WASHINGTON HIGHER EDUCATION COORDINATING BOARD

November 2007

Innovation Opportunity Analysis and Innovation Research Team Draft State Implementation Plan

Background

This document was developed by the Higher Education Coordinating Board (HECB) for the Washington Economic Development Commission to serve two primary purposes:

- Provide an assessment of our state's current research assets with regard to technology commercialization, and the potential of our state's research institutions to provide research-dependent industry clusters with technology support and assistance; and

- Develop a plan for the implementation of Innovation Research Teams in accordance with SHB 1091.

Under SHB 1091, the HECB is responsible for the implementation of Innovation Research Teams in conjunction with the publicly funded research institutions, with policy direction from the Washington Economic Development Commission. The program has received an initial start-up appropriation of $2.37 million for Fiscal Year 2008-09.

The document was developed by HECB staff with support and assistance from the University of Washington and Washington State University Offices of Research and Technology Transfer. The Washington Economic Development Commission has been briefed on the process for the plan's development, and they are expecting to receive the document and discuss it at their next meeting on Friday, December 14.

Following the report is a draft resolution for the Board's consideration that endorses the plan's major findings and recommendations and transmits the document to the Economic Development Commission.

WASHINGTON HIGHER EDUCATION COORDINATING BOARD

Innovation Research Teams:
Innovation Opportunity Analysis and Draft State Implementation Plan

Prepared by the Higher Education Coordinating Board for the Washington Economic Development Commission

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Executive Summary

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Innovation Opportunity Analysis

The University of Washington (UW) and Washington State University (WSU) provide nearly all of Washington's research capacity at higher education institutions. They receive about one-third of all the federal research funding Washington receives. The remainder goes directly to federal agencies, federally-funded research and development centers (Pacific Northwest National Laboratory), non-profit organizations, and industry. Washington industry expends about nine times what the universities expend on research and development, mostly on applied research. Most of the state's basic research is conducted at the UW and WSU.

The table below identifies the universitys' areas of research preeminence that support commercialization opportunities in Washington State:

Areas of Research Preeminence at Washington Research Universities that Intersect Commercialization Opportunities

University of Washington	Washington State University
Biotechnology, Genomics, and Biomedical Applications	Molecular Plant Science and Genetics
Advanced Materials and Nanotechnology	Chromosome Biology and The Science of Reproduction
Clean Technologies	Advanced Materials
Global Health	Clean Energy Technologies
Information Technology (E-Science)	Global Infectious Diseases at the Human-Animal Interface
Sensor and Sensor Networks	The Brain, Behavior, and Performance

These areas overlap considerably and can be combined into five broad categories of research activity—clean technology and advanced materials, global health, human health and medicine, molecular plant science and genetics, and e-science.

Washington State University has successfully commercialized technology in several areas of science, including agriculture, energy, viticulture, hydrology, wood products and genomics. The University of Washington has commercialized technologies for kidney dialysis, diagnostic ultrasound, vaccines against Hepatitis B and liver cancer, "super trout", salmon preservation, and Medic One emergency services. They have also had great success in numerous technologies of major consequence in the fields of biotechnology, genomics, and biomedical applications, information technology, telecommunications, clean technology and sensors.

Both institutions have developed gap-funding programs to enhance the commercial potential of promising early-stage discoveries in the laboratory, and develop them to the point where private investment is possible. However, both institutions are unable to fund these programs at levels adequate to meet the need.

The UW and WSU have comprehensive entrepreneurial assistance programs that support entrepreneurship on campus and in the community at large. These resources include business development coaching and mentoring as well as entrepreneurial training and education programs targeting undergraduates, fellowships, and small business development centers. The University of Washington and Washington State University have research, technology commercialization, and entrepreneurial capabilities that enable them to provide support to research-dependent industry clusters throughout the state of Washington.

Innovation Research Team Implementation Plan

In order to achieve the goals for Innovation Research Teams (IRT) identified in SHB 1091, this initiative must be aimed at attracting researchers who transform their disciplines, while at the same time, are committed to commercialization, entrepreneurship, and economic development. Entrepreneurial faculty of this caliber are highly sought after, and to be competitive, comprehensive recruitment packages are required. Our two major research institutions can rarely afford high-impact hires of this type, and often when they attempt to recruit such faculty, they are not able to compete with other universities that can offer funds of the type envisioned in the IRT program. The Georgia Research Alliance provides public research institutions with $27 million per year in research team, infrastructure (laboratories and equipment) and technology commercialization assistance. The Utah USTAR program provides $19 million. While Washington's current $1.2 million per year initial investment is a great start, it is not sufficient to achieve the IRT program's ambitious goals (recruitment of a minimum of 10 "star" researchers in 10 years) nor comparable to investment levels in competing states.

Each institution proposes to expend IRT funds differently, so that the program can fill the unique funding gaps the institutions face when putting recruitment packages together, and maximize the leveraging of institutional and private resources. WSU plans to use IRT funds to create an endowment to support each recruitment (for team personnel and research expenses), use funds for infrastructure investment to fill out the recruitment package, gap funding, and matching resources for grant-funded equipment. At the UW, the most limited resources available for recruiting leading researchers involve facilities improvements (laboratory renovations), major instrumentation, gap funding, and discretionary research funding. The two institutions have determined that they can successfully recruit 16 new entrepreneurial

researchers over the next 10 years if the program funding is increased to an annual rate of $26 million per year by 2016, a pace of hiring that is commensurate with economic demand and the need to expand the state's research capacity across the commercialization areas identified above. [1] This amount would be comparable to the current (FY 2006) level of funding for the Georgia Research Alliance program. If one takes the time value of the funding into account, $26 million in 2016 is close to the current value of the Utah USTAR program funding level ($19 million in FY2006).

Program Administration and Oversight

The IRT program will be implemented by the Higher Education Coordinating Board (HECB) in conjunction with the publicly funded research institutions. The HECB will take a lead role in planning coordination and the distribution of program funds. It will be necessary to develop a Memorandum of Agreement between the HECB and the Washington Economic Development Commission that details the role and responsibilities of the HECB in fiscal and program oversight, and authorizes the transfer of funds to the HECB for distribution to the research institutions.

An annual planning process will be implemented each spring by the HECB with the goal of transmitting to the institutions new policy goals, industry needs, and economic development opportunities and incorporating that information into an annual program and expenditure plan. This annual plan will also describe how the previous year's funds were expended, program results achieved, program activities to be implemented in the coming fiscal year, institution-level budgets, and performance targets.

[1] Institutional budget requests for the IRT program would go through the standard operating budget review process. This will give the Higher Education Coordinating Board an opportunity to review and comment on future-year IRT program budget requests.

Innovation Research Teams:
Innovation Opportunity Analysis and Draft State Implementation Plan

The Higher Education Coordinating Board is pleased to provide the Washington Economic Development Commission with this draft plan for the development and implementation of Innovation Research Teams. This document also includes an opportunity analysis that describes our state's current research assets and industry partnerships, which form the base on which the Innovation Research Teams are to be built. The document provides specific suggestions for mechanisms to support, enhance, and develop the Innovation Research Teams, and activities that will provide the research teams with needed assistance and support as we seek to commercialize research results produced by research teams and other members of our state's research faculty. Finally, the document recommends the planning and management processes and procedures that will ensure that public resources are properly targeted, that private investment is leveraged, and that accountability is assured for financial integrity and program outcomes.

Legislative and Institutional Context

Substitute House Bill 1091 was signed into law in July 2007. The bill has two sections—the first establishes the process for identifying and designating industry cluster-based Innovation Partnership Zones, and the second creates a new state initiative to support Innovation Research Teams and develop a comprehensive entrepreneurial assistance program at research institutions.

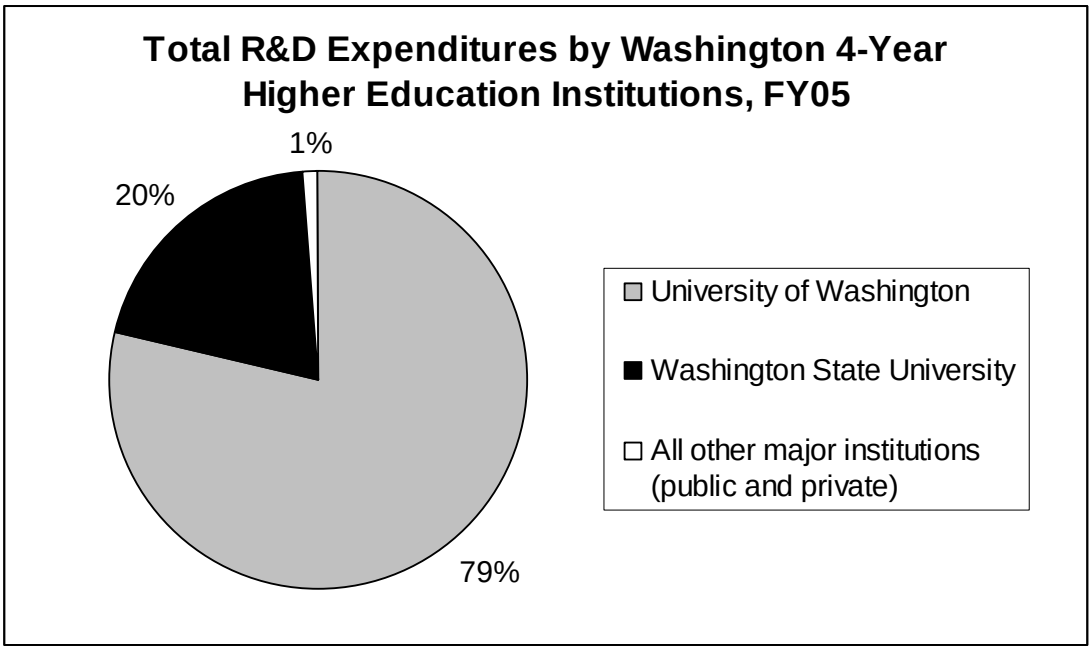
The Washington Economic Development Commission is tasked, under the legislation, with conducting an innovation opportunity analysis identifying the strongest current research assets and teams in the state that are focused on emerging technologies and their commercialization. The Commission is also charged with identifying opportunities to enhance commercialization of research results with additional assistance and resources. Based on this analysis, the Commission, in conjunction with the Higher Education Coordinating Board and research institutions, is responsible for developing an implementation plan for support and development of Innovation Research Teams and commercialization generally, through entrepreneurial assistance. The legislation further states that the HECB is responsible for implementing the final plan developed by the Commission, along with the state's publicly-funded research institutions. The HECB, in consultation with the University of Washington, Washington State University, and other organizations, has developed this document to assist the Commission in completing these tasks.

SHB 1091 also establishes a process for the director of the Washington Department of Community, Trade and Economic Development to designate research-dependent, cluster-based Innovation Partnership Zones. Present within these zones must be research capacity and commercially valuable research, globally competitive firms in a research-based industry, and training capacity. As of the writing of this document, 11 such zones have been designated across the state, and it is anticipated that

more will be designated in the future. The legislation also calls on the Washington Economic Development Commission and the Workforce Training and Education Coordinating Board to establish a working group to develop a methodology for using labor market information and other data to identify strategic clusters important to the state. Unfortunately, that process is still underway and this document has been prepared without the benefit of that analysis. Instead, in the preparation of this document, we have looked to the Innovation Partnership Zone designation process as our primary means for identifying key research-based industry clusters in the state.

Washington has two public universities defined in state statute as research universities—the University of Washington and Washington State University. Together, these two institutions and their seven campuses expended $1.25 billion in research funding in fiscal year2006, accounting for nearly all of the state's R&D expenditures at college and universities. Through their technology transfer offices, last year they completed 225 license agreements to transfer inventions, software, plant varieties and other innovations made in their research programs to outside organizations and firms. This represents a 91 percent increase from just two years earlier. The University of Washington is a leader among its peer public research institutions in both receipt of federal research funding and execution of technology license agreements. Nevertheless, compared to other leading technology states, our total research base is small. According to U.S. Census data compiled by the National Science Foundation, Washington ranked fourth among all states in 2002 in the percentage of total state employment in high technology industries.[2]

Figure 1



[2] National Science Foundation, Division of Science Resources Statistics, *Science and Engineering Indicators, 2006*, Arlington, Virginia (NSB 06-01) [February 2006].

Source: National Science Foundation/Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2005.

Yet, in spite of this collective success, in 2005, our state ranked 18th in total federal research and development (R&D) expenditures per capita, and 30th in total R&D expenditures per $1,000 of gross state product (below the national average).[3]

Our state's technology transfer activities operate within a federal structure that enables public research institutions to engage in public-private technology partnerships. Efforts to transfer research from universities to commercial ventures received a strong boost from the federal government in 1980, when Congress passed the Bayh-Dole Act. This landmark legislation fundamentally changed the federal government's patent and trademark policies by enabling inventors, or their employers, to retain patent rights in inventions developed as part of federally funded research grants. This change promoted licensing and the leveraging of contributions by the private sector toward applied research, and facilitated the transfer of technology from the laboratory bench to the marketplace. It is fair to say that this law also raised the expectations for research universities and changed the standards by which they are measured.

