrepreneurs to discuss their research and preliminary business concepts with representatives from the investment community to gain feedback on how to convert technology innovations into business propositions.
www.ocr.wisc.edu/entrep/resources/campus/

Green Technology Entrepreneurship Academy: University of California, Davis, Center for Entrepreneurship, Graduate School of Management
The Center for Entrepreneurship at UC Davis created the Green Technology Entrepreneurship Academy. This is a one week academy that provides science and engineering research faculty, post-docs and doctoral students with the necessary knowledge and skills to move environmentally sustainable and green technology research out of the laboratory and into practice. Participants leave with the knowledge and skills needed to recognize, develop, and communicate potential commercial and knowledge distribution opportunities arising from their research and how to tap the social networks linking them to the entrepreneurial community. The 5-day program integrates lectures, exercises, and team projects where participants work in teams to identify, design, and validate new business opportunities from their own research, under the guidance of faculty, technology transfer staff, and experienced entrepreneurs and investors from environmental science and technology-based ventures[7].
http://entrepreneurship.ucdavis.edu/

Recommendation #2: Encourage industry and university partnerships to develop and commercialize new technologies

Georgia's Intellectual Capital Partnership Program
Georgia's Intellectual Capital Partnership Program (ICAPP) is the University System of Georgia's economic development program. ICAPP connects the intellectual resources of Georgia's public colleges and universities to the state's business community in innovative ways. ICAPP staff and a team of economic development leaders from each campus help Georgia businesses to tap into the University System of Georgia to recruit college-educated employees, access the latest research, and access business and operations advice. The program helps industry connect to research through a variety of mechanisms. www.icapp.org

- Database of research centers to search more than 400 entries in the ICAPP Catalog of USG Centers, Institutes and Special Programs to find expertise in a wide range of areas.
- Industry-directed research working with businesses to conduct research that meets industry needs through a wide range of programs.
- The regional offices of Georgia Tech Enterprise Innovation Institute help companies improve productivity and quality, reduce costs, plan expansions, start new operations, and implement proven manufacturing technologies.
- Advanced Technology Development Center (ATDC) helps technology-based companies rapidly bring new innovations to market. ATDC has four locations in Atlanta, Savannah and Warner Robins, Georgia.

[7] http://entrepreneurship.ucdavis.edu/green.php

- The SBIR Resource Program helps Georgia companies with less than 500 employees get Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants, available from federal agencies for high-risk research.

University of Washington - LaunchPad Program
In an effort to catalyze the creation of new ventures based on promising University technologies and innovations, the Technology Transfer Office at the University has developed the LaunchPad. Once an entrepreneur expresses an interest in starting a company based on their UW innovation, the staff reviews the case, works with entrepreneurs to develop a detailed start-up plan, and additionally supports the entrepreneur through:

- Managing start-up project plans
- Identifying next steps and milestones
- Finding community mentors and advisors
- Coaching team members
- Facilitating communication and networking with business and investment professionals
- Linking the project team to needed resources

http://depts.washington.edu/techtran/uwcommunity/uw_starting_working_with_techtran.php

University of Michigan, Ann Arbor, Business Engagement Center
Having capacity for world class research at universities is a start to creating economic development. Using this research to generate and partner with companies to commercialize products and services is the next step. Often businesses view the university setting as unapproachable. In 2007 the University of Michigan created The Business Engagement Center (BEC) to bridge this gap and facilitate business access to the University. The Center creates a "business friendly" environment for entrepreneurs to access the University's research discoveries, new technology, faculty expertise, student and alumni talent, and continuing education programs. This is accomplished through technical assistance as well as programs and events that network businesses with university personnel and faculty. While not all of their programs and activities are technology transfer focused, the Center makes it easier for entrepreneurs and faculty to establish relationships which eventually lead to technology transfer.
http://bec.umich.edu/index/

Expert Network of Carnegie Mellon
The Center for Technology Transfer at Carnegie Mellon University developed the Expert Network to assist businesses and entrepreneurs in commercializing University technology. While the Office has full-time staff to provide help, the Expert Network is utilized to match entrepreneurs with alumni, licensees, and members of the business community to provide guidance and expertise. This is done through one-on-one consultation as well as small group panels depending on the need.
www.carnegiemellonctt.com

Georgia Research Alliance - Industry Partnership Grants and Venture Lab Program
The Georgia Research Alliance (GRA) acts as a "deal-maker" for Georgia's research universities to grow Georgia's economy through university-based research. GRA recruits enterprising scholars to Georgia, fuels the launch of companies, strengthens centers of research so that they break new ground on discovery, and brokers working partnerships between businesses and industries.

The Alliance is a public-private partnership of the state's leading research universities, business and state government. The operations of the Alliance are funded through grants from private foundations and industry. The investments that the Alliance makes in its programs are part of the budget of the Office of the Governor of Georgia and are approved by the Georgia Legislature.

Among its commercialization efforts, GRA offers industry partnership grants and manages the Venture Lab Program.

In 2007, the Georgia Research Alliance (GRA) provided grants to fund university-industry partnerships in targeted technology areas. Grants were made up to an amount of $100,000 and all investments required the involvement of at least one active industry partner. Projects had to be within three targeted technologies areas including: advanced communications, computing and content, bioscience, nanoscience and advanced materials. The program provided targeted focus on state strengths while fostering university and industry relationships. www.gra.org

GRA also supports the VentureLab program. According to GRA, VentureLab helps create early-stage businesses that are ready to advance into traditional technology business incubators. Venture Lab reduces both the costs and risks associated with technology transfer in one-stop centers that serve as advocates for faculty researchers through:

- Technology assessment. VentureLab looks for timely innovations that will mesh with marketplace needs. In addition, staff members help faculty determine the best route for commercialization – be it licensing the technology to an existing company or forming a startup.
- VentureLab Fellows. The program connects faculty researchers with experienced entrepreneurs and professional managers who serve as coaches and drive the commercialization process forward.
- VentureLab commercialization grants. Funding is available to bridge the gap between research and commercial product.

Recommendation #3: Increase industry R&D efforts, especially in targeted clusters.

Industry R&D Tax Credit

Economists have found that the private sector invests in research and development (R&D) about half the amount that is optimal for society.[8] R&D tax credits help to lower development costs for R&D-intensive companies competing intensely in global markets. A recent study by Yonghong Wu at the University of Illinois, Chicago found "that the establishment of state R&D credit programs is effective in stimulating more industrial R&D expenditure. In addition, state services in higher education and R&D-targeted programs also matter in private decision of R&D investment. This policy assessment sends a positive message to state policymakers because it shows the great potential in using R&D policy instruments to promote innovation-based economic development."

There have been various comparisons of state R&D tax credits, including a 2007 study in Hawaii.[9] Hawaii is known for having a progressive R&D tax credit that applies to all R&D expenditures, not just increased R&D investment from previous years as is common in most other states. However, a key issue noted by multiple reports is the importance of the R&D tax credit being available to all taxpayers, rather than limiting the credit to specific sectors of qualified businesses. Since the maximum benefit of innovation comes from the spillover effect one industry has on another, limiting the industries that receive the tax credit has been shown to limit industry R&D. Currently, Hawaii's tax credit applies only to qualified businesses.

[8] *Expanding the R&D Tax Credit to Drive Innovation, Competitiveness and Prosperity, Dr. Robert Adkinson, April, 2007*

[9] *Hawaii High Technology Research & Development Tax Credit Survey, Grant Thorton LLP, 2007*

Promoting Industry R&D in Small Companies

Wisconsin Technology Bridge Grants
Introduced as part of the state's Grow Wisconsin Initiative, the Technology Bridge Grant program provides funding to businesses with fewer than 100 employees, which have received early-stage financing from the federal government (e.g., SBIR award) or another source and are waiting for follow-on sourcing. Funds granted under this program may only be applied to necessary costs related to maintaining research and basic business operations until the company's follow-on funding or federal grant application is approved or denied.
http://www.commerce.state.wi.us/bd/BD-Act255-technologybridgegrants.html

Kentucky SBIR/STTR Match Program
State matching funds are awarded to companies that win grants in Phases 1 and 2 of the federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) programs. Kentucky is the first state to *match both phases of the federal grants, dollar for dollar, doubling the value and impact of federal funding*.

The announced matching grants are up to $100,000 per company for their Phase 1 research. Kentucky also has started matching federal awards for Phase 2 research and development, during which a company aims at making the technology ready for commercialization. The maximum state match for Phase 2 federal awards is up to $500,000 per year for up to two years. The opportunity for recipients of Phase 1 and Phase 2 federal awards to earn up to $1.1 million in matching funds from Kentucky has drawn attention to the nationally advertised program from high-tech firms in other states that are interested in relocating to Kentucky. The funding for the program comes from the state general fund and is provided on a first-come, first-served basis and have assisted more than 20 businesses each year. Initial results indicate a dramatic increase in SBIR applications and awards for Kentucky businesses, which ranks among the lowest of all states for industry R&D. http://www.thinkkentucky.com/DCI/SBIR/SBIRSTTR.aspx

North Carolina
The One North Carolina Small Business Program provides grants to reimburse qualified North Carolina businesses for a portion of the costs incurred in preparing and submitting Phase I proposals to the federal government's SBIR/STTR Programs. It also provides matching grants to qualified North Carolina businesses that have been awarded a federal Phase I SBIR/STTR: 100% of the federal SBIR/STTR Phase I award up to a maximum of $75,000.