> "The past fifty years have clearly established the major research university as the principal provider of basic research in the U.S. Many may not realize that in the 1950s, only one-third of all basic research discoveries came from U.S. universities. Today that proportion has doubled to two-thirds of all basic research and discovery. This high proportion – mostly funded by the government – comes with the expectations of results. The modern university must continue to find new paths to the marketplace."
>
> Elson S. Floyd, President, WSU

The fertile ground for technology transfer is faculty expertise and research. Only a small portion of research results have commercialization potential, and a much smaller proportion have the potential to spawn new products or services. The main benefit of technology transfer is to accelerate the product cycle by making it easier for industry to find the incremental improvement in their product quality or production process that will lead to the next iteration, the next version, or the next model of their product or service. Technology transfer is more likely to benefit existing firms' competitive position and market share than it is to lead to substantial increases in firm births or employment.

[3] From National Science Foundation and U.S. Census data, as compiled by the National Center for Higher Education Management Systems, see http://www.higheredinfo.org/.

Part 1: Innovation Opportunity Analysis

The UW and WSU have demonstrated research expertise and commercialization strength in several areas that are vital to the state's current and future economy. WSU has sought to define its strengths both in fundamental and applied research, including its historic role serving as the research enterprise for our state's largest employer, agriculture. WSU has a balanced portfolio of research funding, with approximately equal amounts of federal funds derived from the NIH, NSF, Department of Defense, Department of Agriculture, and Department of Energy. This fundamental and applied research have resulted in innumerable discoveries that have advanced the economy and the well-being of Washington's citizens.

The UW is a larger institution with corresponding successes. About half of its research funding is in the life sciences/biomedical sciences area, about 10 percent in engineering, computer sciences, and materials science/chemistry not involving life sciences, and the remainder is spread broadly across the many areas of research at the university -- with a significant amount in environmental sciences. The breadth and depth of this research base has led to great commercialization success in a number of fields. In fiscal year 2007, 501 researchers from 64 departments disclosed a total of 335 innovations to UW TechTransfer, and 198 agreements were completed. One hundred sixty-six U.S. patent applications were filed in this same time period, and 11 companies were started from innovations made at the UW. Ten companies were started in 2006. In fiscal year 2007, UW innovators earned $6.2 million from their successful technologies, and the university as a whole recouped about $36 million. On average, about half of the licenses, patent applications, and start-up companies fall into the category of Biotechnology, Genomics, and Biomedical Applications.

Research Strengths and Technology Commercialization Success

The table below summarizes the academic fields where our two public research institutions exhibit national and international strength in areas of interest for commercialization. These fields are the areas that should be the focus of our commercialization efforts and strategies to support industry clusters.

Table 1: *Areas of Research Preeminence at Washington Research Universities that Intersect Commercialization Opportunities*

University of Washington	Washington State University
Biotechnology, Genomics, and Biomedical Applications	Molecular Plant Science and Genetics
Advanced Materials and Nanotechnology	Chromosome Biology and The Science of Reproduction
Clean Technologies	Advanced Materials
Global Health	Clean Energy Technologies
Information Technology	Global Infectious Diseases at the Human-Animal Interface
Sensor and Sensor Networks	The Brain, Behavior, and Performance

From this strong research base come opportunities for commercialization of research products across a wide range of industries, products, and services. The list below provides a general sense of the richness of Washington's research and technology capacity.

WSU Areas of Research Preeminence

As noted above, over the past year, the WSU Provost's Office has undertaken an exercise to clearly identify our most successful, preeminent research programs. These distinctive, multidisciplinary fields build on strong foundations of excellence and have the capacity for transformative economic and societal impact while raising the university's reputation at international and national levels. While not focused exclusively on these areas, over the next several years WSU will strategically invest in these areas of preeminence, maximizing our impact on the state and nation while growing our research reputation. Those areas are:

Advanced Materials: Advanced materials research examines and develops the properties of those materials the world relies on to build systems that support and advance our society, including transportation, defense, and energy systems. Specifically, this cadre of researchers examines the composition and properties of materials subjected to high temperatures and pressures, the interface between polymers and natural fibers, and materials for energy transformations. Their research improves existing materials and creates those with even greater strength, durability and flexibility, and that are less toxic to the environment. This work affects national security and energy and environmental policies and practices, and creates new economic opportunities in the state.

Chromosome Biology and the Science of Reproduction: Research into the molecular basis of reproduction seeks to prevent and eliminate suffering from reproductive problems and disabling diseases such as birth defects, cancer, mental illness, and diabetes. WSU has a strategic niche in research related to mammalian reproduction in molecular signaling and chromosome biology. From understanding the impact of toxins over generations to advancing early diagnostics of genetic defects, these researchers are breaking new ground in understanding what affects and threatens the health of this and future generations. Results of their work influence health care and environmental practices and policies worldwide.

Clean Energy Technologies: Clean energy research develops and deploys innovative technologies to address pressing global energy and environmental issues. WSU researchers are advancing alternatives to fossil fuels by developing technologies for methods such as hydrogen storage and bio-based fuels. They also lead technology developments aimed at securing the nation's electrical power grid, and in radiochemistry and atmospheric transport research that seeks to minimize the environmental impact of energy production and consumption. Related social and behavioral science research informs the selection of technologies and strategies for their sustainable application and positive societal benefit.

Global Infectious Diseases at the Human-Animal Interface: Since more than 70 percent of all infectious diseases are zoonotic in origin, controlling infectious diseases that move within animal populations and from animals to humans is fundamental to safeguarding and improving human health worldwide. WSU is an international leader in this area, from facilitating the development of vaccines for diseases

transmitted between animals, to providing prevention, surveillance, and detection of emerging diseases moving across animals – and potentially to humans—worldwide. The work of these faculty and students will make the difference between poverty and progress in developing countries and will improve the health of Washington's citizens.

Molecular Plant Science and Genetics: The understanding and development of plant sciences for the advancement of humankind continues as one of the greatest scientific opportunities of our world. As one of the largest and most distinguished multidisciplinary programs in the country, molecular plant science at WSU focuses on fundamental research in molecular biology, physiology, and biochemistry that has applications in forestry and agricultural biotechnology. From the development of new pharmaceuticals to fight cancer to applications of biotechnology tools to improve agricultural commodities of importance to the state, nation and world, plant science research has enormous promise for improving the quality of life of people in all circumstances worldwide.

The Brain, Behavior, and Performance: The functions and complexities of the brain are among the most fascinating and least understood areas of human health. WSU is leading targeted research in this area, advancing our understanding of how the brain produces complex behaviors such as sleeping, eating, emotion, motivation, and memory; and how disturbances in the brain's intricate organization contribute to poor performance in the workplace and society. Research in this area concentrates on three interrelated and interacting foci: sleep and performance, emotion and well-being, and motivation and reward. Better understanding will improve disease therapies and diagnostics, improve substance abuse treatment, and help manage performance and risk in the work place, the military, and other arenas that are affected by sleep restriction.

UW Areas of Research Preeminence

The UW has a broad base of research preeminence across many disciplines and areas of the university. The UW has among its faculty awards six Nobel prizes, five National Medal of Science winners, 11 MacArthur "genius" fellows, and over 200 members of the three National Academies. Broad areas of research preeminence that intersect with commercialization opportunities are listed in Table 1. Among these, eight specific areas of excellence have been chosen as being especially timely in terms of emerging opportunities that span the basic research/commercialization spectrum: nanophotonics, molecular medicine, e-science, molecular engineering, alternative energy, environmental monitoring/sensors, global health, and biomedical devices/robotics. As described for the WSU areas of research preeminence, these eight have the capacity for transformative economic and societal impact. These areas of research preeminence are multidisciplinary and build on existing research strengths, and are all areas in which the university has committed to invest resources. Each is poised to make a major impact on the state's economy.

Nanophotonics: The development and application of optically-active materials at the nanoscale (nanophotonics) is an emerging area of importance within the Advanced Materials and Nanotechnology umbrella. Applications range from ultrafast and ultraminiaturized sensors and communication devices, to flexible computer screens and "smart" window shades. The UW is a national center for research in photonic materials, with an NSF Science and Technology Center in this area, a new Institute for

Advanced Materials funded by NSF and DARPA, and a successful start-up company based on UW technology (Lumera). Moving this area of research into devices at the nanoscale will position the UW as the undisputed leader in this technology-rich research and commercialization effort. In part due to the strengths in this research area at the UW, a business community interested in photonics and nanophotonics is beginning to emerge in the Puget Sound area.

Molecular Medicine: The interface between bioengineering, imaging, and clinical medicine is the area of molecular medicine. Molecular medicine has profound applications in life sciences for diagnostics, monitoring, and treatment for a variety of disorders. This highly interdisciplinary effort involves molecular design of biologically-compatible compounds that have optical and material characteristics conducive to live imaging, and development of methods to use these compounds for diagnostic and treatment applications. Examples are "magic bullet" compounds that target cancer cells and destroy them upon activation. The UW is a national leader in imaging and bioengineering, and the marriage of these strengths with clinical applications in association with biotechnology companies will create a robust and exciting cluster of academic and economic excellence.

E-Science: Nationally and internationally, we are at the dawn of a revolutionary new era of "e-science", involving acquisition of extraordinarily vast datasets, mining of those datasets, and visualization of them for extraction of breakthroughs in a variety of fields. The data can come from simulation models, but now and more importantly it is coming from new generations of sensors – sensors on the sea floor, in buildings and roadways, in forests, in telescopes, in gene sequencers, and in living organisms—and someday, in our cars and homes to monitor our health. The volume of data is overwhelming, and the challenge is to capture, mine, visualize, and interpret these data in order to extract knowledge. This "computational knowledge extraction" lies at the heart of 21st Century discovery, and e-science will transform the process of discovery in all fields of science and engineering. In order to take advantage of this transformational and emerging area, recruitment of an entrepreneurial star researcher who works across the computer science/basic science boundary is a key element. E-science is a foundational area, affecting commercialization in all major areas of strength for the UW (information technology, life sciences, aerospace, and clean technology). Not only does the UW expect start-up companies to spin out to develop and market software in the e-science area, breakthroughs based on e-science approaches will spin out new technology, products, and companies as well.

Molecular Engineering: Molecular Engineering is an emerging interdisciplinary field that seeks to accelerate and optimize the discovery, design, and synthesis of functional molecules that will serve as a foundation for a vital and sustainable economy. Molecular Engineering has many of the same attributes as the emerging field of bioengineering in 1967, when the UW launched a bioengineering initiative that grew into the current high-impact interdisciplinary department. Important components of this initiative involve biomolecules, self-assembled nanomaterials, and molecular recognition sensors, which have the potential to affect fields from both basic chemical and biological research to health care applications, aerospace materials, and clean technology. The UW is already a leader in Molecular Engineering as a result of disciplinary research carried out by faculty in the College of Arts and Sciences, College of Engineering, and the School of Medicine, as well as interdisciplinary research carried out in several federally-funded centers.

Alternative Energy: Approaches to generating environmentally friendly, renewable energy sources are central to solving a variety of economic and environmental issues for the United States. The UW has a number of programs in this area, involving biofuels from forestry biomass, fuels from microorganisms, fuel cells, and catalysts for solar energy. The strength of these programs was recently recognized in the awarding of an NSF IGERT grant to the UW in alternative energy. We expect these areas to grow in importance in the commercial sector in the Puget Sound region under the umbrella of clean technologies and of the aerospace sector.

Environmental Monitoring/Sensors: We are at the dawn of a revolution in environmental science, based on the emergence of a plethora of sensors; multi-function, highly miniaturized, networked, and embedded in platforms as diverse as the ocean observatory on the floor of the Juan de Fuca plate (Project Neptune) to sensors imbedded in cars that sample atmospheric conditions. These capabilities will forever change environmental science and environmental monitoring, and have a direct impact on the health of the Puget Sound. The UW has a great deal of strength in this area, as a result of collaborative groups that span the environmental science/device engineering/nanotechnology boundaries. Some of the work in nanophotonics and e-science will be relevant in this area. The applications of this area are very broad, encompassing life sciences, aerospace, clean technology -- all areas in which environmental sensing will become a mainstay of the future.

Global Health: The importance of the health of the world's population has gained broad recognition after recent global social, political and environmental crises. Furthermore, the HIV/AIDS and SARS epidemics also have emphasized the worldwide impact of disease. Public and private funding, through visionary foundations (*e.g.,* the Bill and Melinda Gates Foundation, the Wellcome Trust, *etc*.) have made unprecedented contributions to these important efforts, but the challenge is still growing.

At the UW, the Department of Global Health is working to generate new approaches to improving the world's health by integrating faculty with diverse backgrounds, expertise and perspectives from a variety of fields. This program builds on existing UW strength and brings together educational and service programs for creating or improving public health systems in various developing countries; programs that are advancing our knowledge of global pathogens and nutritional disorders, and a variety of social science, economics, law, and business programs focused on Global Health problems. The department recently recruited Chris Murray from Harvard, an internationally renowned expert in health metrics who was recently awarded a $105 million grant from the Bill and Melinda Gates Foundation. With the strengths of the UW and other research institutions and the presence of the Gates Foundation, Seattle is poised to become the global health center of the world. In addition, we expect the global health area to begin to generate products, both in pharmaceuticals and in programs for addressing health disparities.

Biomedical Devices/Robotics. The broad field of biomedical devices coupled to robotics has the potential to transform health care for the disabled. Imbedded monitoring devices in the home and car, prosthetics that function like natural limbs, robotic surgery for highly delicate operations, inexpensive and painless diagnostic tests in the clinic—all are emerging possibilities with strong commercial potential in the life sciences area. The UW already has strength in these areas across a number of departments, with significant commercialization success.

Washington State University Technology Licenses

Below is a listing of some of the major research innovations that have been licensed to outside organizations and companies in the past few years by Washington State University.

Agriculture: New wheat varieties that enable Washington's farmers to be among the most productive in the nation. Such advances are built on solid foundations, such as those that led to semidwarf wheat that brought tens of millions of dollars in profits per year to Washington's farmers, while serving as the foundation for the Green Revolution. Plant sciences remains one of WSU's strongest research programs.

Energy: Electric power research that led to one of WSU's most successful spin-off companies, Schweitzer Engineering Laboratories (SEL). Based in Pullman, SEL introduced the world's first digital relay in 1984, revolutionizing the power protection industry by offering fault locating and other features for a fraction of the cost of earlier systems. Today SEL employs more than 1,000 individuals.

Viticulture: WSU's Dr. Walter Clore is widely considered to be the *Father of Washington Wine.* Starting in the 1960s, Dr. Clore conducted trials of grape varieties in Prosser and tested more than 250 American, European and hybrid varietals. Dr. Clore's meticulous research was instrumental in assuring Washington farmers that they could grow vinifera grapes and produce fine wine. Today, Washington's wine industry annually generates $2.4 billion and employs more than 11,000 people.

Hydrology: Decagon Devices was founded in 1983 by Dr. Gaylon Campbell, a WSU soil scientist. Decagon is the world leader in the measurement of water activity in foods and pharmaceuticals. Further, a hybrid of Decagon's biophysical research instrument was sent to Mars in August 2007 as part of NASA's Phoenix Scout Mission. Decagon employs more than 40 people in Pullman.

Wood Products: Growing from WSU's Wood Materials Engineering Laboratory, Pullman-based Metriguard has become the wood products industry leader in the design and manufacture of machine stress rating (MSR) equipment. This equipment is used worldwide by sawmills, wood products companies, and research facilities. Based in Pullman, Metriguard employs more than 30people.

Genomics: Soon after moving to WSU Spokane from Baylor University, WSU faculty members Lisa Shaffer and Bassem Bejjani started Signature Genomics, a state-of-the-art, array-based comparative genomic hybridization diagnostic laboratory. Growing rapidly, Signature Genomics currently employs nearly 30 scientists, MDs, and technicians in Spokane.

University of Washington Technology Licenses

The University of Washington has a long history of commercialization successes with a major impact on the state. A few examples are:

Kidney Dialysis: UW medicine professor Belding Scribner invented a Teflon shunt that could be implanted in patients with kidney failure. Scribner's shunt made the long-term use of kidney dialysis machines possible. His discoveries have improved and extended the lives of millions of patients, and are used in kidney dialysis machines worldwide.

Diagnostic Ultrasound: Doppler ultrasound is based on the research of electrical engineer Donald Baker and UW professor Robert Rushmer. ATL Ultrasound partnered with the UW to turn this emerging technology into a non-invasive diagnostic procedure that is one of the most the effective diagnostic tools in the world today. The UW's Center for Industrial and Medical Ultrasound continues to be a world center for this field of research.

Vaccine against Hepatitis B and Liver Cancer: The National Cancer Institute cites the Hepatitis B vaccine as the world's first anti-cancer vaccine. UW botanist and genome scientist Ben Hall invented a revolutionary technique for producing proteins that is now used to manufacture a safe and affordable Hepatitis B vaccine and many other biotechnology products. Over one billion doses of the vaccine have been administered since its introduction in 1992, and the World Health Organization estimates that each year the vaccine averts at least 600,000 Hepatitis B-related deaths. Hall's vaccine was the world's first genetically engineered vaccine against a human disease, and because liver cancer is one of the potential consequences of Hepatitis B infection, the National Cancer Institute cites the Hepatitis B vaccine as the world's first anti-cancer vaccine.

Medic One Emergency Services: UW cardiologists created Medic One, a Seattle-based program that trains paramedics to provide emergency care outside the hospital. Medic One's innovations resulted in dramatically improved outcomes for heart attack patients, and the program has become a model for emergency care services throughout the world.

Super Trout: Using selective breeding and nutrition programs, UW fisheries scientist Lauren Donaldson developed a "super trout" that matured twice as fast, weighed 10 pounds and produced many more eggs than normal fish. He also created a completely artificial salmon run and spawning ground at the UW on Portage Bay- the first salmon hatchery in an urban setting.

Saving Salmon Runs: Why have Alaskan salmon runs stayed strong, while other fisheries have crashed? One crucial factor is the 60-year collaboration between UW fishery scientists and Alaska fishermen, one of the world's most successful examples of sustainable resource management. When the Bristol Bay salmon run began declining in the 1940s, Alaskan fishermen asked UW scientists to look for the reasons why and create strategies for reversing the downward trend. After intense study of the run's environmental requirements and population structure, the researchers worked with fishermen to create guidelines for maintaining habitat and avoiding over-fishing. Their partnership continues today, and is one of the key reasons that the Bristol Bay salmon runs are now at some of the highest levels in recorded history.

The UW continues to move innovations into the commercial sector. Below are some examples of current and future commercialization opportunities, grouped by category.

Biotechnology, Genomics, and Biomedical Applications

- MacArthur Fellow Yoky Matsuoka's work as director of the Neurobotics Laboratory focuses on the creation of robots to help people with disabilities and spinal injuries. Yoky's most recent invention is a robotic hand, with lifelike movements that provide the hope of normal movement.

The laboratory's current list of collaborators includes rehabilitation hospitals, sports and orthopedic medicine, and the military.

- The Institute for Surgical and Interventional Simulation (ISIS) has changed the way surgical training is conducted. ISIS provides surgical educational opportunities with the use of simulation techniques for surgeons at all levels to practice new techniques or improve on current techniques. ISIS has a stellar list of industrial and academic partners tha include: Stryker Endoscopy, Medical Education Technologies, Syneture, Simulab, and Premera Blue Cross. Their academic partners at the University of Washington include the Biorobotics Lab in the Department of Electrical Engineering and the Human Interface Technology Lab.
- Phil Green's work in gene sequencing and his DNA sequencing tools are used throughout industry and academia and "represent the most important technical advance in DNA sequencing of the 1990s." Three software products are the outcome of this research: Phred, Phrap and Consed-Autofinish.
- The "Vocal Joystick" is an exciting application currently being worked on in Professor Bilmes' research group in Electrical Engineering. This tool will enable people to use their voices to control objects on a computer screen. Future applications with this system would be the ability to manipulate instrumentation to assist with improving quality of life issues for people with disabilities.
- Another area in which significant progress has been made is high-intensity focused ultrasound or "bloodless surgery" as a replacement for standard surgical practices. Doctors could pass a sensor over the areas of injury with beams that are thousands of times more powerful than those currently used in imaging, which would heal wounds and increase recuperation time.
- A new imaging technology for use in protein crystallography is poised to transform the process of identifying protein crystals. Werner Kaminsky, UW associate professor of chemistry, developed a software algorithm for fast image processing. UW TechTransfer licensed the technology to Emerald BioSystems, Inc., a Bainbridge Island company that provides tools to the protein crystallography marketplace.
- Internationally recognized UW scientists John Harlan and Robert Winn discovered a protein that may lead to a drug treatment for one of the most challenging problems in medicine: preventing damage to tissues when blood flow that was blocked is restored to the body, as can happen in heart attacks or stroke. A major component of the damage is caused by an inflammatory response by the body. Harlan, professor of Hematology, and Winn, professor of Surgery and Physiology Biophysics, discovered that a certain family of proteins was uniquely effective in preventing tissue damage. The researchers' next goal was to found a start-up to further research and test the protein as a potential drug candidate. With the help of UW TechTransfer, the new company, Seredigm, became part of Accelerator, a large Seattle-based business development incubator. A drug that could prevent or greatly reduce the inflammatory response would improve the lives of millions of patients with cardiac diseases, stroke, and other inflammatory conditions.
- UW TechTransfer recently licensed technology for predicting patient response to warfarin, an anticoagulant drug commonly prescribed for patients at risk for stroke or heart attack caused by blood clots. Patient response to warfarin varies widely. Traditionally, this has meant that finding the correct dose was a challenge that could sometimes take months of frequent monitoring and readjusting. Serious side effects, such as excessive bleeding, can occur if too much of the drug is administered, while too little can be insufficient to prevent blood clots from forming.
- An important project for human health is now moving forward, to develop a Scanning Fiber Endoscope. This will advance minimally invasive medical imaging by using ultra-thin flexible

endoscopes that allow access to more regions of the body than previous technology. The clinical potential of this system is vast, since it will enable low-cost, minimally-invasive approaches to monitoring and treatment not previously available.

Information Technology

- A team of computer science researchers are tackling the problems of internet security by developing tools to prevent Spyware threats. Computer Science Professor and Department Chair Hank Levy and team have also designed a new Web browser architecture called Tahoma that protects users from harmful Web content.
- Yoshi Kohno, an assistant professor in the Department of Computer Science and Engineering, was recognized as one of Technology Review Magazine's top innovators under the age of 35. Kohno research is in the area of computer security. He invented the concept of systems-oriented provable security that would provide security in multiple applications – such as voting machines, Web browsers, etc.
- The mission of the UW's Network Security Lab (NSL) is to conduct basic and applied research in the security of critical networks and network components. Contributions are in the areas of wireless network infrastructure, Internet security, and commercial/industrial applications.

Advanced Materials and Nanotechnology

- The recently unveiled Boeing 787 Dreamliner's plastic body is in part the result of contributions of UW research collaborations. The Department of Mechanical Engineering is conducing research in the area of composite materials as well as nanotechnology applications. Zelda Zabinsky and Mark Tuttle have developed a design algorithm for composite structures called COSTADE that was used in the design of the 787 fuselage.
- A team of researchers in Materials Science and Engineering and in Chemistry have developed materials and methods for the manufacture of bright white OLED light for commercial use. UW TechTransfer recently licensed the technology to a Washington-based start-up formed to commercialize the OLED technology. Advanced Electroluminescent Systems (AES) plans to develop lighting materials to compete with traditional incandescent and fluorescent bulbs.

Telecommunications

- In telecommunications, signal propagation and switching speeds are becoming limiting factors, and bandwidth expansion is desperately needed. Devices fabricated from photonics materials can be used for the basic applications of electrical-to-optical signal transduction (conversion), optical switching at nodes of an optical network, and optical beam steering. The first two applications can be thought of as providing the on-ramps and interchanges of the information superhighway. Researchers at the UW working in photonics have achieved significant progress in reaching the goal of using light for this type of signaling in telecommunications.
- One of Technology Review Magazine's top innovators under the age of 35 is Tapan Parikh whose research won him the honor of TR's Humanitarian of the Year. Parikh research focuses on the use of mobile phones to "support sustainable economic development" in developing countries. He has founded a company called Ekgaon Technologies tailored for small business in developing countries to help them expand and manage their operations in areas where other types of communication resources are not viable.

- Physware, Inc., a new start-up company, develops high-speed field solutions for signal and power issues in high-frequency package and board-level electrical modeling and design for the microelectronics industry.