North Carolina establishment of a new tax break for research and development includes a 50% rebate for sales taxes paid by medical testing laboratories for medical reagents. The same provision also established a broader 50% rebate for increases in sales taxes paid by medical and other testing laboratories for supplies used or consumed in analytical activities.

Maine Technology Institute
The Maine Technology Institute is a nationally recognized state funded program that offers seed grants with few strings attached, providing ready access to small technology companies to advance their products and services towards commercialization. Since its beginnings in the late 1990's, MTI has provided funding to more than 500 entities in the state of Maine. Seed grants can be for amounts up to $12,500 per project and up to two awards can be made per project. One:one match is required but can include value of time, equipment, and facility use by the applicant. These are grants that do not need to be paid back. Applications are accepted 6 times a year (every other month). While the funding amounts are small, ease of access to the funds has helped companies meet immediate R&D needs leading to commercialization and has then led them to additional funding through other state and federal programs.
www.mainetechnology.org

National Reports of Interest

A New Technology Transfer Paradigm: How State Universities Can Collaborate with Industry, Catherine S. Renault, PhD, Jeff Cope, MSM, Molly Dix, MIP, and Karen Hersey, JD; Journal of the Association of University Technology Managers, Volume XIX 2007

Characteristics and Trends in North American Research Parks: 21st Century Directions, Battelle, October 2007

Expanding the R&D Tax Credit to Drive Innovation, Competitiveness and Prosperity, Dr. Robert D. Atkinson, April 2007

The Effects of State R&D Tax Credits in Stimulating Private R&D Expenditure: A Cross-State Empirical Analysis, Yonghong Wu 2008

Education & Workforce

Over the past decade, Hawaii has established multiple workforce and education programs to address the skills and jobs needed for the 21st century. These programs involve a range of education partners, workforce organizations and the business community. Like most education investment, these are intermediate and long-term strategies yet are essential to the ongoing competitiveness of the state's economy.

The number of organizations addressing innovation-based workforce and education in Hawaii is high. Despite the recent surge of STEM efforts there are still some remaining challenges faced by Hawaii. Since the projected gap for technology workers in Hawaii is estimated to be up to 50%, existing and dislocated workers will need to be rapidly retrained through affordable and flexible education and training systems. Increased coordination between industry and education to ensure degree programs and training meet the needs of Hawaii's businesses will be essential.

Hawaii's Recommendations for Education and Workforce

	Recommendations from Innovation & Technology In Hawaii Report (2008)	Recommendations from other reports	**Combined Recommendations**
Adequate Science & Technology Workforce	Design a comprehensive technology workforce retention strategy to reduce turnover and keep talent in Hawaii Enhance workforce programs designed both to increase internships with technology companies and provide information about STEM careers Systematically examine how two-year and four-year degree programs at UH and the private universities can better meet industry needs and expand or develop new programs to meet those needs	Enhance the number of STEM teachers and teacher preparation Increase STEM learning opportunities and academic standards for students Enhance the connections between education and business to ensure degree and certificate programs meet industry needs Increase the alignment and articulation of STEM related programs between high schools and post-secondary institutions	**1. Actively promote STEM careers and enhance access and affordability of these programs** **2. Enhance incumbent workforce efforts to increase the availability of qualified technology workers** **3. Continue to fund and support efforts to enhance STEM programs for students and teachers**

Examples from Other States: Education & Workforce

Recommendation #1: Actively promote STEM careers and enhance access and affordability of these programs.

In 2006, **Delaware** created the **Student Excellence Equals Degrees (SEED) merit-based scholarship** as an incentive for high school students to stay in school and to succeed inside and outside the classroom. The SEED program provides students with financial support to acquire an associate's degree at a state college or university. In 2003, Governor Minner established the P-20 Council by Executive Order to improve communication and cooperation among all of Delaware's education providers. The council's Dual Enrollment Task Force is establishing policy for dual enrollment partnerships between high schools and postsecondary institutions to increase access to higher education. SEED Scholarship and P-20 Council

In 2006, Governor Kathleen Sebelius signed into law the **Kansas Academy of Mathematics and Science**. The academy provides an accelerated program for Kansas high school juniors and seniors who are academically talented in science or math. The two-year curriculum includes coursework designed to meet both high school graduation requirements and requirements for associate of arts or associate of science degrees and is conducted by faculty of a Kansas postsecondary educational institution. KansasBio is developing a strategy to enhance bioscience education and training that includes supporting workforce development programs, establishing KansasBio student chapters at state and private universities, and working with educators to develop K-12 bioscience curriculum.

Minnesota's new Achieve Scholarship program addresses two critical barriers to college attendance: lack of academic preparation and financial access. Under the program, Minnesota high school graduates who complete any one of four sets of courses defined as rigorous earn a one-time scholarship of $1,200 to help pay for college at a public or private college or university. To qualify, students must be from a family with an adjusted gross income of less than $75,000 for the previous tax year, file the Free Application for Federal Student Aid, and enroll in a postsecondary education within four years of high school graduation.

North Carolina launched an unprecedented high school innovation initiative with support from the Bill & Melinda Gates Foundation. During the last three years, the North Carolina legislature has created nearly 90 **Learn & Earn Early College High Schools** and redesigned other high schools organized around academic themes. The Learn & Earn Early College High School Initiative allows students to leave high school with a diploma and an associate's degree or two years of transferable college credit. The Learn & Earn program was implemented to be an economic development driver and many of the high schools in the Learn and Earn program focus on STEM themes that are frequently tied to a community's economic development needs. Governor Easley's New Schools Project

Washington has established the **GET Ready for Math and Science Scholarship program**, which offers four-year scholarships to students who score in level 4 of the 10th grade math or science Washington Assessment of Student Learning, or who finish in the top 5 percent on the SAT or ACT. Students receiving the scholarship must enter and complete a math- or science-related degree program and work in a related field in Washington for three years following graduation. GET Ready for Math and Science Scholarship, House Bill Report as passed.

Washington has targeted thousands of **new enrollment slots at state universities to high-demand math- and science-related programs** for construction, engineering, and allied health professions. Additionally, the state is planning a new University of Washington campus that will emphasize math, science, and technology programs.

Virginia is providing $2,000 annual grants to community-college graduates who have associate's degrees in STEM disciplines to continue their education at four-year colleges.

Wyoming has initiated the **Hathaway Scholarship program** to improve the rigor of the high school curriculum through an emphasis on math and science while helping more students achieve their college dreams. The scholarships can be used at the University of Wyoming and the state's seven community colleges and are funded by interest from the Federal Mineral Royalties. State aid of up to $1,600 per student per semester depends on high school grades, college entrance exams scores, financial need, and, beginning in fall 2007, on high school curriculum. The top funding level will go to students who will have taken four years of math and science.
Hathaway Scholarship

Recommendation #2: Enhance incumbent workforce efforts to increase the availability of qualified technology workers.

Two years ago, **Michigan** established an unprecedented partnership with the Charles Stewart Mott Foundation and the Joyce Foundation, aimed at doubling the number of Michigan residents with a college degree or certificate. In February, Governor Granholm launched the **No Worker Left Behind initiative**, which provides an opportunity for thousands of residents to gain new work skills and greater educational attainment—tuition-free —in high-growth and high-demand occupations or entrepreneurship through a community college, university, or trade program.
Commission on Higher Education & Economic Growth
No Worker Left Behind

Last year, **Michigan** launched the **21st Century Workforce**: **Developing Coordinated Regional Strategies Initiative**, which made awards to regional Michigan Works! agency coalitions across traditional geographic and agency boundaries to work with local partners on developing regional strategies to deal with worker dislocation. Michigan is encouraging partnerships among firms in specific industry sectors—defining workforce issues in recruitment, retention, and training—and developing solutions, all in collaboration with educators and workforce leaders.

Connecticut is bridging the gap between what is being taught to students and what is needed by industry through its **Business and Industry Services Network**, a collaborative program that links business, state government, and education to train and produce a highly skilled workforce.
Business and Industry Services Network

Georgia's Work Ready Initiative is a statewide program that matches job seekers and employers through a skills assessment system powered by ACT WorkKeys. Statewide service delivery of the voluntary, free credential and job profiling is handled by the technical college system of Georgia. The Work Ready initiative enables Georgia businesses to easily communicate to the education community the skills needed to fill jobs. Georgia Work Ready

Louisiana has launched **LA ePortal,** a state-of-the-art lifelong learning education portal. This online college- and career-planning tool expands student engagement and career exploration and aligns education with the needs of the state's economy. LA ePortal serves as Louisiana's one-stop solution for complete education and career information. The program is designed to facilitate academic and career pursuits along a workforce education and training continuum to assist users as they navigate through life.
LA ePortal

Recommendation #3: Continue to fund and support efforts to enhance STEM programs for students and teachers.

Education Coordinating Councils

Colorado has created a **P-20 Education Coordinating Council**, a statewide, multisector body, charged with designing recommendations to halve the high school dropout rate and double the production of postsecondary degrees and technical certificates in the state. Governor Ritter's P-20 Council

In 2007, Governor Sebelius signed into law the **Kansas Technical Education Authority**. This 12-member body will coordinate the state's technical education programs to ensure that students are receiving the education they need and that schools are operating efficiently and effectively. Several state agencies have cooperated to initiate an alignment study for postsecondary education. The alignment study seeks to identify the potential disconnects between the outputs of postsecondary education and the occupational and skill demands of Kansas industries. Results of the study will identify best practices for educational institutions, enhancing their ability to offer programs that will produce graduates with the skills to enter high-wage, high-tech occupations that drive the Kansas economy. http://www.kansasregents.org/techauthority/index.html

Missouri's newly created P-20 education council is charged with better linking the state's higher education system with the public education system and the state's workforce needs. In addition, Governor Blunt has directed the state's Coordinating Board to develop a system of performance measures across public education as well as a set of common competencies across entry level college coursework. These initiatives are designed to ensure that all students attending public institutes of higher education have the skills they need to meet the state's workforce needs.

Project Making the Grade is **Rhode Island's** action plan for STEM education, higher education preparation, and successful careers in a technology-driven workplace. The project's blue ribbon panel report identifies 12 core strategies targeting systemic, comprehensive, and sustainable actions to improve STEM education and training. Working with Vermont and New Hampshire, Rhode Island has implemented new mathematics and science standards and drafted engineering and technology standards. The state has launched a high school science curriculum pilot, Physics First Rhode Island, requiring all students take physics, chemistry and biology and has invested in e-classroom learning and a STEM Center to improve teacher preparation and student outcomes. Project Making the Grade *Blue Ribbon Panel Report*

Wyoming Governor Dave Freudenthal has appointed a blue-ribbon panel to explore the governance, mission, and funding of the state's community colleges, with a specific charge of recommending ways in which **workforce development and career and technical education can be better integrated into the existing system**. Additionally, since 2001, the state has appropriated grants to the University of Wyoming that match private donations. These grants have been used to leverage the private sector for donations that are improving research, attracting top-level faculty, enriching academic programs, and building new, state-of-the-art facilities.

Teacher Preparation & Learning Networks with Industry & Graduate Fellows

Delaware's Career and Technology Education workgroup has been directed to create a five-year plan that revises standards and develops pathways aligned with industry and postsecondary institutions in coordination with the state's work on the NGA Honors State Grant. With the

governor, the University of Delaware and the New Castle County Vocational and Technical School District instituted a Graduate Teaching Fellows Program in K-12 Education. Fellows are paired with district high school science teachers to form a learning community that examines and reflects on current issues in education while addressing critical needs in science education. Graduate Teaching Fellows Program

The **Florida Center for Research in Science, Technology, Engineering, and Mathematics** was created to improve student achievement through research, technical assistance, and dissemination of research-based practices. One of the center's major roles is to enhance the rigor of secondary programs to better prepare high school graduates for postsecondary education and the workforce. Governor Crist has also charged the new Office of Mathematics and Science with overseeing the implementation of new world-class K-12 mathematics and science standards, as well as invigorating professional development and coordinating state and federally funded programs in these subject areas. Florida Center for Research in Science, Technology, Engineering, and Mathematics and Florida Department of Education Office of Mathematics and Science

Massachusetts has proposed at least three years of mandatory high school math and science. In recognition of the key role that teachers play in the **Professional Development Institute Program**, 26 STEM institutes will offer professional growth opportunities for teachers during the school year. Professional Development Institutes for Educators

The **Nevada Math Project** is a grant-funded partnership among the Nevada Department of Education, the National Science Foundation, and the U.S. Department of Education. The project is one of only two in the United States. Through a select group of participating mathematics teachers, a team of educators provides instruction that promotes the incorporation of research advancements into mathematics teaching techniques. The immediate goal of the project is to train coaches within the state, who will work with teachers to better balance instruction and problem-solving in mathematics classrooms.

Pennsylvania Department of Education is working with Penn State University to build a **partnership between the colleges of Engineering and Education**, respectively. The purpose is to infuse engineering content into teacher-preparation programs, combined with pedagogical strategies, so that graduates will be better prepared to help young children familiarize themselves with STEM fields, building an early STEM pipeline for the commonwealth. Classrooms for the Future

Texas is the second state to raise the standards for graduating high school seniors in the areas of math and science by adding a fourth year of required study to the curriculum. This has improved students' college and workplace readiness. The state has also created six Texas-Science, Technology, Engineering, and Math (T-STEM) centers and 35 T-STEM academies. T-STEM centers are partnerships among public education, business, and community groups, which collectively develop innovative teaching materials that integrate engineering and technology concepts into the curriculum and provide training for teachers and administrators.

Utah is expanding 7th- through 12th-grade science and technology programs that expose students to a college-level science and technology curriculum. **Applied Science, Technology, and Engineering Camps** will be held across the state for youth in grades seven through 12. The camps will motivate middle- and high-school students to take additional science, technology, and math classes in hopes that they will eventually pursue higher education in those fields. At the same time, through the **Science Olympiad Teacher Training Camp**, the state's science teachers will also have access to content-based professional development opportunities. Utah Applied Science, Technology, and Engineering Camps

Washington is offering **expanded professional development time for math and science teachers**, particularly to bring new and rigorous STEM courses to their schools. Washington has also created a Department of Early Learning to recognize the importance of teaching math and science to young children. In addition, state universities recently expanded their training programs for educators to increase the focus on early math and science awareness.

STEM Performance Standards & Academic Standards

Michigan has become one of 12 states to align its high school graduation requirements with college and workplace expectations. The state has also created the **Michigan Merit Exam**, a high school assessment that includes elements of the ACT college-readiness exam. Last year, Michigan became the first state in the nation to require all students to take an online course or have an online learning experience to graduate from high school. This year, with financial support from Microsoft's Learning Program, students in Michigan have access to *CareerForward®,* a powerful, free online course dealing with globalization, career planning, and entrepreneurship.
Michigan Merit Curriculum
About the Michigan Merit Exam
Michigan Merit Curriculum High School Graduation Requirements

Georgia has significantly strengthened its K-12 STEM curriculum with the new **Georgia Performance Standards**, which have received high praise from Georgia educators as well as national policy institutes. In 2006, the Fordham Foundation rated Georgia's curriculum one of the top 5 in the nation. It also rated Georgia's science curriculum a 'B' in 2006, up from an 'F' in 2000.
Georgia Performance Standards

The governor and **the Indiana Commission for Higher Education** have also modified the formula for state funding to public institutions of higher education: The new formula provides incentives for increasing graduation rates and speeding the time to degree completion. This will discourage a tendency to focus on enrollment numbers and reward universities for producing talented graduates to strengthen the state's workforce.

The Minnesota Office of Higher Education developed **Minnesota Measures**, the state's first higher education accountability report. One of the main goals of this report is to include indicators that measure the state's effectiveness in producing graduates in STEM disciplines and health care. Minnesota Measures

West Virginia is the second state to become a 21st Century Skills Partner State. Through this partnership, West Virginia has increased its high school graduation requirements to include four math credits, at least three of which must be Algebra I and above. West Virginia is also working to increase the rigor of math and science standards to ensure that its students are prepared for the workplace. West Virginia's 21st Century Skills Initiative

National Reports of Interest

A National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System, National Science Board, October 2007

Education and Training for the Information Technology Workforce, US Department of Commerce, 2003

Innovation America: A Compact for Post-Secondary Education, National Governors' Association, 2007

Learning for the 21st Century, Partnership for 21st Century Skills, 2002 with updates in 2007 & 2008

Technology Clusters

For almost two decades now industry cluster theories have shown how groups of related businesses and organizations can work together to enhance the environment for growth and innovation. States have invested in collaborative research centers, targeted research funds, value-chain initiatives and other efforts to strengthen connections among these cluster-based groups. As the recent *Technology and Innovation in Hawaii* report indicates, the ability to facilitate greater interaction and the leverage of resources will be critical for growing the states tech-based economy.

Hawaii's Recommendations for Technology Clusters

	Recommendations from Innovation & Technology In Hawaii Report (2008)	Recommendations from other reports	**Combined Recommendations**
Growth of Targeted Technology Clusters	Support existing trade and professional group efforts to develop cluster networks that support the key technology segments	Develop centers of excellence and signature research centers around specific industry clusters Provide incentives that promote industry-university partnerships	◆ **Promote sector-specific partnerships that enhance research, start-ups, and growth of targeted industry clusters**

Lessons from Other States: Technology Clusters

Recommendation: Promote sector-specific partnerships that enhance research, start-ups, and growth of targeted industry clusters.