Clean Technology

- Advances are being made in fuel cells, through a team of researchers located in Chemical Engineering, Materials Science and Engineering, and Chemistry. Basic areas of research include electrochemical surface science and the issues of electrochemical fuel cells and water transport in fuel cells.
- Teams of UW researchers including David Ginger, an assistant professor of chemistry who this year won both a Dreyfuss Teacher-Scholar Award and a Sloan Research Fellowship award, are working on novel approaches to develop portable and more efficient solar cells.
- Minoru Taya, UW professor of mechanical engineering, heads a project to design energy harvesting and storage systems for future aircraft. The goal is to help develop technology to create an airplane covered in a skin of flexible solar cells, which would help power the craft while the sun is shining. Researchers will also delve into ways to efficiently store power for dark or cloudy conditions.
- In 2006, UW TechTransfer licensed a unique technology for mapping air pollution to Arcadis, an international environmental remediation and engineering firm. The patented technology, referred to as Radial Plume Mapping, accurately maps a wide range of air pollutants from landfills, chemical plants, refineries, and many other emission sources.
- The Department of Energy estimates that over $50 billion in electricity is wasted annually in the United States because of the inefficiency of traditional lighting. The OLED-lighting based systems described above represent an exciting alternative to traditional lighting. These devices could be the first step to highly efficient, environmentally friendly lighting for home and commercial use.
- The UW's StarLab led by Professor Yinhai Wang focuses on research in the area of advanced traffic detection technologies and their applications for safer and more effective traffic operations, saving energy and reducing pollution.

Sensors

- Babak Parviz, recent recipient of the distinction of Technology Review Magazine's top innovators under the age of 35, is recognized for his research at the interface between biology and electrical engineering. His research in the area of self-assembly and sensor development has led to the development of tools that are able to study biology at the single-cell level such as flexible plastic circuits, nano-scale electronics and low-cost biological sensors for detecting diseases such as HIV.
- Professor Paul Yager's research focuses on the industries and technology needs that arise from the decentralization of medical care such as developing microfabrication based technology for us in biomedical diagnostics. Distributed Diagnosis and Home Healthcare (D2H2) research focuses on instrumentation for measurement, computing, data processing, and healthcare informatics.
- An acoustic technology developed at the UW is soon to be a critical component of a system for tracking and monitoring ship cargo containers and securing them against terrorist threat and loss through pilferage, theft and spoilage. The ultrasound-based technology was developed in the laboratory of Les Atlas, UW professor of electrical engineering and internationally regarded expert in the development and use of acoustic signal processing technologies. Atlas is partnering

with local company Erudite Inc. to incorporate the low-cost security technology into the company's system for tracking and monitoring the security and integrity of ship cargo containers.

- Professor Wei-Chih Wang has developed new optical techniques for use in a viscosity sensor. This work allows for a further reduction in size from previous prototypes. Applications of this sensor include whole blood viscosity measurement, environmental monitoring, food and paper processing, and imbedded sensors for ink monitoring.

WSU Industry Partnerships and Technology Transfer Improvements

WSU recognizes that the top research universities in the nation—those having the most profound impact on the greater world and lead the international research agenda—invest in the strength and talents of innovative and creative faculty, programs, and facilities in areas where they have the potential to make the greatest difference. As a result, over the past year, the WSU Provost's Office has undertaken an exercise to clearly identify its strongest and most prestigious research programs. These distinctive, multidisciplinary fields build on strong foundations of excellence and have the capacity for transformative economic and societal impact while raising the university's reputation at international and national levels. These programs have significant synergy with existing and anticipated Innovation Partnership Zones.

Figure 2 WSU Statewide

WSU is also home to the state's research and extension system, a mission of the land-grant universities nationwide. Through its four-campus system, nine research and extension centers, 11 learning centers, 27 small business development centers, and 39 local extension offices in partnership with county government, WSU has faculty in every county in the state. The number and location of these sites is shown in Figure 2. These faculty link the university to the people of the state, ensuring that research is responsive to societal and industrial needs and that the latest research results are translated and effectively transferred to affect the lives of Washington's citizens. In addition, such a network helps ensure WSU's relevancy in actively seeking feedback and advice statewide.

Four years ago, WSU began a significant effort to revitalize its technology transfer organization, building a new culture of entrepreneurial achievement at Washington State University. At that time, the WSU technology transfer organization had a very poor reputation both within the university and with corporations that sought to work with the institution. As a result, few inventions were disclosed and even fewer were effectively transferred to industry.

Early in his tenure, WSU Provost Robert Bates directed that the technology transfer organization be revitalized. As a result, WSU proactively took steps to reinvigorate the board of the WSU Research Foundation (WSURF), conducted strategic planning, recruited and effectively engaged new, high profile board members, and hired a new executive director, Keith Jones. Dr. Jones has extensive experience in technology transfer and working with commercial enterprises. WSU also adjusted the technology transfer budget, and negotiated a new, more equitable contract between the university and WSURF. With significant support from the WSU provost, WSU doubled the number of staff in the Office of Intellectual Property Administration over the past two years. The office is now staffed with five technology licensing associates, four in Pullman and one in Spokane. These new staff members work with faculty to educate them regarding the necessity and importance, the personal benefits, and the benefits to the university of disclosing new intellectual property. They also help the faculty link their research with commercial enterprises.

While WSU was reinvigorating its technology transfer organization, it was simultaneously growing its research enterprise. Data from the Association of University Technology Managers (AUTM) indicates that the number of technologies under license from an institution are directly correlated with the institution's science and engineering research and development expenditures. Thus, it is also significant that WSU's science and engineering research and development expenditures have nearly doubled over the past five years (from $107 million in 2001 to $196.5 million in 2006).

As a result of the changes in the Office of Intellectual Property Administration and the associated WSU Research Foundation, coupled with the significant growth of research, WSU has seen dramatic increases in the number of intellectual property disclosures; the first step in the technology transfer process. It is this disclosure process that starts research findings along the path toward successful commercialization. In 2004, there were 20 intellectual property disclosures, in 2005 there were 47, and in 2006 there were 76. Moreover, the number of WSU-developed technologies that are licensed to commercial enterprises has increased by 300 percent over the past three years. Clearly, WSU faculty are encouraged by the progress and once again engaged in technology transfer activities. Yet, there is much more progress to be made. As we will outline below, given sufficient resources, WSU will further refine its structures to enable better engagement with industry.

Gap Funding

Gap funding refers to support provided at the critical and often resource-starved initial stage of the technology commercialization process that takes a promising basic or applied research product and develops it further into a technology with the potential for use by an outside organization or industry. The objective of these resources is to bridge the "gap" between traditional academic discovery-driven science and the significant funds that may be required for commercial development. Projects are of a limited duration and have a work scope designed to either develop a prototype or to answer key questions about the development of a product. Thus, the projects are designed to reduce risk and create a more favorable outcome for a prospective licensee.

The University of Washington's Technology Gap Innovation Fund

The Technology Gap Innovation Fund (TGIF) was established in 2004 to enhance the commercial potential of promising early-stage discoveries made in the research programs of the University of Washington. The expected outcomes from TGIF are the formation of new companies and increased licensing activity. The commercial outcomes of projects funded by TGIF are varied – just like the research programs of the UW and the projects that have been funded.

TGIF is a reinvestment of royalty proceeds into research and the further development of research projects with commercial potential, and it is supported by the Royalty Research Fund and by matching funds from the Washington Research Foundation. Funding is awarded on a competitive basis to projects that require additional research or prototype development to make them ready for licensing or for a company start-up. Suitable projects are typically those that are beyond the basic research stage and beyond the interest of most federal funding agencies. Proposals must demonstrate a high probability of increasing the commercial opportunities for UW innovations.

Grants of up to $50,000 are awarded to researchers for projects up to 12 months in duration. Proposals are reviewed for funding by a panel from the local business and venture community who have expertise in the evaluation and development of early-stage technologies.

At the completion of year three, there have been positive outcomes of TGIF in several areas:

Four companies have started from projects funded by TGIF.

- Advanced Electroluminescent Sciences
- Physware
- Cirrus BioSystems
- Hi-Tech Initiatives

Five projects with potential as start-ups have become LaunchPad projects (see below).

- Device for monitoring atrial fibrillation - David Linker, Internal Medicine and Cardiology
- IS4D – Rapid patient prototyping technology - Randal Ching, Mechanical Engineering
- Non-fouling paints and coatings - Shiaoyi Jiang, Chemical Engineering
- Compound to inhibit herpes virus - Ram Samudrala, Microbiology
- Protein modeling software - Valerie Daggett, Medicinal Chemistry

Three projects funded by TGIF have been licensed.

- Surgical simulator software was licensed to Medical Education Technologies
- Nanostructures for use in cancer diagnosis and treatment were licensed to Cambrios
- Tissue repair scaffolding technology was optioned to Ratner Biomedical

One unique partnership was enabled.

This past spring at Bellevue High School, Desktop Democracy was the centerpiece of an AP course under a grant provided by the George Lucas Foundation. Desktop Democracy was

developed by John Wilkerson in political science and John Gastil in communications, and has become a highly recognized educational tool. There have been more than 3,000 fee-paid licenses obtained through a Web portal – *FolioDirect*, and there have been more than 2,500 free downloads of *Election Day*.

The WSU Innovation Opportunity Fund

Similar in concept to UW's TGIF fund, the creation of the Innovation Opportunity Fund (formerly known as the Cougar Gap Fund) has helped create a new entrepreneurial culture at WSU. The Innovation Opportunity Fund is an important part of helping create a culture where researchers are eager to work toward the commercialization of their research results. Investments by the Office of Research and a generous donation from the Washington Research Foundation have enabled the Innovation Opportunity Fund to invest more than $300,000 in 12 different projects. These investments have already led to the development of additional intellectual property disclosures and new start-up companies. Twenty months after the initiation of this program, significant results have been obtained. In particular, as a result of this program:

Two companies have been founded:

- GeoMonkey
- Recondagen

Three projects which have potential to develop into a start-up were funded:

- Drug Discovery: Line Walking Recursive Partitioning for predicting inhibition of drug metabolism. Jeff Jones, Chemistry
- Agriculture: Glyphosate tolerance in non-GMO wheat. Kimberly Kidwell, Crop and Soil Science.
- Chavicol – Eugenol for bio-products. Norman Lewis, Institute for Biological Chemistry.

One project was licensed to an existing WSU start-up:

- Inhibitors of aging – induced memory dysfunction licensed to PN Biotechnology Inc.

Additional Entrepreneurial Assistance Resources

Sometimes research results have such significant commercialization potential, they may form the basis for entirely new enterprises. In the relatively few instances where this is the case, entrepreneurial assistance and small business development support is needed to take the technology to its full potential. Both the UW and WSU have established systems to provide entrepreneurial assistance to support new business start-ups arising from their research commercialization efforts.

As the information below indicates, each institution has developed a distinct approach and array of resources for the promotion of entrepreneurship on their campuses. They have also developed different mechanisms for linking these services to their research commercialization programs. Efforts to support and enhance these services will most surely need to be differentiated by institution, so that they build on existing programs and focus on the unique service gaps that exist at the two institutions.

Entrepreneurial Assistance at UW

LaunchPad

LaunchPad is a UW TechTransfer initiative that is designed to catalyze the creation of new ventures based on promising UW innovations. LaunchPad has already proven to be an effective tool to jumpstart business development. LaunchPad creates diverse teams of advisors, including UW licensing and intellectual property professionals, business community mentors, and thought leaders to provide burgeoning start-ups with guidance and networking to generate momentum for the launch of new ventures.

Specific support is provided in:

- 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

Center for Innovation and Entrepreneurship

The University of Washington Business School was one of the first in the country to begin teaching entrepreneurship courses in the mid-1970s. Professor Karl Vesper, known as the "father of entrepreneurship education," was part of a national cohort of faculty who worked to promote teaching entrepreneurship. Vesper also founded the entrepreneurship division of the Academy of Management.

The Center for Innovation and Entrepreneurship (CIE) supports leading-edge research on innovation and entrepreneurship. An interdisciplinary team of faculty, many of whom are among the elites in their fields, are drawn from across campus.

Educational opportunities offered by CIE:

- A Ph.D. in Technology Entrepreneurship for graduate students in the UW Business School.
- Certificate in Innovation & Entrepreneurship for MBAs and other graduate students beginning with a bridge elective, Foundations of Entrepreneurship (BPOL 509).
- An Undergraduate Option in Entrepreneurship for students accepted into the UW Business School. Students begin the program with Introduction to Entrepreneurship (ENTRE 370)**,** which introduces students to the skills entrepreneurs need to start their own businesses and follows with coursework in entrepreneurial marketing, finance and selling.

CIE offers a variety of opportunities for Puget Sound entrepreneurs and companies to become involved with students and programs:

- Representatives from the business community serve on CIE's Advisory Board. The board provides the community support needed to actualize programs, such as judging the Business Plan Competition, serving as mentors for student teams, and contributing financial support.
- The CIE Expert in Residence program brings entrepreneurs, venture capitalists and business executives from prominent Northwest firms to campus to work with students.
- The WRF Capital/Gates Technology Entrepreneurship Fellowship program provides an evaluation of concepts for future industry application and marketability, and integrates nationally prominent research on innovation and entrepreneurship with the business community.
- Companies throughout the Northwest sponsor CIE's annual Business Plan Competition.
- CIE routinely engages entrepreneurs and technology leaders as student mentors.
- CIE offers two fellowships in venture creation to UW graduate students:

Washington Research Foundation–Capital Gates Fellowship
This summer quarter opportunity was created to capitalize on the many scientific and technological innovations developed in the Pacific Northwest. With the support of Pacific Northwest National Laboratory, WRF Capital, UW TechTransfer, and Boeing, each year a highly select group of UW graduate students from business, engineering, law, medicine and the sciences explores the viability of transforming research into revenue-generating new ventures.

Stars Venture Creation Course
Using Battelle/Pacific Northwest National Laboratories and UW TechTransfer technologies, leading Seattle venture capitalists provide the oversight and guidance to interdisciplinary teams of graduate students assessing commercial viability.

Program in Technology Commercialization
The Program in Technology Commercialization is a four-course sequence that is offered through the Department of Bioengineering and is open to late-stage undergraduates and early-stage graduate students from all disciplines. The courses are designed to produce the best educated students, well trained not only in their disciplines, but also in commercializing technologies and how to move technologies to market. In addition to this primary objective, additional benefits of the program are to make UW technologies more accessible to investors and licensees, help faculty and students conduct their research and develop realistic expectations, and create a closer relationship between the local community of experienced practitioners and the UW and its faculty.

During the first two courses in the sequence, volunteer experts from the local community teach specific topics and give students a sense of the realities involved in each area.

BIOEN 599D: Introduction To Technology Commercialization
Topics Covered:

- What is business?
- Structure, parts/purpose of a company
- Protecting Intellectual Property
- Licensing Intellectual Property
- Contracts and Legal Issues
- Taxes and Tax Planning
- Equity Issues
- Project Management
- Opportunity Recognition
- Selling Your Business Idea
- Product Development & Product Analysis
- Costs Analysis
- Marketing, Sales and Distribution
- Pro Forma Projections
- Funding and Financing
- Regulatory Issues
- Selecting, Hiring & Building Teams
- Ethics in R&D
- Working with Professionals

BIOEN 599Y: Studies in Technology Commercialization
Topics Covered:

- Critical Market Analysis
- Product Marketing
- Sales
- IP Strategies
- Negotiations
- Strategic Planning and Management
- Business Life Cycle
- Corporate Governance
- Financing
- Mergers and Acquisitions
- Case Studies

BIOEN 599Z: Applying Technology Commercialization
In this advanced course, student teams analyze technologies that have been disclosed to UW TechTransfer or that a team member is currently researching as a case study to apply the concepts of commercialization that they studied in the first two courses. Each team produces a high-quality market feasibility analysis for their technology and recommends the most appropriate path to commercialization. Feasibility analyses are presented to faculty, inventors, mentors, and UW TechTransfer staff for review and comment.

Full-Time Summer Fellowship
This is an intensive 10-week summer fellowship that enables students to further develop their skills in the analysis of a specific technology. Fellows work closely with mentors and experienced practitioners to develop a professional business plan for the technology. As part of the planning, students may identify and recruit a qualified management team and may attempt to start a venture.

Entrepreneurial Law Clinic
The Entrepreneurial Law Clinic (ELC) is a program of the UW School of Law and the UW Business School. The mission of the ELC is threefold: to promote economic development in Washington by assisting entrepreneurs who face significant economic barriers to success through preventative legal services that minimize risk and reduce operating costs, to provide real-life education to UW students in transactional law, counseling and business, and to provide meaningful *pro bono* opportunities for transactional lawyers.

The ELC teams' law and MBA students work with *pro bono* attorneys to provide legal advice to low-income microentrepreneurs, entrepreneurs in economically distressed communities, and pre-funded high-tech start-ups. The ELC provides advice regarding: entity selection and registration, state and local business licenses, federal, state and local tax issues, financing documents, leases and other commercial contracts, employment agreements, and intellectual property issues, such as trademark and copyright registration, provisional patent applications and licensing agreements.

Every year, the ELC enrolls two-to-four MBA students and 12-15 law students, divided into three different academic tracks—corporate and securities law, intellectual property law, and tax law. Each student is matched with a *pro bono* supervising attorney that specializes in their track. The students are then divided into teams based on the needs of clients. Clients are screened and selected by the clinic directors before the start of each quarter.

Pro bono attorneys teach, supervise, and mentor ELC students in conjunction with ELC staff. Supervising attorneys also review all student work product and communications to clients, supervise client meetings, and help students uphold a high standard of professionalism and ethical behavior. Attorneys from 13 firms volunteered in the ELC in 2006-07.

Entrepreneurial Assistance at WSU

WSU has recently initiated several entrepreneurship programs:

Harold Frank Entrepreneurship Institute

Through a $3 million gift, WSU established the Harold Frank Entrepreneurship Institute. Through this institute, junior-level engineering and business undergraduates who are interested in technological entrepreneurship are given the tools and experiences needed to pursue their entrepreneurial ideas. The institute also sponsors programs designed to empower student innovators to take their ideas to the marketplace, providing support for mentors and resources to help the students create innovative products within multidisciplinary teams. The institute is overseen by an Advisory Board, whose members have excelled in society with their entrepreneurial skills. This board provides an industry perspective and input to the continuous evaluation of the objectives and goals of the institute.

WSU-TriCities Institute for Technology Entrepreneurship

In another program, students engaged in the WSU-TriCities Institute for Technology Entrepreneurship evaluate a technology provided by a local company, academic research, or Pacific Northwest National Laboratory. The students investigate the market potential and business feasibility, develop a business plan and enter into a business plan competition. This hands-on, real-world approach helps students develop the entrepreneurship skills critical to technology commercialization.

Center for Entrepreneurial Studies

Within the WSU College of Business, the Center for Entrepreneurial Studies is designed to provide education and training in the critical skills essential for business creation and innovation, to conduct research to better understand these processes, and to develop practical solutions to the management problems of small-and medium-sized businesses. Focusing on business students, this program is

intended to build the human resources necessary to stimulate, develop, and promote a climate for accelerated business development and expansion in the Washington State region.

Small Business Development Centers

WSU manages the Small Business Development Centers (SBDC) located strategically throughout the state. Funded in partnership with the U.S. Small Business Administration, the SBDCs are located where local stakeholders also contribute to operating an office, such as many community colleges and economic development councils. They focus on individual small business and entrepreneurship counseling.

Other Partnerships

Considering local county-based WSU Extension offices, the Agricultural Research and Extension Centers, the SBDCs, and Learning Center sites for distance program delivery—as Washington's land-grant university, WSU has a footprint of nearly 100 distinct sites across the state with local faculty and/or staff. These are linked directly with local business, community, and social networks that contain a host of other resources and entities involved in local economic development. Though not all-inclusive, a summary of such local partners, their mission, and proximate focus (considered split among business start-ups, recruitment, retention, and expansion) is shown in **Table** . Statewide linkages, such as those shown below, will largely determine the success of Innovation Partnership Zones.

Table 2 *WSU Partnerships Statewide*

Entity	Sites	Funding	Start-Up	Recruit	Retain	Expand	Core Mission
Accelerator Corp	1	private	5				tech-based business incubation
Alliance of Angels	1	private	4			1	funding innovation-based start-ups
Community Colleges	34	public		1	1	3	education and workforce development
Community Development Corporations	23	public	1		2	2	lending, small business assistance
WA Dept. of Community Trade and Economic Development (CTED)	1	public		1	3	1	state-wide economic development agency
US Economic Development Administration (EDA)	3	public			2	3	federal economic development funding
Prosperity Partnership	1	public/ private		1	2	2	policy and economic development project management
SBA – Procurement Technical Assistance Center	9	public				5	government contracting assistance
US Small Business Administration (SBA)	1	public	2			3	small business assistance and funding
SCORE-SBA Resource partner	7	public/ private	4			1	small business counseling
Women's Business Centers-SBA	3	public	3		1	1	small business counseling/woman focus
Sirti	1	public	2		1	2	state incubator, business assistance
Technology Alliance	1	private	1	2	1	1	association of tech-based businesses

Entity	Sites	Funding	Start-Up	Recruit	Retain	Expand	Core Mission
University of Washington (UW)	3	public	2	2		1	education, research, workforce development
UW Business and Economic Development Center	2	public	2		1	2	business assistance for small, minority-held firms
WA Association of Cities	281	public		3	1	1	governance, promotion, marketing
WA Association of Small Business Incubators	24	public/ private	4			1	state incubator lobbyist, business assistance
WA Chambers of Commerce	200	private		1	2	2	promotion and marketing
WA Manufacturing Services	1	public		1	2	2	manufacturing business assistance
WA Ports Association	75	public		3		2	infrastructure for business and transportation
WA Economic Development Association affiliates	~70	public/ private		3	1	1	local economic development services
Workforce Development Councils	12	public		1	1	3	workforce development
Washington State University (WSU)	73	public	1	1	1	2	education, research, business consulting, workforce development
WSU Small Business Development Centers	27	public	1		1	3	small business expansion & entrepreneurial development
Washington Technology Center (WTC)	2	public	2	2		1	tech-based business assistance

In summary, WSU has a statewide mission to conduct research and transfer the results of that research to advance the well-being of Washington's citizens and the economy of the state. Over the past several years, WSU has taken many steps to advance its research programs and their impact on the state. As such, WSU is uniquely positioned to attract and retain eminent scholars, while also ensuring that their research advances the economy of the state and uniquely addresses the needs of Innovation Partnership Zones.

Building Strong Innovation Research Teams

As we consider the mechanisms to support Innovation Research Teams, it is important that we understand the characteristics that make such teams successful. Research teams must be built upon the solid foundation of strong fundamental science. Next, the team must incorporate translational research that moves the science from discovery to application. In this stage, it is important that the team have access to professionals who work with industry, learn of their problems, bring those problems back to the team to determine how to address them, and take research results to industry for potential commercialization. Of most importance, however, the team needs to have an outstanding leader. Here, we provide more details on these considerations.

First, consider the importance of fundamental research. In this regard, the seminal document authored in 1945 by Vannevar Bush, the director of President Truman's Office of Scientific Research and

Development, still applies today. Recalling that scientific advances such as radar had a dramatic impact on U.S. success during WWII, Bush authored a policy document entitled *Science, the Endless Frontier: A Report to the President.*[4] In that report, Bush called on the federal government to make a massive and sustaining investment in scientific research to be conducted at America's research universities. As a result of Bush's report, the federal government established several agencies, including the National Science Foundation, which have significantly invested in the basic research that provides the "pacemaker of technological progress." He noted that such basic research "provides the fund from which the practical applications of knowledge must be drawn."

As we consider the importance of basic research to the state, we must recall Governor Gregoire's statements in which she notes that Washington is now much like a small nation. Keeping the governor's comments in mind, we would paraphrase Bush and affirm that ***a state such as Washington that depends exclusively upon others for its new basic knowledge will be weak in its competitive position in world trade***. Thus, it is essential that the Innovation Research Teams attract and retain researchers who will build a strong base of fundamental research. It is also imperative that we recognize that these strong fundamental science researchers bring significant revenues to the state as they successfully compete for federal research funds and employ a variety of others who work with them. For example, during the recent legislative field visit to the Georgia Research Alliance, the field team heard a presentation by a researcher who brings some $20-million per year to Georgia for fundamental science research. This example clearly illustrates that basic research is a good engine for economic development, in and of itself, even before considering the potential commercial applications of the research.

Strong fundamental scientists, while a necessary condition for a thriving state technology enterprise, are not sufficient, however, to provide the engine for a technology-based economy. In addition, the basic research must be translated to affect commerce.

As noted above, leadership is an essential ingredient for the success of these Innovation Research Teams. Recently, Bercovitz and Feldman conducted a study in which they sought to determine those factors that most encourage individual researchers to engage in the technology commercialization process.[5] Among the most important factors, they found that individuals whose department chair actively files invention disclosures will more likely file their own invention disclosures, that individuals will more likely disclose their inventions if departmental peers also engage in technology transfer activities, and that graduates from institutions with a history and track record in technology transfer are more likely to file invention disclosures. These results illustrate the transformative power of selected hires. ***A research leader can help transform the faculty culture at an institution so that a greater portion of the faculty is engaged in the technology commercialization process. Respected leaders who successfully engage in both fundamental research and technology transfer must be hired and placed in strategic, influential positions.*** It is essential that outstanding, eminent scholars be hired to provide this

[4] http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm
[5] http://www.hhh.umn.edu/centers/slp/clusters_entrepreneurship/bercovitz_academic_entrepreneurs.pdf.

level of transformative leadership to the Innovation Research Teams. In essence, this is the goal of this program.