Lessons learned from other states on development of industry-focused initiatives and research centers indicates that a state must be very practical about the number of centers it can realistically support at a scale that would be competitive. In Oregon, the Oregon Council on Knowledge and Economic Development agreed that in order to compete at a national and global scale the state could only support three signature research centers. Ohio's $1.1 billion Third Frontier program and larger population base allows that state to support more centers of excellence. One lesson that has been learned from others is that excellence is hard to achieve when resources are spread too thin or are not focused.

Recent examples of state funding for higher education infrastructure[10] include the following: Note these are annual or biennial budget amounts, not the total investment for higher education.

- Arizona's $25 million for the 21st Century Fund
- Indiana's $20 million Life Sciences Fund
- Missouri's $13.4 million for animal health, nutrition, renewable energy and plant science
- North Dakota's $20 million for Centers of Excellence
- Oklahoma's $75 million for endowed chairs

[10] *Provided by SSTI*

- Oregon’s $11.5 million for a signature research center
- Washington’s $70 million for the Life Sciences Discovery Fund

Missouri's Lewis and Clark Discovery Initiative (LCDI) has used $325 million in state funding and an additional $100 million in private funds, to support regional high growth industries. LCDI has funded research facilities for the public higher education system, helped develop business incubators and made funds available to align math and science curriculum with the workforce needs of high growth industries. LCDI has also provided $15 million for economic strategic planning and the implementation of regional innovation initiatives.

Iowa has provided investment to improve the state's biorenewable research infrastructure and accelerate its economic opportunities in this growing sector. The governor championed a biofuels building at Iowa State University, one of the nation's premier institutions for biorenewable research. Additionally, worker training was funded at the state's community colleges for jobs in the renewable energy field. The governor also created the **Generation Iowa Commission** to further Iowa's investment in activities and practices that attract young adults to the state. The members of the commission represent a variety of different geographic, professional, and educational backgrounds as well as cultural differences. The commission's goal is to create a more innovative, vibrant, and exciting Iowa now and for future generations.
Office of Biorenewable Programs at Iowa State University

Established in February 2006, the **OneKC WIRED** initiative represents a dynamic, entrepreneurial and innovative partnership strategically designed to drive significant economic and workforce development transformation within a bi-state region in the Kansas City area. A similar proposal was recently submitted for the South central Kansas region to maintain the competitiveness of the area's aviation industry. The following activities have been initiated to prepare for this change:

- Significant investment in the National Institute for Aviation Research
- Development of a regional manufacturing skills certificate to train 4,000 aviation workers
- Investment in a technical training and education center in Wichita

OneKC WIRED
National Institute for Aviation Research

Governor Pawlenty has **expanded the influence of Minnesota's universities on the state's economy by expanding centers of excellence and higher education.** The governor has presided over a new University of Minnesota campus in Rochester to expand high-demand instructional programs that focus on the life sciences disciplines, nanotechnology, and entrepreneurship. The new campus builds on local partnerships with the Mayo Clinic and IBM. Two centers of excellence in manufacturing engineering have been established at Minnesota State University, Mankato and Bemidji State University. Each center will work with regional two-year colleges to build unique flagship programs to attract the participation of employers, students, and faculty from outside the region.
Minnesota Center for Engineering and Manufacturing Excellence

Governor Rendell has worked toward aligning **Pennsylvania’s** workforce and education spending with the needs of the economy. The **Governor's Workforce Development Task Force** defined nine industry clusters with competitive advantages and potential for long-term economic growth. These clusters account for 69 percent of the state's employment base and have served as the basis for industry-driven workforce, economic, and education development across Pennsylvania. The commonwealth has also developed the **High Priority Occupation** process to meet employer demand for high-growth, high-demand jobs in industries vital to the stability and growth of Pennsylvania's economy.
Pennsylvania's Industry Cluster Analysis

South Dakota is reopening the Homestake Mine in Lead South Dakota for consideration as the **National Science Foundation's Deep Underground Science and Engineering Laboratory (DUSEL).** Selection as the DUSEL will bring scientists, engineers, and mathematicians to South Dakota for a variety of experiments. DUSEL will include a world-class science education center. South Dakota is also expanding its value-added agriculture products, particularly with beef and turkey commodities. As part of Governor Rounds' 2010 Initiative on Energy, South Dakota is actively promoting the production of ethanol and biodiesel as well as the development of wind energy.
Sanford Laboratory at Homestake

The **Texas Industry Cluster** Initiative establishes state and regional partnerships with organizations, state agencies, higher education, and others to foster growth and development of industry-based strategies for business recruitment and expansion within the state. Also, Texas is preparing a high-tech workforce through the Nanoelectronics Workforce Development Initiative. This novel and transferable program demonstrates the feasibility of immersing large numbers of associate, undergraduate, and graduate interns in a real-world, leading-edge nanotechnology facility. The program allows students to engage directly with industry scientists and engineers for 3 to 12 months. The program is designed to improve student employment opportunities and inspire more students to focus on high-tech careers.
Texas Industry Cluster Initiative
Nanoelectronics Workforce Development Initiative

Building on Governor Doyle's **Grow Wisconsin** plan, the state's biotechnology/stem cell initiative will maintain Wisconsin's leadership in this area of research by capturing 10 percent of the stem cell technology market by 2015 and expanding Wisconsin's $7 billion biotechnology industry. The initiative includes support for stem cell companies and for the Institute for Discovery at the University of Wisconsin–Madison, a research collaboration facility. The Governor's Business Council, created in April 2007, brings together government and regional business development groups to promote innovation, streamline regulation, enhance entrepreneurial spirit, and make Wisconsin a national leader in workforce skills and efficient manufacturing.
Grow Wisconsin Initiative

Promoting Regional Centers

Texas has advanced regional economic growth to assist with the commercialization of new technologies through the **Emerging Technology Fund**. This $200 million program is a research collaboration between public- and private-sector entities to develop new Regional Centers of Innovation and Commercialization, where ideas can be developed in university labs and eventually grow into new products marketed by new firms. The fund is used to expedite innovation and commercialization; attract, create, or expand private-sector entities that will drive a substantial increase in high-quality jobs; and increase applied-technology research capabilities in higher education institutions. Texas Emerging Technology Fund

Washington passed the **Innovation Partnership Zone** legislation that identified five zones with competitive and linked research-based companies and research institutions. The legislation created an academic "star" recruitment plan through the Economic Development Commission and the Higher Education Coordinating Board to build intellectual and research capacity in the state. It also provides competitively awarded infrastructure funds to the five zones. Additionally, Washington has updated and improved funding for its network of 36 associate development organizations, which deliver economic development services to companies. The bill directs these organizations to work with regional partners to improve regional economic planning, particularly around industry clusters.

As part of the **Governor's 2010 Research Initiative, South Dakota** has developed six research centers within the state's Regental system of higher education and workforce development

institutions. These centers are focused on commercialization of higher education research and the acquisition of federal grants and other sources of funding. Already, the four original research centers have leveraged $40 million in non-state funds in just two years. The National Science Foundation has reported that their most recent statistics show South Dakota leading the nation in the rate of growth in federal research funding.

Governor Rounds' 2010 Initiative

APPENDIX: Inventory of Existing Hawaii Reports

An array of innovation studies and strategies has been developed by state agencies, business groups and educational institutions. Each of these studies provides insights, assessments and recommendations for the state in general, and for specific sectors or geographic regions. This section summarizes, in one location, performance data and the key findings and recommendations of these previous studies. The information is categorized under four topic areas: capital formation, entrepreneurial development, R&D infrastructure, and education and workforce.

Reports evaluated for this section:

Cook, Dan. (2004). *A Turning Point in Capital Formation: Assessing Hawaii's Strategic Options.*

Department of Taxation, State of Hawaii. (October 2007). *Report on the Operations of Qualified High Technology Businesses From 2002 Through 2006.*

Department of Business, Economic Development & Tourism, State of Hawaii. (January 2000). *A New Millenium Growth Strategy for Hawaii's Economy*.

Department of Business, Economic Development & Tourism, State of Hawaii. (2001). *Science & Technology: The Key to Hawaii's Economic Future*.

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Educational Workforce Working Group. (2007). *Report to the 2008 Legislature: Findings and Recommendations of the Educational Workforce Working Group.*

Hawaii EPSCoR: Catalyst for Enculturation of STEM Disciplines, Maurice Kaya, CTO, Hawaii DBEDT, presentation at 20th National EPSCoR Conference, Waikoloa, Hawaii, November 7, 2007.

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Hawaii Life Sciences Council. (July 2005). *Hawaii's Life Sciences Road Map: Competitive Opportunities in the Global Economy*.

Office of the Vice President for Academic Planning & Policy. (May 2008). *University of Hawaii System Strategic Outcomes and Performance Measures, 2008–2015*

The Center for Regional Economic Competitiveness. (October 2008). *Innovation and Technology in Hawaii : An Economic and Workforce Profile* Honolulu: The Hawaii Science & Technology Institute.