Innovation Partnership Zones Established in 2007

We fully anticipate that the UW and WSU areas of research preeminence will synergize with and enhance innovation partnership zones (IPZ) established around the state. Although it is likely that additional IPZs will be established, the zones established this year illustrate the potential for interactions. This year's IPZs include:

- Bellingham Innovation Zone, Port of Bellingham – For low-wake, fast ferry vessel prototypes, hydroscience and engineering and design, wake wash energy studies, advanced composite and aluminum alloy techniques.
- Grays Harbor Sustainable Industries Innovation Partnership Zone, Port of Grays Harbor – For research and development of bioenergy, bio-based product manufacturing, particularly high-value byproducts from bio-based energy production.
- Pullman Innovation Partnership Zone, Port of Whitman County – For clean information technology and datacenter technologies, such as energy efficient technologies, and power and cooling infrastructure.
- Spokane University District Innovation Partnership Zone, Greater Spokane Inc. – For biomedical research such as computational biology, bioinformatics, systems biology, epigenetics, genomics, chromosomal biology, and drug discovery.
- Walla Walla Valley Innovation Partnership Zone, City of Walla Walla – For agricultural innovation with a focus on enology/viticulture and water/environmental studies.
- Aerospace Convergence Zone, Workforce Development Council Snohomish County – For research in new materials and processes for aircraft production.
- Battelle, Sequim Marine Research Operations, Clallam Economic Development Council – For marine biotechnology, coastal assessment and restoration, forecasting stressors on marine and estuarine systems.
- Bothell Biomedical Manufacturing Corridor, City of Bothell – For the establishment of a University of Washington Biotechnology and Biomedical Technology Institute, principally to support medical device/ultra-sound manufacturing.
- Discovery Corridor Innovation Zone/Steinmueller Innovation Park, Columbia River Economic Development Council – For semiconductor and micro-device design, IC manufacturing and processing, display technology and multimedia.
- South Lake Union Life Science Innovation Partnership Zone, City of Seattle, Office of Economic Development – For bioscience and biotechnology, pharmaceuticals, cardiovascular and regenerative biology, cancer research, infectious disease research.
- Tri-Cities Innovation Zone, Port of Benton – For research in sustainable development, with a focus on integrated electrical-thermal production, solar dish generating systems, and commercial-scale fuel cells.

Industry clusters that have been documented through the IPZ planning process or other similar efforts, and have not yet applied for or received designation as Innovation Partnership Zones include:

Table 3

Other Locally-Identified Industry Clusters

Primary Industry	Area(s)	Counties
Marine Industry	Hood Canal Watershed	North Kitsap, Mason
Energy Technology	Satsop Development Park Area	Lewis, Mason, Grays Harbor, Pacific, Thurston
Information Technology	Eastside and Seattle	King
Logistics and Trade	S. Seattle/S. King Co. and Port of Tacoma Area	King, Pierce
Clean Technology	Central Puget Sound Region	King, Snohomish, Pierce, Kitsap
Health Sciences, Education	Spokane University District	Spokane
Nanophotonics	Central Puget Sound Region	King, Snohomish, Pierce

Congruence of UW and WSU Areas of Preeminence and Innovation Partnership Zones

Comparison of the UW and WSU "Areas of Preeminence" and the established IPZs shows a great deal of congruence. Many of the established IPZs, as well as those that are likely to be established in the future, will be supported by researchers located throughout the two institutions' seven campuses. Moreover, the same researchers will support efforts in multiple zones, multiplying the impact of the various Innovation Research Teams. Relationships will develop based on interests and personalities, and it is anticipated that significant partnerships will be developed (and in some cases already exist) between campus-based researchers and the firms and supporting organizations of the IPZs.

In addition to the currently articulated IPZs, one must anticipate that over the course of the next 10 years, new technologies will be developed and new, hitherto unforeseen, IPZs will be initiated. This will lead to new linkages between faculty within the institutions' areas of preeminence and the new IPZs.

Table 4 ***Congruence Between UW and WSU Areas of Preeminence and Innovation Partnership Zones***

Area of Preeminence	Related Innovation Partnership Zones	WSU Critical Basic Research Strengths	UW Critical Basic Research Strengths	Primary Location(s) of IRT Research
Clean Technology and Advanced Materials, including Nanophotonics, Energy, and Environmental Monitoring/Sensors	Tri-Cities IPZ, Pullman IPZ, Grays Harbor IPZ; Aerospace (Snohomish County), Life Sciences (Seattle), Discovery Corridor (SW Washington), Grays Harbor Sustainable Industries IPZ	Atmospheric Sciences, Chemical Engineering, Electrical Engineering, Mechanical Engineering, Chemistry, Physics, Materials Science, Biosystems engineering, Materials Sci & Engr, Architecture, Wood Materials, plant sciences, extension	Chemistry, Chemical Engineering, Physics, Electrical Engineering, Materials Sci & Engr, Mechanical Engineering, Microbiology, Oceanography, Forest Resources, Fisheries, Conservation Biology, Architecture and Urban Planning	Pullman, Tri-Cities, Vancouver, Spokane, Seattle
Global Health and Infectious Diseases at the Human-Animal Interface (Global Animal Health)	Life Sciences (Seattle), University District (Spokane, future)	Global Animal Health, Veterinary Microbiology and Pathology, Molecular Biosciences, International Programs, Economics	Global health, Environmental Health, Public Health, Infectious Diseases, Law, Economics	Pullman, Seattle, Spokane
Human Health and Medicine, including Molecular Medicine, Biomedical Devices, Chromosome and the Science of Reproduction, and Brain, Behavior and Performance	Life Sciences (Seattle), Bothell Biomedical Manufacturing Corridor, University District (Spokane, future)	Molecular biosciences, Basic medical sciences, bioengineering, chemical engineering, chemistry, nursing, pharmacy, VCAPP, psychology, and physics	Chemical Engineering, Chemistry, Electrical Engineering, Materials Sci & Engr, Bioengineering, Medicine, Radiology	Spokane, Pullman. Seattle, Vancouver
Molecular Plant Science and Genetics (WSU)	Walla Walla Valley IPZ, Tri-Cities IPZ	Institute for Biological Chemistry, Crop Sciences, horticulture, molecular biosciences, biological sciences, extension	N/A	Pullman, statewide research and extension centers
E-science (UW)	Discovery Corridor (SW Wash.), Life Sciences (Seattle), Aerospace (Snohomish County), Pullman IPZ, Information Technology (Seattle-Bellevue-Redmond, future)	N/A	Computer Sci & Engr, Medicine, Biochemistry, Astronomy, Aerospace and Aeronautical Engineering, Chemical Engineering, Oceanography, Physics	Seattle

Innovation Opportunity Analysis Conclusion

The University of Washington and Washington State University have research and commercialization capabilities and capacity that enable the institutions to provide support to research-dependent industry clusters throughout the state of Washington. Among the most beneficial assets they can deploy are:

- Research capacity of significant scale and a commitment to maintaining and growing the physical and business/administrative/IT support infrastructure required to support a large-scale research operation.
- World-class fundamental and applied research capacity in a range of fields relevant to existing and nascent, emerging industry clusters in the state, and capable of providing a continuous stream of research products with commercialization potential.
- Strong partnerships and linkages with private and other public research organizations across the state (such as the Pacific Northwest National Laboratory and the Fred Hutchinson Cancer Research Institute, and the Seattle Biomedical Research Institute) to ensure that other research and commercialization assets are leveraged.
- Comprehensive systems to support research commercialization that include gap funding, patent and licensing support, and entrepreneurial training and assistance.

What has become clear in the preparation of this report is how related and, in some ways, complementary the research strengths of the two institutions have become in several major emphasis areas. In fact, while the two institutions identified a dozen different areas of research preeminence with commercialization potential, they overlapped so significantly that they could be consolidated into three "jointly held" areas of expertise and two areas held by a single institution. In short, **our state universities' research capacity at the basic research/commercialization nexus is focused on five major areas of endeavor—clean technology and advanced materials, global health, human health and medicine, molecular plant science and genetics, and e-science**. Logically, these are the fields where we are best positioned to support industry clusters with commercially-viable research products. These areas include more mature industries like pharmaceuticals, aerospace, and agriculture, and emerging fields such as low-emission fuels and energy systems, energy-efficient manufacturing systems and products, data mining and analysis systems, and new approaches to disease prevention and cure in under-developed areas.

With regard to entrepreneurial assistance, each institution has a strong array of entrepreneurship and small business development programs and services that it makes available to students and the general public. However, the strength of their linkages to the technology transfer systems, and the reliance of those systems on entrepreneurial services and support is uneven, and can be enhanced and improved. The Innovation Research Team program provides the institutions with an opportunity to rethink when and how they can rely on and use those entrepreneurial development services that already exist on their campuses and integrate them into their approach to the development of research products for the market. It also provides an opportunity to think about how entrepreneurship programs can augment and support institutional efforts to change the culture of the institution toward one that embraces technology commercialization as a valued outcome of academic research.

Part 2:
Draft Innovation Research Team Implementation Plan

General Approach in Comparison to Initiatives in Other States

For any strategy aimed at recruiting researchers to Washington State to be successful, it must be firmly based on the existing research strengths of the state. The primary reason that researchers leave one state for another is to work with colleagues that are already there doing groundbreaking and interesting work directly related to the researcher's own interests. Leading researchers are often pushing knowledge in new directions, looking at old issues in new ways, or integrating concepts from other fields of research into their work to expand a technological frontier. The best research involves collaboration across many different colleges and departments.

As Table 4 in Part 1 of this document illustrated, our state's research strengths are focused on just a handful of broadly-defined research areas. These areas provide the best opportunities for successful recruitment of research "stars". Furthermore, they match up nicely with existing and prospective innovation partnership zones. Additional labor market and statistical analysis should be conducted to help validate the importance of these research areas and related industry clusters to our state's economy. It may even help us identify additional clusters that we may not already be aware of. Additional analysis could help us decide the order of recruitment targets. But we know enough now to get started with the resources we currently have in hand. This report will identify the current opportunities for recruiting research "stars" that we are now faced with, and how they would support innovation partnership zones already designated in the state.

In order to achieve the goals for Innovation Research Teams identified in SHB 1091, this initiative must be aimed at attracting researchers who transform their disciplines, while at the same time, are committed to commercialization, entrepreneurship, and economic development. Entrepreneurial faculty of this caliber are highly sought after, and to be competitive, significant and comprehensive recruitment packages are required. Our two major research institutions can rarely afford high-impact hires of this type, and often when they attempt to recruit such faculty, they are not able to compete with other universities that can offer funds of the type envisioned in the IRT program. Exceptions have generally involved private donors. For instance, the recruitment to the University of Washington of Leroy Hood from Caltech with a gift from Bill Gates, and the recent recruitment of Chris Murray from Harvard, partly based on the investment in global health research and teaching by the State of Washington and the Bill and Melinda Gates Foundation, and partly by a major grant ($105 million) from the Gates Foundation. The IRT program provides the possibility for future recruitments of entrepreneurial high impact faculty, not only at the senior level, *e.g.,* Leroy Hood and Chris Murray, but also at more junior levels—assistant professor or associate/full professor. It would be prudent to consider all levels, with corresponding differences in both initial investment required and long-term impact for economic development.

The state will realize both direct and indirect benefits from these IRT recruitments (Table 5). Direct benefits include jobs created from research funding and start-up companies, and the economic spin-off of such jobs (usually about a 4-fold multiplier). The University of Washington estimates that about eight full-time positions are directly created for each $1 million of external research funding, and another 34 people in the local economy indirectly rely on the same $1 million in research funding for their jobs. Other indirect benefits include the attraction of more external funding and commercial activity in the area, as the reputation of the IRT/IPZ clusters expands. As the funding model goes up, so does the direct impact of the IRT. As suggested in Table 5, below, the economic impact generated by an entrepreneurial, established associate professor or newly promoted full professor might be expected to be four-to-six times that of a starting assistant professor, and for a senior, internationally renowned full professor, it might be expected to be 2.5-3 times the impact of the associate professor, proportionate with the required investment. In addition, the time to achieve payback is much less as the seniority increases. Thus, it makes sense for the state to provide funds to recruit at all three levels, generate a combination of investment/ payoff scenarios and take advantage of opportunities as they arise.

Table 5: *Comparison of Expected Investment and Return on Investment for IRT Researchers Recruited at Different Career Stages*

Recruitment Level	Level of IRT funding for recruitment	Expected annual return within 3 years			
		Research Funding	Innovations reported	Jobs** (direct)	Jobs** (indirect)
Assistant Professor	**$3M**	**$0.5M/yr***	**every 3-5 years***	**4**	**17**
Associate Professor/Full Professor	**$5M**	**$2-3M/yr**	**every 1-2 years**	**16-24**	**68-102**
Senior Full Professor	**$10M**	**$5-10M/yr**	**Multiple annually**	**40-80**	**170-340**

* Ramping up by 5 years to $1-1.5M/yr research funding and innovations every 1-3 years

**Jobs: Assume 8 FTE per $1M external research funding and using a standard economic multiplier, about 34 jobs in the state per $1M external funding. Does not include jobs from commercialization.