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Capital Formation

Lack of venture capital funding is one of the most oft-cited criticisms of the innovation and entrepreneurial environment in Hawaii. This dissatisfaction felt by business people and other stakeholders is also backed up by data that indicates a lower than average performance for many capital measures.

New companies built around science and technology offer the prospect of diversifying Hawaii's economy, yet without sufficient capital to finance such development, this potential will not be fully realized. There is a widespread perception that private venture capital to fund the start-up of high-tech companies in Hawaii is difficult to attract, especially compared to established technological centers elsewhere in the country. Moreover, national trends note a growing concentration of venture capital in fewer regions, and the movement to later stage funding is resulting in larger gaps for governments, angel groups and individual investors to fill.

Capital Formation Data

The following information was provided by the Hawaii High Technology Council and the Department of Business, Economic Development and Tourism as part of their recent research on the state's innovation economy:

	Hawaii	US	Performance compared to US	Latest trend
Innovation Research Grants (SBIR) per $1,000 GDP (2004)	$.29	$.17	+	Improving
Previous performance				
2000	$.12	$.11	-	
2001	$.08	$.12	-	
2002	$.08	$.14	-	
2003	$.09	$.16	-	

	Hawaii	US	Performance compared to US	Latest trend
Tech Transfer grants (STTR) per $1,000 GDP (2004)	$.24	$.18	+	Improving
Previous performance				
2000	$.02	$.07	-	
2001	$.02	$.06	-	
2002	$.14	$.09	+	
2003	$.17	$.09	+	

Venture capital is often used as a performance metric for capital formation. However, the highly concentrated nature of venture funding in just a few states significantly skews the use of a national average as a barometer for success. Instead, it may be more beneficial for Hawaii to examine the practices of states with a high ratio of venture funding per capita. In this case, states like Utah, New Hampshire, Minnesota, and North Carolina provide good models. These states and other western states still outperform Hawaii.

	Hawaii	AZ	OR	UT	NH
Venture Capital investments per capita 2007	$4.13	$31.67	$80.45	$68.96	$124.19
2006	$25.40	$42.59	$41.40	$72.67	$61.33
2005	$12.37	$21.84	$37.02	$82.28	$82.99

Source: SSTI & PricewaterhouseCooper's Moneytree

Other Capital Metrics:

The 2008 Milkin Institute Study ranked Hawaii 27th among states in terms of risk capital and entrepreneurial infrastructure - posting the largest increase of all states jumping from a ranking of 43rd in 2004.

The 2007 New Economy Index from the Kauffman Foundation and ITIF ranked Hawaii 32nd in terms of venture capital.

Findings from Previous Reports

Previous reports conducted from 2001 to 2008 shared many findings related to capital formation. The following information highlights key reports and findings from those documents.

Hawaii reports with information and/or recommendations for capital formation:

Innovation & Technology in Hawaii: An Economic and Workforce Profile, Hawaii Science & Technology Institute, October 2008

Innovation Indicators: Hawaii Innovation Initiative, Department of Business, Economic Development & Tourism, September 2008

Hawaii Life Science Innovation Road Map, Hawaii Life Sciences Council, July 2005

A Turning Point in Capital Formation, by Dan Cook for Enterprise Honolulu, 2003

Science & Technology: The Key to Hawaii's Future, Department of Business, Economic Development & Tourism, Millennium Edition, 2001

Key Challenges

Data and previous reports indicate three specific challenges facing Hawaii's capital formation:

- Lack of translational research or pre-seed funding that translates the growing R&D capacity of universities and research institutions into concepts with commercial potential. *"Getting more deals into the pipeline"*

- Lack of stage-specific Angel and VC funding that provides a continuation from smaller rounds of capital to later, larger rounds that are typically a combination of local and mainland VC funds. This includes a lack of entrepreneurial experience in developing business plans and pitches for equity funding. *"Improving the quality of deals"*

- Lack of growth capital for product/market expansion causing companies to relocate outside of Hawaii when they reach a certain size. *"Increasing the impact and success of deals"*

	Capital Formation
Key findings cited in existing reports	There is no strategy to create a full pipeline of capital, from early-to-late-stage funding. Capital formation is more than just venture capital: grants, loans and angel investment is required, especially since only a handful of companies seeking venture capital funding actually receive VC level funding. Others must rely on alternative means of funding. Start-up capital investments in Hawaii appear to be small compared to investments nationally. However, with state help, very small firms in Hawaii are doing a better job of securing capital in the SBIR and STTR grant programs. There is a perception that investors from Hawaii don't invest in Hawaii companies. Hawaii venture capital (VC) is at a crossroads. The local VC sector is highly underdeveloped and entrepreneurs in-state face severe gaps in growth financing. Hawaii's venture community is young and has not reached the scale nor developed the track record to sustain itself. At this early stage in Hawaii VC, the public sector has the potential to catalyze capital formation and mobilize private sector involvement. National competition for second and third tier VC markets is intense and state governments have been creative about leveraging scarce resources and capital to generate early track records in emerging VC markets. Importantly for any multi-sector initiatives, the private sector should be engaged from the outset and should drive eventual investment decisions that are managed best by professionals rather than government officials. Hawaii's VC market is constrained by small VC funds limited to series A investments and lacks series B and later stages of financing. Evidence of this is underscored by the extremely low number of VC funded companies in Hawaii that raise more than $10m. Local context is critical in developing VC models for Hawaii: not everything is a Silicon Valley, Route 128, or Research Triangle Park model. Hawaii has a unique set of assets and challenges that must be considered as the state addresses capital formation issues. Capital is only part of the picture: Entrepreneurial clusters succeed due to many factors, including links between research and industry, high profile local success stories, and a connected social network of innovation that recognizes and endorses entrepreneurial initiative. While capital formation represents a critical component of entrepreneurial development, economic development stakeholders (public and private) will need to supplement financing programs with initiatives to build entrepreneur and technical capacity and support infrastructure for Hawaii-based entrepreneurs. It is not clear that leaders fully understand the breadth, depth and complexity of challenges facing the tech community in Hawaii. We are in a race for global competition as much as a race to solve local problems. There is a chicken and egg scenario: will more capital attract technology and talent or does technology and talent attract more capital? The debate over Act 221/215 has split the tech community and disrupted progress on the larger competitiveness discussion.

Key Opportunities	Hawaii has steadily increased its R&D funding. Now is the time to take advantage of this R&D capacity and translate research into commercial application. We need to focus capital solutions on industries that offer us the greatest promise (alternative energy, tropical biotech, creative arts, etc.) Enhance efforts to tap into the R&D and strategic spending for military and homeland security efforts in Hawaii. Take advantage of our geographic placement between Asia and North America continents and our ethnically diverse population. Capitalize on a large wealth base of high net worth individuals, and a formidable knowledge base of industry leaders and over 100 VCs with part or full-time residence in the state. In 2003, there were an estimated 24,000 individuals with assets between $600,000 and $10,000,000.
Previous Recommendations	Create a statewide and multi-institutional funding strategy to identify and attract federal, state, private sector, industry, international and philanthropic resources to invest in the life sciences. Increase the number of deals entering the pipeline by increasing investment in pre-seed and seed stages of funding: • Focus on increasing the commercialization of research from universities • Better connect local angel investors to each other and to promising start-up businesses • Increase linkages between established Hawaii VC funds (PacificCap, Allegis, KVH and HEAVEN) and mainland VCs and Angels • Enhance and promote the use of local institutional investors (banks and insurance companies) that have programs to provide capital to start-up ventures Upon sizing the market, Hawaii will need to adapt its early stage, private equity model to a local context, refine its development support, and establish early successes, while realizing that failures along the way are part of the process and are inevitable. Hawaii can increase local VC if they are competitive with second tier regions (instead of trying to compete with first tier regions). Hawaii technology companies are smaller than the US average; we need to increase later stage growth capital (series B and C) so companies can reach their next stage of competitiveness.
Existing Programs/ Incentives	**Act 221/215** is a 100% tax credit against Hawaii state taxes, for equity investments in Qualified High Tech Companies (QHTC). Investors claim this credit front-loaded over five years. There are other benefits including a 20% refundable tax credit for research and development (as defined by the Federal Internal Revenue Code), no Hawaii income tax on royalty income paid on the licensing of intellectual property, and more. **Hawaii SBIR Matching Grant and Assistance Program**: Provides up to $25,000 to match the federal Phase I award and helps companies become more competitive for Phase II awards. **Hawaii Strategic Development Corporation**: HSDC has committed $16 million to ten limited partnerships, which provide equity and/or debt financing to companies ranging from seed stage to later stage in their business development. It has also formed a diversified venture capital Fund of Funds.

Entrepreneurial Development

Previous studies and surveys indicate that Hawaii has a small, limited capacity of entrepreneurs experienced in technology or high growth companies. These studies also note an array of business and technical assistance for entrepreneurs, however, there is little focused coordination among groups and few high profile events that promote the desired level of entrepreneurial culture.

Entrepreneurial Data

While Hawaii is a state of small businesses, its tech-based or high growth business entrepreneurs appear to be more limited. The following chart compares Hawaii with four other western and smaller states highlighting the entrepreneur metrics from the widely used 2007 State New Economy Index.