How will we be successful in recruiting these high-impact, entrepreneurial faculty? The main attractions for these types of candidates to our state are:

a) Quality of colleagues and graduate programs. By targeting the areas chosen, we build on and leverage existing strengths.

b) Connections with industry. The opportunity to interact with Innovation Partnership Zones and the emphasis on commercialization will be a significant attraction. The presence of both commercial and non-profit partners in the region will provide even more funding and partnering opportunities.

c) Availability of entrepreneurship support systems. The existing and proposed development of structures for support of commercialization activities will not only enable these research teams, most of these researchers will be interested in participating as instructors.

d) Facilities available. Existing and planned interdisciplinary facilities coupled to IRT funds for facilities and major instrumentation will provide the necessary facilities.

e) Availability of discretionary research support. The most successful and entrepreneurial researchers will expect to bring in large amounts of external research funding but at the same time, will expect to have discretionary research funding available for some period of time to use as research venture capital, funding to allow them to explore new areas and create new projects that will subsequently attract external funding. Especially in the current conservative funding climate, it is very difficult to obtain major external funding without significant preliminary work having been carried out.

The recent field visits organized by Sen. Jim Kastama and the state Legislature were invaluable aids to organizing thoughts about the resources needed to develop and support the Innovation Research Teams. During these trips, delegations visited San Diego State University and Connect in San Diego, the USTAR (Utah Science, Technology and Research) Initiative, and the Georgia Research Alliance. The team learned that Connect was focused on the development of a focused region with an emphasis on supporting scientific innovation, and that Connect grew organically, spurred on by local business leaders' concern over the crisis of the loss of the military sector of the economy, rather than by design. Because the various regions within Washington have a variety of interests and strengths, and because Washington lacks the time for organic growth and the urgency of an economic crisis, the visits to Utah and Georgia were especially applicable to our current situation. For this reason, in Table 6, we compare and contrast the approaches used in Georgia and Utah.

Table 6: *Comparison of Georgia Research Alliance and Utah STAR programs*

Program Feature	Georgia Research Alliance	Utah STAR Initiative
Salary for researcher	From institutional funds	Provided by the Initiative, initially at 100%, ramped down to 65% after 3 years
Endowment	Yes, $750,000 one-time funds used to attract the eminent scholar and support her/his laboratory, matched by private donations	None
Building construction	No, but a portion of the Research Infrastructure program may be used for laboratory renovation as an element of the package to attract the eminent scholar	Yes, to support the team
Assistance with commercialization of technologies	Yes - VentureLab o Phase I - $50,000 to Universities to lead to development of a preliminary business plan o Phase II - $100,000 to university with matching outside investment that	Yes o entrepreneurial assistance, o research interaction with Utah companies o research collaboration between faculty

Program Feature	Georgia Research Alliance	Utah STAR Initiative
	demonstrate external market validation o Phase III – $250,000 seed fund to companies as non-collateralized loans. - Technology acquisition for university-based incubators	o interns to assist business analysis and program directors
Research areas	54 eminent scholars in various areas	Medical and energy
Programs supported at:	Research universities only	Research universities only
Research infrastructure	Yes, more than half of each year's fund is used to support this activity and provide matching for federal proposals, invest in state-of-the-art technology	Yes, initial acquisition of state-of-the-art technology
Linkages to other universities	Yes, for focused purposes	Yes, through technology outreach centers
Time horizon for measuring success	Several years to decades	Several years
Scholar supports industry	Statewide in appropriate clusters	Statewide in appropriate clusters
Maturity	Hire only eminent scholars who bring significant federal funding and history of successful research commercialization	Hire member needed to "complete the team", regardless of rank and experience
Venture Partner or "Entrepreneur in Residence" program	Yes, experienced entrepreneurs work with the universities to commercialize university-developed technology. These entrepreneurs are not paid a salary. Rather, they receive an equity position in the spin-out company	None

The State of Washington can and should benefit from the experience of the Georgia Research Alliance and the Utah USTAR program. We propose to take elements from each of these that are appropriate to our situation and which promise maximum return for the State. Table 7 shows the fiscal year 2006 funding for research and commercialization efforts under the two state programs.

Table 7. ***Comparison of Funding By Category of the Georgia Research Alliance and the Utah USTAR Program, for FY 06***

Program	Research Teams	Infrastructure (equipment and laboratories)	Commercialization programs	Total
Georgia Research Alliance	$7,400,000/yr	$14,085,000/yr	$5,338,000/yr	**$26,823,000yr**
Utah USTAR	$15,000,000/yr	$50,000,000 (one-time)	$4,000,000/yr	**$19,000,000/yr + $50,000,000 one-time**

As a further set of comparisons, in Table 8, below, are several measures of technology commercialization performance for Georgia, Utah, and Washington – including a comparison of the investments being made by these states. Some of the observed differences can be attributed to the state programs. Within Washington, however, the institutions focus on the number of technology license agreements completed, since this indicator measures the extent to which ideas move into the marketplace—either through licenses into existing companies or to spin-off companies. Revenues are probably the least useful measure, however, since this indicator tends to be dominated by large, "blockbuster" technologies. Likewise, since prosecution of each patent can cost as much as $100,000, the number of patents awarded can be grown rapidly if the Technology Transfer offices have large budgets that allow the prosecution of high-risk-to-be-licensed invention disclosures. Typically, these offices are primarily self-supporting and "live" off of their revenues.

Table 8: ***Measures of Technology Transfer Success, 2006***

Measure	Georgia	Utah	Washington
Research Expenditures	$1.16B	$0.39B	$1.07B
Invention Disclosures	602	234	380
Patents	71	28	41
Technology license agreements	132	71	177
Start-up companies formed	12	21	10
TTO revenues	$37.5M	$16.5M	$36.8M
Annual State Investment	$26.8M[6] (FY 2006)	$19.0M (FY 2006)	

Source: Association of University Technology Managers, 2006 data.

[6] Utah has also invested in buildings and is growing the investment each year. While in Utah, the legislative team was told that the budget for the Utah STAR program was to be increased by $10M/y starting in FY2008. The team was, however, provided with no documentation

Specific Mechanisms Supporting Washington's Innovation Research Teams

Because the two institutions are trying to attract different levels of talent for different types of research activities, and because they have different sets of institutional and private resources at their disposal, they will require institution-specific strategies to support and fill the gaps, as they develop recruitment packages. There are significant differences in what each institution requires from the IRT program to maximize its potential to leverage these other resources.

WSU's Strategic Approach to Using IRT Funding Support

A variety of strategies will need to be used to support or enhance Innovation Research Teams at WSU. To use a sporting metaphor, WSU needs to be able to hire the player who completes the team. Sometimes, they will need a third baseman. Other times, the most critical need will be for need a general manager. Similarly, one Innovation Research Team may need a senior researcher, while another may be best served by an up-and-coming mid-career researcher or a junior researcher.

WSU does, however, anticipate that in the vast majority of cases, a senior researcher will be needed to provide the visionary leadership that the team needs to be highly competitive for philanthropic and federal funds, to engage industry, and to serve as the respected leader who successfully engages in fundamental research and technology transfer. In so doing, this individual will transform the entire team. Thus, WSU anticipates that they will usually need to hire an individual who will serve as both the team's "general manager" and star player.

Even with the inducements noted earlier, it will not be easy to attract such eminent scholars. Some of the attractions would include:

- **Endowed Chair:** As seen in Georgia, a named, endowed chair position has been shown to be a significant inducement to attract and sustain an eminent scholar. We would therefore propose that, for each scholar to be hired, $1.5 million be provided by the IRT program, to be matched by contributions from institutional philanthropic sources, thus creating a $3 million endowment. This endowment would then be used by the researcher to hire postdoctoral scholars, graduate or undergraduate students, to explore new ideas, and to pay for a portion of the supplies as the researcher interacts with partners within the IPZ.
- **Salary Support for the Researcher:** It is essential that the eminent scholar not have to think first about how s/he will pay his/her salary. If the faculty member has to think first about how her/his salary will be paid, interactions with partners and colleagues will likely be minimized. Recognizing that these eminent scholars are being recruited by many institutions, we would propose that WSU provide the salary and benefits for the eminent scholar. We anticipate that this will require approximately $250,000 per year. These funds would meet the scholar's annual salary and benefits. Summer salary would be derived either from philanthropic or competitive grant sources.
- **Infrastructure:** WSU would propose that, like the programs in both Georgia and Utah, the IRT program partner with the institutions provide the infrastructure needed to maximize the effectiveness of the IRT. Such funds would be used to enable the acquisition of unique scientific

research equipment that will advance discoveries and innovation in associated IPZs, and renovation of space to create state-of-the-art laboratories needed to enable such innovations. Moreover, recognizing that intellectual capital is today's most important currency, such infrastructure funds may also be used to enable the hire of postdoctoral or graduate students to work within the IRT. We anticipate that each time an eminent scholar is hired, significant amounts will be needed for such infrastructure. WSU proposes that, like Utah and Georgia, funding for this activity would be drawn both from the IRT program and institutional sources.

- **Equipment and Matching for Federal and Industrial Equipment Proposals:** In both Georgia and Utah, we were told that funds that can be used to acquire equipment and to provide matching for federal equipment proposals are essential. WSU would therefore propose that the IRT program be grown to provide a pool of approximately $5 million per year that could be tapped for the acquisition of unique equipment. Recognizing that programs such as the NSF Major Research Instrumentation program and the Murdock Trust Research equipment programs require significant institutional match (30-50 percent of the total cost must be drawn from non-federal or non-trust sources), we would suggest that priority be given to matching funds.
- **Funds for Commercialization:** Both Georgia and Utah noted that funds that can be used to advance potentially commercializable ideas are essential for success. Small amounts are needed for each potential idea to be so advanced. However, if these programs are successful, we anticipate that a significant number of ideas will need funding similar to that provided by the Georgia VentureLab. We would therefore recommend that the IRT program provide funds to support the WSU Innovation Opportunity Fund, a concept that has been demonstrated to have significant impact on the commercialization of WSU research results. Although far short of the $8 million per year provided in Georgia for these purposes, these funds would help considerably in moving research products to industry.
- **Industrial Liaison:** Each team will require an industrial liaison to work closely with both the researchers and the commercial enterprises in the IPZs. Like several of those who have been hired into WSURF, these individuals will serve multiple functions. Most notably, however, these individuals will translate research results to commercial application, will be intimately familiar with the research being conducted in the IRT, will understand the needs of the enterprises within the various IPZs, and will work to link the two. In so doing, these individuals will help grow industrially sponsored research at the university, to facilitate the commercialization of university-developed technologies, and to advance the economy of the state. WSU anticipates a growing expectation for such impact. Thus, we anticipate that by using institutional funds, new WSU Extension specialists or other employees will be hired who will be located within the WSU OIPA/WSURF (technology transfer) enterprise, to provide these linkages.
- **Venture Partner:** Georgia demonstrated that an "Entrepreneur in Residence" or Venture Partner significantly helped advance technology commercialization. There, we saw that only a small portion of faculty can successfully serve as the CEO of a company that spins out from the university. Instead, Georgia Tech was able to attract seasoned CEOs who served in this capacity, being compensated through an equity stake in the company they were able to make successful. We suggest that WSU is not at the same point as Georgia Tech, and that seasoned entrepreneurs will not take on these duties without cash contribution. Thus, as called for in the EDC report, we

anticipate that WSU will work with partners such as the Alliance of Angels, the Technology Alliance, the NWEN, Seattle Execs, the Washington Roundtable and a host of others to identify individuals who can serve as the CEO of companies using WSU technology.

We note that several of the above items require a commitment from WSU to raise funds from philanthropic sources. WSU is currently starting a capital campaign. We anticipate that funding for endowed professorships will be one of the highest priorities in this campaign. Moreover, WSU has publicly stated that it seeks to both grow our research and the impact of this research on the state. This commitment is personified in the hiring of John Gardner as the first vice provost for economic development and extension.

UW's Strategic Approach to Using IRT Funding Support

In all cases, the candidates for IRT recruitments will be researchers with established records in commercialization and with in-depth experience working with the private sector to reach commercialization goals. We anticipate that most of these researchers will have already established successful companies or have been successful in moving a research idea into the marketplace before coming to the UW. At the UW, the most limited funds available for recruiting such researchers involve facilities improvements (laboratory renovations), major instrumentation, and discretionary research funding. We propose to focus the majority of the IRT funding on these categories. In addition, gap funding and help with start-ups, especially for biomedical commercialization, remains a limiting factor for our most entrepreneurial faculty and so we propose to address that need also. The endowments that are currently part of the Georgia program and proposed by WSU would not have as much impact for the UW in recruiting, so we do not propose to use that mechanism.