	Hawaii	AZ	OR	UT	NH
"Gazelle" Jobs: Jobs in companies with a 20% or higher growth rate for four consecutive years	4.0% (47th)	6.5% (27th)	6.2% (30th)	8.2% (17th)	6.2% (28th)
Job Churning: Number of new start-ups and business failures, combined as a share of total firms	25.6% (20th)	26.7% (15th)	27% (12th)	36.7% (3rd)	24.5% (25th)
Entrepreneurial Activity: The adjusted number of entrepreneurs starting new businesses as a share of adult population	.26% (31st)	.25% (35th)	.34% (15th)	.31% (17th)	.25% (37th)
Inventor Patents: Number of independent inventor patents per 1,000 people	.051 (43rd)	.095 (14th)	.057 (39th)	.123 (2nd)	.119 (3rd)

Findings from Previous Reports

Previous reports conducted from 2001 to 2008 shared many findings related to entrepreneurial development. The following information highlights key reports and findings from those documents.

Hawaii reports with information and/or recommendations for entrepreneurial development:

Innovation & Technology in Hawaii: An Economic and Workforce Profile, Hawaii Science & Technology Institute, October 2008

Innovation Indicators: Hawaii Innovation Initiative, Department of Business, Economic Development & Tourism, September 2008

Hawaii Life Science Innovation Road Map, Hawaii Life Sciences Council, July 2005

A New Economy in Hawaii: Benchmarking Hawaii's Progress in the New Economy, Hawaii Institute for Public Affairs, March 2003

Science & Technology: The Key to Hawaii's Future, Department of Business, Economic Development & Tourism, Millennium Edition, 2001

Key Challenges

Data and previous reports point to three key challenges facing Hawaii's entrepreneurial climate

- Increasing the entrepreneurial culture and fully connecting the array of existing entrepreneurial programs with a shared set of statewide goals.
- Enhancing the applied knowledge and business savvy of entrepreneurs through in-depth, hands-on technical assistance.
- Building the next generation of entrepreneurial talent.

Highlights from previous reports

	Entrepreneurial Development
Key findings cited in existing reports	Since executive talent in Hawaii is weak, most management needs to be relocated to Hawaii. There is a noted lack of top tier management and experienced entrepreneurs who can commercialize the technology and research in Hawaii, especially in life and bio sciences. Building a science and tech economy requires more than capital: technology, talent and capital must work together. Being a magnet for leading entrepreneurs, having a positive business climate, and overcoming the excessive distrust among organizations will be essential. There is no critical mass for Hawaii's investment ready entrepreneurs, and only a nascent infrastructure for supporting widespread activity. The ecosystem is incomplete and there are not enough start-ups clustered together. Presently, Hawaii's small group of world-class entrepreneurs is growing despite a lack of local resources. These local role models will need to succeed in order for Hawaii to build a sustainable foundation for high growth entrepreneurship. Hard to get small Native Hawaiian companies to want to grow.
Key Opportunities	UH Manoa and the Manoa Innovation Center are assets for helping build entrepreneurial and executive talent. Expanding this model would be beneficial in growing more technology based entrepreneurs. Geography (psychologically): Successful entrepreneurs from Hawaii have removed geography from the equation in pursuing partnerships, funding, etc. We can learn from this and apply this thought and business process on a more widespread basis. Entrepreneurial clusters succeed due to many factors: Technology, talent and capital, including links between research and industry, and a connected social network of innovation that recognizes and endorses entrepreneurial initiative. While capital formation represents a critical component of entrepreneurial development, economic development stakeholders (public and private) will need to supplement financing programs with initiatives to build entrepreneurial and technical capacity and support infrastructure for Hawaii-based entrepreneurs.

Previous Recommendations	Take additional steps to simplify the process of business startup for entrepreneurs including the integration of government processes for business registration, taxation, employment and specific industry requirements. Establish a stronger and more formalized network of entrepreneurial assistance, rather than having our small existing organizations duplicating efforts. Establish rigorous entrepreneurial type education (boot camps) taught by serial entrepreneurs and investors that provide budding entrepreneurs hands-on education about starting and growing a science or technology enterprise. Develop a means to enhance the connection between investment-ready entrepreneurs and angel and venture capital funding sources.
Examples of Entrepreneurial Programs in Hawaii **(not a complete list)**	HiBEAM helps to launch and build promising early stage Hawaii technology, biotechnology and life sciences companies by providing expert professional advice and access to funding sources. The Hawaii Science & Technology Council supports the acceleration of Hawaii's science and technology economy through the provision of services to industry including networking, advocacy, sector research and development. Hawaii Center for Entrepreneurship offers a training program geared toward helping develop better businesses. FastTrac Technology Program by HTDC offering hands-on business development workshops for entrepreneurs. Hawaii Venture Capital Association: A variety of events including the Technology Entrepreneur of the Year. ThinkTechHawaii is a group of local business people committed, as volunteer directors, to tracking the development of the tech industry in Hawaii and promoting public awareness of the importance of that industry to the diversification of Hawaii's economy. The Pacific Business Center provides diverse management and technical assistance to entrepreneurs, companies, government agencies and not-for-profit organizations starting-up, revitalizing or expanding private sector business in the Pacific Island communities. Chaminade University’s Hogan Entrepreneurial Program gives students the unique opportunity to be mentored by some of Hawaii’s most successful business leaders. Enterprise Honolulu is a private, non-profit organization created to help existing businesses expand and become diverse, new businesses to grow and succeed, and to create quality jobs on the Island of Oahu.

R&D Infrastructure

The primary goal of a strong R&D infrastructure is to have the ability to innovate not once, but over and over again. Research indicates that R&D infrastructure typically requires:

- People who have experienced taking research ideas to market,
- A streamlined technology transfer system that allows effective collaboration between businesses and research institutions,
- Leading edge research facilities and
- An ongoing environment that rewards reinvestment in research.

As noted in the recently released Innovation and Technology In Hawaii, there is an array of research centers focused on key sectors with opportunities for growth. Targeted large scale investments can push these centers to global leadership positions. Hawaii's university system has a relatively strong R&D capacity. Hawaii's total university R&D expenditure is competitive with other states, however commercial outcomes of this research still underperforms. Therefore, accelerating the transfer of technology between education and the private sector will serve to greatly benefit both parties. Finally, industry R&D in Hawaii is well below the national average and those of comparative states. There needs to be a focused public-private effort to increase industry R&D in order to build both short and long-term capacity to compete.

R&D Data

	Hawaii	US
R&D spending in public sector: $ per $1000 GDP (2004)	$7.14	$7.06
R&D spending in private sector: $ per $1000 GDP (2004)	$2.61	$17.26
Patents issued per 1,000 workers (2007)	0.13	0.61

Hawaii's only research university has steadily increased the amount of R&D expenditures over the years. In 2006, the university total of R&D was similar to many other recognized universities. While research expenditures appear to be competitive, commercial outcomes of the university R&D appear to lagging. The following chart compares the University with an array of other institutions with similar research expenditures.

	Univ. Of Hawaii	CO State Univ.	NC State Univ.	OR State Univ.	Rutgers (NJ)	Univ. of South FL	Univ. of Utah
Tech Transfer Office FTE	5	3	4	4	7	3	10
R&D Research Expenditures $M	$237	$267	$207	$189	$264	$265	$246
Licenses & Options Executed	11	15	65	42	35	21	61
Cumulative Active Licenses	8	44	533	175	288	81	165
Start-up Companies	4	5	5	1	0	6	17
Invention Disclosure	64	42	208	49	132	109	180
Patents Issued	1	8	41	9	41	29	20
Patent Application	37	31	128	22	120	88	92
License Income $1,000	$900	$1,100	n/a	$1,880	$5,100	$1,700	$16,300

National Data on Industry R&D

While federal funding to industry was primarily concentrated in a handful of industry sectors, industry R&D was much more distributed among industries. In addition, the sectors that received federal dollars were rarely those with large amounts of company investment, pointing to strategies that are more focused on matching sector strengths to funding sources.

- Not only is federal funding a small portion of overall industry R&D, 80% of federal funding went to just 3 industries: *Navigational, measuring, and control instruments, aerospace, and scientific R&D services*. Pharmaceutical, computers/semiconductors, and IT/telecommunications received less than 3% of federal funds given to industries for R&D.[11]
- By comparison, 80% of company funded R&D came from a wide range of industries including *manufacturing (wood products, furniture, food processing, primary metals, etc.), pharmaceuticals, semiconductor and electronic products, motor vehicles, aerospace, software, architectural and engineering services, and scientific R&D services*.

Unlike venture capital, industry R&D is much more distributed among states, and top performers include smaller states. Of the top states for industry R&D in the *2007 State New Economy Index*, Delaware was ranked #1, Rhode Island #2, Minnesota #8, Oregon #10, and Idaho #12. By comparison, Hawaii ranked #45 in the index.

Perhaps one reason smaller states can be competitive in industry R&D is the fact that small companies performing R&D spend more per employee than their larger counterparts. For a state like Hawaii where companies tend to be small, capitalizing on this dynamic would be beneficial.

R&D Performance for companies performing industrial R&D, 2006 national data

Company Size (employees)	Company R&D ($ m)	Domestic Employment (1,000)	R&D per employee
5-24	$ 6,087	243	$ 25,049
25-49	$ 6,485	241	$ 26,909
50-99	$ 8,360	482	$ 17,344
100-249	$ 12,101	689	$ 17,563
250-499	$ 7,944	665	$ 11,946
500-999	$ 12,482	1087	$ 11,483
1,000-4,999	$ 36,019	2393	$ 15,052
5,000-9,999	$ 19,776	1393	$ 14,197
10,000-24,999	$ 35,049	2270	$ 15,440
25,000+	$ 78,082	6835	$ 11,424

Findings from Previous Reports

Previous reports conducted from 2001 to 2008 shared many findings related to R&D infrastructure. The following information highlights key reports and findings from those documents.

[11] IBID

Hawaii reports with information and/or recommendations for R&D infrastructure:

Innovation & Technology in Hawaii: An Economic and Workforce Profile, Hawaii Science & Technology Institute, October 2008

Innovation Indicators: Hawaii Innovation Initiative, Department of Business, Economic Development & Tourism, September 2008

Hawaii Life Science Innovation Road Map, Hawaii Life Sciences Council, July 2005

A New Economy in Hawaii: Benchmarking Hawaii's Progress in the New Economy, Hawaii Institute for Public Affairs, March 2003

Science & Technology: The Key to Hawaii's Future, Department of Business, Economic Development & Tourism, Millennium Edition, 2001

Key Challenges

Summaries of existing studies suggest that the challenges facing Hawaii with regard to R&D infrastructure fall into three main categories:

- Increasing the higher education R&D infrastructure for commercialization and technology transfer, including research centers connected to industry clusters and the ability to more readily transfer technology from universities.
- Connecting academic R&D with business opportunities - increasing the means for tech transfer between industry and education.
- Increasing industry R&D – including the overall amount performed and the number of businesses performing R&D.

Key findings cited in existing reports	Existing facilities and infrastructure need significant investment. There are no set priorities for future tech parks or innovation centers. Research and development effort has risen to the national level in the public sector but trails far behind in the private sector. On the technical side, Hawaii hosts a solid group of research institutions in areas from energy and astronomy to life sciences and oceanography, with over 2,550 doctoral scientists and 310 doctoral engineers. Hawaii's pillars of technically-oriented research excellence and advanced research facilities include Pacific-wide tropical agriculture, aquaculture, marine sciences and ocean engineering, alternative energy, information technology, medical research, astronomical research, geology and geophysics, and remote sensing. Its universities and federally-funded East-West Center are highly regarded institutions in these disciplines, as well as in the social sciences, arts, and linguistics, thus forming the basis for a "globally-informed" center of knowledge. The IT and computing resources in the state are strong: Supercomputer on Maui, and an excess of dark fiber. Hawaii posted a remarkable rise on the Milkin 2008 *State Technology and Science Index*, climbing 11 spots to rank 28th overall. The state has focused on attracting small businesses, especially targeting clean energy and life sciences. While part of the strategy is geared toward cultivating strong science education at the pre-college level, the state has also established $5 million in R&D funding for small businesses, in particular science and engineering fields, to

	commercialize defense related dual-use technology. Recent legislation also seeks to put Hawaii on the map as a leader in bioenergy and other energy-efficient technologies. Our significant presence of military and defense installations can be a great test bed for commercial applications and a large market for successful products. There needs to be better hub development that makes it easy for others to learn what opportunities are available for partnering in Hawaii. It is very hard to get involved if a partner is outside of Hawaii and looking to find opportunity. There is no real "infrastructure" in Hawaii that is holistic in regard to trying to address gaps or create opportunity, and no funding to create it. UH technology transfer and encouragement for start-ups seems to lag behind other parts of the country (system appears indifferent vs. focused). An effort to bring in "stars" of science research, if successful, would help to bring in even more researchers, and gradually grow a fine science research infrastructure. Professional resources, such as intellectual property attorneys, are limited.
Key Opportunities	Hawaii's opportunity for research is vast because of location (east-west contact), and unique assets for earth and space science. Within the technology sector, there has been relative growth in research and development activity over the last five years, paralleling similar increases at the national level. Creative industry employment is a bright spot in the innovation sector, with a proportion of total jobs well above the national level. See *Innovation & Technology in Hawaii, October 2008* Report to the Hawaii Science & Technology Institute for industry sector specific opportunities.
Previous Recommendations	Enhance ties and forge partnerships between the University of Hawaii and local business communities that can seed collaborative research and development programs while enhancing technology transfer and commercialization. Important for Hawaii is the transition from research and discovery to creation of intellectual property that leads to the manufacturing of new products and services. Work as a partner with high-tech firms and researchers to better understand and address their challenges. Hawaii's high-tech sector is growing in experience, building important relationships and becoming increasingly organized. Our research facilities and the people that work in them are becoming increasingly renowned. These are assets for government to learn from, encourage and nurture.
Existing Resources	**'Imiloa Astronomy Education Center** (http://www.imiloahawaii.org/) **Biomedical Research Infrastructure Network (BRIN)** (http://www.brin.hawaii.edu) **Cancer Research Center of Hawaii (CRCH)** (http://www.crch.org) **Collaborative Software Development Laboratory (CSDL)** (http://csdl.ics.hawaii.edu) **East-West Center** (http://www.eastwestcenter.org) **Hawaii Institute of Geophysics and Planetology (HIGP)**

	(http://www.higp.hawaii.edu/) **Hawaii Institute of Marine Biology (HIMB)** (http://www.hawaii.edu/HIMB/) **Hawaii Natural Energy Institute (HNEI)** (http://www.hnei.hawaii.edu) **Hawaii Space Grant Consortium** (http://www.spacegrant.hawaii.edu/) **Hawaii Undersea Research Laboratory HURL)** (http://www.soest.hawaii.edu/HURL/hurl.html) **Infrasound Laboratory of the University of Hawaii (ISLA)** (http://www.isla.hawaii.edu/) **International Pacific Research Center (IPRC)** (http://iprc.soest.hawaii.edu) **Marine Bioproducts Engineering Center (MarBEC)** (http://cmmed.hawaii.edu/) **Maui High Performance Computing Center (MHPCC)** (http://www.mhpcc.edu) **Pacific Biomedical Research Center (PBRC)** (http://www.pbrc.hawaii.edu) **UNIVERSITY R&D RESOURCES** **Office of Technology Transfer and Economic Development (OTTED)** http://www.otted.hawaii.edu **Research Corporation of the University of Hawaii (RCUH)** (http://www.rcuh.com) **University Connections** (http://www.hawaii.edu/connections) **OTHER RESEARCH CENTERS & RELATED NONPROFIT ORGANIZATIONS** **Pacific International Center for High Technology Research (PICHTR)** (http://www.pichtr.org) **Oceanic Institute (OI)** (http://www.oceanicinstitute.org/) **Hawaii Open Source Education Foundation (HOSEF)**(http://www.hosef.org) **Hawaii Life Sciences Council (HLSC)** (http://www.hawaiilifesciences.org) **Foundation for a Renewable Energy Economy in the Pacific (FREE Pac)** (http://www.freepac.net/) **HAWAII TECHNOLOGY PARKS** **Hawaii Innovation Center at Hilo (HICH)** (http://www.htdc.org/hich) **Kapolei Business Park** (http://www.kapolei.com) **Manoa Innovation Center (MIC)** (http://www.htdc.org/mic) **Maui Research & Technology Center (MRTC)** (http://www.mrtc.org) **Mililani Technogy Park** (http://www.mililanitechpark.com) **Natural Energy Laboratory of Hawaii Authority (NELHA)** (http://www.nelha.org) **University Science and Technology Park** **West Kauai Technology and Visitor Center** (http://www.kedb.com/techcenter/)

Education & Workforce

Over the past decade, Hawaii has established multiple workforce and education programs to address the skills and jobs needed for the 21st century. Recent efforts by K-12, community colleges, universities, and workforce development boards and councils will help build a foundation for growing a stronger, more competitive science and technology workforce. Highlights of these efforts include:

- Increasing the basic skills and workforce readiness of all students,
- Increasing science technology, engineering and math (STEM) skills of students and providing them with more exposure to STEM careers,
- Enhancing the alignment between career pathways taught in schools and the state's business and industry,
- Recruiting more STEM teachers and increasing STEM teacher skills,
- Improving articulation between high school and post-secondary education (including running start),
- Providing business internships and mentoring to students,
- Increasing opportunities and affordability of dislocated and incumbent worker training,
- Targeting workforce assistance and training to under-represented groups, and
- Enhancing outreach and response to business workforce needs.

Workforce Development Council accomplishments for 2007 included: a tool for employers willing to hire individuals from populations currently under-represented in the workforce; a planning guide which assists career decision-makers, adults and youth; revised and published the *2007 Hawaii Directory of Workforce Development Programs*, which provides information on most federal, state and locally funded programs for workforce development in the state; assisted work and college-bound students with career assessments and planning; and facilitated the Education-Workforce Working Group as it examined questions related to incorporating work-relevance into Hawaii's public education system.

Education & Workforce Data

Education performance: The 2008 *Innovation Indicators* by the Department of Business, Economic Development & Tourism provide valuable insight into the education and workforce performance of Hawaii's students and workers. Highlights of this data include:

- From 1992 to 2000 the percentage of Hawaii high school graduates going directly to college was above US average; since 2000, **high school graduates are less likely to go directly to college**.
- In the past 10 years, the gap for SAT scores of college-bound seniors has widened with **Hawaii student SAT scores less than US average**.
- Compared to the US average, just over **42% of Hawaii high school students receive a Bachelor's degree within six years of graduating (compared to approximately 50% nationally**). However, Hawaii high school students are **more likely than other US students to receive their Associates degree**.
- **Hawaii's adult workforce is more educated than the US average**. Approximately 30% of the state's population 25 years and older have a Bachelor's degree or higher; this is above the US estimate of 27%.

- Accounting for Associate degrees and above, the educational attainment of Hawaii's population 25 years and older is 39% compared to just under 35% for the US.

Higher Education Measures

Examining data from the National Science Foundation, Hawaii's higher education institutions are outperforming US counterparts with the percent of S&E undergraduate degrees as a share of all degrees conferred. Yet at a graduate level, the percent of S&E degrees conferred drops to below the US average.

Although Hawaii's public institutions are more affordable than the US average, Hawaii is far less likely to provide their undergraduates with state-supported student aid.

Counter to the population in general, workers 25-44 years old have educational attainment less than the national average. (If the population 45 and older is included, Hawaii's educational attainment is higher than the US average.)

Measure	Year	HI	US
Bachelor's Degrees Conferred per 1,000 Individuals 18–24 Years Old	2005	41.5	48.4
Bachelor's Degrees in Natural Sciences and Engineering Conferred per 1,000 Individuals 18–24 Years Old	2005	5.9	7.9
S&E Degrees as Share of Higher Education Degrees Conferred *(%)*	2005	33.4	29.9
S&E Graduate Students per 1,000 Individuals 25–34 Years Old	2005	10.8	11.7
Advanced S&E Degrees as Share of S&E Degrees Conferred *(%)*	2005	22.9	24.2
Average Undergraduate Charge at Public 4-Year Institutions as a Share of Disposable Personal Income *(%)*	2006	28.4	38.2
State Expenditures on Student Aid per Full-Time Undergraduate Student *($)*	2006	12	802
Associate's Degree Holders or Higher Among Individuals 25–44 Years Old *(%)*	2005	36.5	37.4
Bachelor's Degree Holders or Higher Among Individuals 25–44 Years Old *(%)*	2005	26.7	29.0
Bachelor's Degree Holders Potentially in the Workforce *(%)*	2005	32.6	31.7

Source: National Science Foundation

Science & Engineering Workforce

Hawaii's research focus on life and physical sciences is clearly illustrated in the distribution of science and engineering (S&E) occupations. While in general, Hawaii has fewer workers in S&E jobs, the state has a higher than average concentration in life sciences. Like all innovation plans, the goal is not just increasing the raw number of graduates, but connecting those graduates to the state's industry base to minimize the brain drain.

	S&E occupations (employment)		Workforce in S&E occupations (%)	
	2004	2006	2004	2006
United States	5,065,330	5,383,860	3.64	3.72
Hawaii	16,360	18,940	2.74	3.01
	Engineers (employment)		Engineers in workforce (%)	
	2004	2006	2004	2006
United States	1,480,520	1,535,620	1.06	1.06
Hawaii	4,560	5,380	0.76	0.86
	Life and physical scientists (employment)		Life and physical scientists in workforce (%)	
	2004	2006	2004	2006
United States	546,160	577,890	0.39	0.40

Hawaii	2,400	3,390	0.40	0.54
	Computer specialists (employment)		Computer specialists in workforce (%)	
State	2004	2006	2004	2006
United States	2,806,910	2,960,460	2.02	2.05
Hawaii	7,440	8,140	1.25	1.30

Source: National Science Foundation

Highlights from Previous Reports

Previous reports conducted from 2001 to 2008 shared many findings related to workforce and education. The following information highlights key reports and findings from those documents.

Key Hawaii innovation reports related to education and workforce:

Innovation & Technology in Hawaii: An Economic and Workforce Profile, Hawaii Science & Technology Institute, October 2008

Innovation Indicators: Hawaii Innovation Initiative, Department of Business, Economic Development & Tourism, September 2008

Hawaii Life Science Innovation Road Map, Hawaii Life Sciences Council, July 2005

A New Economy in Hawaii: Benchmarking Hawaii's Progress in the New Economy, Hawaii Institute for Public Affairs, March 2003

Science & Technology: The Key to Hawaii's Future, Department of Business, Economic Development & Tourism, Millennium Edition, 2001

Key Challenges

While Hawaii efforts for building a science and technology workforce included many initiatives, reports and data still identify some remaining challenges:

Supporting Existing STEM Efforts: Hawaii has recently funded STEM related academies, recruitment and attraction of STEM teachers, STEM teacher training and business internships. While these programs contribute to the state's workforce gap, *their levels of funding are modest*.

Building Excellence in Higher Education: In 2007, several innovation workforce efforts were not passed. They included endowed chairs/eminent scholars for STEM disciplines, and efforts to streamline commercialization and enhanced partnerships between universities and businesses.

Incumbent Worker Training: With the pipeline of student graduates at rates up to 50% below projections, such gaps will need to be filled by existing workers or risk tech-based businesses moving out of Hawaii as they grow. Therefore, *efforts to retrain and retool the skills of incumbent or existing workers are essential*.

Key findings cited in existing reports	Hawaii's technology workers earn less than their counterparts on the mainland, 77% of the US average for the same industries. Hawaii's workers across the

	whole economy earn about 94% of the US average for all workers. Projections by the Department of Labor and Industrial Relations ("DLIR") indicate that more than 24,000 openings will occur annually in Hawaii's economy between 2004 and 2014 due to growth and replacement of workers. At the same time, only 12,000 to 14,000 young people will enter the workforce each year over that period. Even assuming all of them enter the workforce, which is unlikely, they will only fill about half of the expected openings. Following a national trend, there will be a continued shortage in healthcare occupations (particularly in nursing), education and engineering. Hawaii trails the nation in getting high school graduates into college and keeping them there long enough to get their degrees or certificates. In workforce development, Hawaii is behind in turning out graduates in science and math. Hawaii is doing a little better than the nation in getting working adults back into post secondary training, but the rate is less than 7 percent. Hawaii is behind in attracting skilled workers from abroad, and there is no measure at this time reflecting efforts to attract skilled, former residents back to Hawaii. Hawaii is also behind the nation in the proportion of STEM occupations and the pay levels for those jobs. There are indications that these gaps are narrowing. There is a groundswell of support and teamwork among the Legislature, the administration, the university and business communities in support of education and workforce efforts. Labor productivity has slipped from well above national levels to about the national average in 2006. The proportion of workers earning over $50,000 (inflation adjusted) in the state has declined recently from above the national level to about matching that level. This is possibly the result of inflation increasing faster than wages.
Key Opportunities	In 2006 and 2007, the Hawaii State Legislature appropriated $10 million to the county Workforce Investment Boards ("WIBs") and WDC for eligible "Reed Act" initiatives. The funds are available through June 30, 2009. The "Reed Act" is a provision of the Social Security Act that provides for the distribution of federal unemployment tax funds to state unemployment insurance and employment service programs in the event the federal government collects excess unemployment tax revenues. Established in 1996, Hawaii's **E-School** operates as a supplemental virtual school accessed via the Internet and instructional television to provide additional coursework to any student, any place, at any time. DBEDT is providing supplemental funding to help formulate and implement innovative human resources development programs to expand and diversify Hawaii's technologically-skilled workforce. These efforts are being facilitated through a coordinated effort involving the University of Hawaii and Community College System, the State Department of Education, the State Department of Business, Economic Development & Tourism (DBEDT), the State Legislature, and Hawaii's local business community.
Previous Recommendations	Enhance ties and forge partnerships between the University of Hawaii and local business communities that can seed collaborative research and development programs while enhancing technology transfer and commercialization.

	Expand and diversify workforce development activities statewide, with an emphasis on education and training programs for K-12 and college students, as well as incumbent workers, in technical skills that are currently or are projected to be in high demand within Hawaii's business and research communities. The state, the university and Kamehameha Schools have forged the path with Kakaako's biotech hub. Take steps to expand links between university programs in the natural sciences and engineering with business administration programs and private industry. Replicate the Engineering Clinic Program in mathematics, natural science, agricultural sciences, and other fields. Establish an Endowed Chair matching fund to increase expertise in STEM fields of study and establish a public-private university research commercialization partnership to increase the commercialization outcomes of university research.