Salary Support for the Researcher: Like WSU, the UW proposes to provide the faculty salaries for these recruitments from institutional or private funds, although in some cases IRT funds could be used to bridge salary for two years until other funds were available.

Infrastructure: Like WSU, the UW proposes that the IRT program partner with the institutions to provide the infrastructure needed to maximize the effectiveness of the IRT. At the UW, these funds would be part of the recruitment package, and would be used for renovations and major instrumentation needed to enhance the IRT interactions with the IPZs.

Equipment and Matching for Federal and Industrial Equipment Proposals: As at WSU, the UW proposes that the IRT program be grown to provide a pool of funds that could be tapped for the acquisition of unique equipment. Most of this funding (ramping up to a final level of $10 million per year) would be used as matching funds for federal and foundation equipment grants. In addition, part of this funding would be used for equipment and facilities that would enhance partnerships with the Innovation Partnership Zones (IPZ). These funds will serve as incentives for IRTs to work closely with the IPZs and to leverage the IRT funds with outside funding.

Funds for Commercialization: In providing entrepreneurial assistance, for the UW the greatest leverage would be gained from funds that directly support commercialization, including gap funding, LaunchPad funding, and an entrepreneur-in-residence program.

Laboratory Infrastructure: The UW is currently expanding laboratory infrastructure as part of the South Lake Union campus project, the Benjamin Hall Interdisciplinary Research Building, and the proposed Molecular Engineering Building. Depending on the topic area, we will use these three sources of research space to provide laboratory infrastructure for these recruitments, and recruitment funds will be used to provide upgrades as needed.

Interactions with Innovation Partnership Zones. We will work closely with the developers of each relevant IPZ in the recruitment process, and partner together to recruit researchers for whom these interactions are a magnet for their interest. The key to success will be to build relationships from the start, and provide incentives to continue those relationships in a productive manner. For example, we propose funds for major equipment that would be used to create and enhance partnerships with the IPZs, providing further incentive for long-term productive relationships.

Solicitation of Public/private Support. Each of the researchers recruited will have a track record of success in working with industry to achieve commercialization. The more senior researchers will also have a strong track record in attracting public/private support, and will bring with them significant outside funding. The more junior researchers will be assisted in this effort by our development (fund-raising) and research offices, via workshops and contacts that are standard within these departments and dean's offices.

Although in this plan it is assumed that all funds will be spent within the biennium in which they are appropriated, it should be noted that for senior faculty, a much more attractive approach would be to provide ongoing discretionary research funds to build the team and explore new research areas for five years, renewable for a second five years. In general, the lack of such funding is a major reason the UW fails in recruitments of "star" researchers, as it is common for other competing universities to provide such incentives.

Comprehensive Entrepreneurial Assistance

As described in Part 1 of this document, the UW and WSU already provide extensive entrepreneurial and small business development assistance both on campus and in the communities in which they have operations. Each institution offers a range of programs and services that include small business incubation, entrepreneurial education and training, business consulting and support, and gap funding. IRT funding can help expand these services and enhance their linkages with technology transfer/research commercialization activities.

Expanding Entrepreneurial Assistance at WSU

As indicated above, WSU has several multidisciplinary programs touching students and faculty on several campuses. Such programs include the Harold Frank Entrepreneurship Institute, the WSU-TriCities Institute for Technology Entrepreneurship, and the Center for Entrepreneurial Studies within the WSU College of Business. Through the creativity of one of our technology licensing associates, who happens to be a Ph.D. chemist, we have initiated discussions with several science and engineering departments that may, eventually, enable such students to serve as interns in our OIPA/WSURF

(technology transfer) offices. We are finding that many science and engineering students are not only interested in entrepreneurship, but in the technology commercialization process itself. These internships would help these students be better prepared for a career path that would include technology commercialization, patent law, etc. We have had several law students serve in such a capacity, having a significant impact on their education and eventual career. In short, we have implemented a range of programs that enhance the education of entrepreneurial students and prepare them for the highly entrepreneurial, competitive future.

The OIPA/WSURF enterprise conducts training in technology commercialization for undergraduate and graduate students, post-doctoral research associates, faculty and staff in several formats. Training sessions include formal half-day, conference-style events such as the conference "Commercialization of Plant Research: The Toolbox"[7] and the "WSU Entrepreneurship Workshop."[8] The latter was conducted in collaboration with the College of Engineering and Architecture while the former was conducted in collaboration with the WSU College of Agricultural, Human and Natural Resource Sciences. These sessions typically attract 60 to 80 people, ranging from students, to professors and industrial representatives.

Further, staff from OIPA/WSURF regularly make presentations on aspects of commercialization to numerous classes in the College of Business and in various technical colleges, such as Sciences, Engineering, Pharmacy, and Veterinary Medicine. OIPA/WSURF staff also engage regularly in one of the most productive, but resource intensive, methods of training: focused work with an individual. Such training includes counseling on opportunities and work on presentations and business plans. WSURF also utilizes its board of directors and it extensive network to supply access to real world advice and education. We have found such focused sessions to be more useful than a generalized certificate program since the education is given to a prepared learner who is motivated to use the information to commercialize a technology.

We have also implemented a number of programs that will help ensure the successful commercialization of technologies resulting from the IRTs. In this document, we have also proposed unique mechanisms, such as the Industrial Liaison, Innovation Opportunity Fund and Venture Partners (entrepreneur-in-residence) program, which will advance the commercialization of the technologies resulting from this program. We are also engaged in internal discussions of how to reorganize the university's contracting mechanisms to enable "one-stop shopping" for commercial enterprises seeking to work with the university.

Finally, we note that many institutions offer a distance certificate in entrepreneurship. A quick Google search for the phrase "certificate in entrepreneurship" and distance returns 990 hits. Of these, several distance education programs are offered by institutions with dubious credentials, but several are also offered by outstanding institutions. At WSU, we anticipate that we will examine the entrepreneurship programs we currently offer and determine if there is a market opportunity to create a new certificate

[7] http://research.wsu.edu/commercialization.html
[8] http://wsurf.org/ResearchHighlights.aspx?article=98

program uniquely crafted to serve the faculty, researchers, and students within the state. Such a program would complement the training offered through OIPA/WSURF and the degree programs described above.

Expanding Entrepreneurial Assistance at UW

As detailed in Part One, the UW has a suite of existing and successful entrepreneurial assistance programs that IRT researchers and their teams could contribute to and participate in. However, these programs do not completely cover the needs of entrepreneurial researchers, and if funds were available, it would be advantageous to invest in a few areas where gaps exist. It should be noted that in fiscal year 2006, the Georgia Research Alliance program provided $5,338,000 for commercialization programs, and the Utah USTAR program provided $4,000,000 for this purpose.

Gap Funds/LaunchPad. Although the current Technology Gap Innovation Fund program has been successful, the funds for this important function to move breakthroughs from the laboratory to the stage at which external investment is feasible are limited. This is especially problematic in the Life Sciences area, where both the cost and the time required to bridge the gap tend to be higher than in other commercialization areas. The UW places gap funds as the highest priority for stimulating and encouraging commercialization related to the IRT research. In addition, the UW's LaunchPad entrepreneurial coaching program for start-up ventures would be more effective with additional funds. We propose a ramp-up to $700,000 per year for stimulating commercialization via these two programs, which will add to the funds already provided ($500,000 annually for the Technology Gap Innovation Fund from a combination of the UW and the Washington Research Foundation, and $100,000 annually for LaunchPad).

Entrepreneur-in-residence program. Currently, the UW does not have an entrepreneur-in-residence program, and we propose to establish one, with support from the IRT program. It is clear that having expertise on campus from entrepreneurs who have successfully set up companies and commercialized technology outside of academia creates a positive climate and support system for researchers who are not experienced in these areas. We propose to test a set of models, either one-month, one-quarter, or one-year programs. The advantages of the shorter terms are the greater likelihood of recruiting top entrepreneurs away from their compelling work, and the opportunity to bring entrepreneurs from different fields within the IRTs to campus. The advantage of the longer terms are the extended contact for relationship-building and impact. Since we have not attempted such a program yet, we will try multiple approaches. This program would require on the order of $250,000 per year to run, per full-time entrepreneur, plus funding for staff to administer the program ($50,000 per year). We propose to ramp up to a total of $300,000 per year.

Full-fledged Entrepreneurial Assistance Program. If sufficient funds were available, commercialization would benefit significantly from a full-fledged entrepreneur assistance program like those at the Georgia Research Alliance and Utah USTAR programs. These would cost on the order of $4-5 million per year, and would provide funding beyond Gap and LaunchPad funding to help launch companies based on university technology, and in addition, would provide business and legal expertise for fledgling companies.

Plan for the Expenditure of IRT Resources in FY 2008-09

Each institution has developed plans for expending IRT resources in the remaining months of fiscal year 2008 and in fiscal year 2009 that will allow them to take advantage of opportunities and research needs that are currently available, that leverage their existing research preeminence, and that support critical industry clusters and IPZs. These plans will also leverage current and pending institutional and outside private support, using the IRT resources to fill gaps that strengthen the recruitment offers.

WSU IRT Expenditure Plan for FY 2008-09

Recognizing that the current allocation is not sufficient to implement all program elements within this first biennium, our specific proposal for the use of the fiscal year 2008-09 funds is:

1) Provide $830,000 to be matched by contributions to Washington State University to create an endowment for an endowed chair. Although personal conversations with representatives of the Georgia Research Alliance indicated that such an endowment should equal at least $3 million, the current budget allocation does not allow this level of investment. If such funds are provided, WSU would use them to help attract and enable the success of an eminent scholar to lead the institution's efforts in bioproducts and biofuels. We further anticipate that this individual would be located at WSU-TC, would link with the IPZs in the Tri-Cities and in Grays Harbor, and would lead efforts from across the institution, as well as link WSU programs with efforts at the Pacific Northwest National Laboratory.
2) Provide $165,000, to be matched by institutional or philanthropic funds, for the Innovation Opportunity Fund. Of this, we would suggest that $40,000 be provided in the first year of the biennium, and the remainder in the second year. These funds, which would be managed by the WSU Office of Intellectual Property Administration, will be used to continue to enhance WSU's successful program.

In response, WSU will commit to provide:

1) $830,000 from private philanthropic sources to match the endowed chair position ($1.66 million total endowment). Together with the proposed funds from the IRT program, an endowment would be created that would provide $66,400 per year to be used to support basic and applied research in the scholar's laboratory that supports industry in associated zones and to leverage associated federal and industrial funding for the research.
2) Salary and fringe benefits for the industrial liaison who will work closely with the IRT and partners in appropriate IPZs. These positions are estimated to cost approximately $85,000 per year, including salary and benefits.
3) Infrastructure needed for eminent scholar's success, including start-up funds and state-of-the-art laboratory space. Laboratory space will be in the newly constructed Bioproducts Science and Engineering Laboratory (BSEL) building on the WSU-TC campus.
4) Matching funds required for any proposals to acquire major equipment needed for the IRT submitted within two years of the hire of the eminent scholar. The expected cost of such equipment would range from $750,000 to $4 million.

5) Matching funds for the Innovation Opportunity fund, from either institutional or philanthropic sources that equal or exceed the funds provided by the IRT program.

UW IRT Expenditure Plan for FY 2008-09

Nanophotonics. The Nanophotonics area is described previously in this report. The UW has existing strengths in both the underlying basic science and in the applications of nanophotonics. Federal funding at the UW for photonics-related research in general is over $10 million per year at present, and is projected to increase substantially. Partly due to this strength at the UW, a business community interested in photonics and nanophotonics is beginning to emerge in the Puget Sound area, and we expect to work with this group to develop an IPZ in this area. Thus, this is an outstanding opportunity to achieve the goals of the Innovation Zone legislation. Work in nanophotonics can support innovation in both the life sciences (Seattle) and biomedical devices (Bothell) IPZs.

The UW is currently recruiting a rising star in the Nanophotonics area from Caltech, Dr. Michael Hochberg. Dr. Hochberg is not only internationally renowned for his research in nanophotonics, he started a company in this area as an undergraduate at Caltech, and that company (Luxtera) has now raised $50 million in venture funds and is on target for high success. Dr. Hochberg already has been involved in writing successful interdisciplinary proposals to federal agencies, and we expect him to rapidly build a major funded research area, if we can recruit him. Clearly, Dr. Hochberg embodies the intent of the IRT legislation. His current track record of success in both collaborative research and commercialization is highly impressive.

Dr. Hochberg has agreed to accept our offer of a position, if in addition to the committed recruitment package of $1 million and space in the Benjamin Hall Interdisciplinary Research Building, we can provide funds to purchase an e-beam system for highly precise micromachining. This tool is an essential element of his research and he cannot be successful without it, but is not available in the Pacific Northwest. The entire system will cost approximately $4 million but the basic system can be purchased for $1.5 million. We propose to use $1,245,000 from the fiscal year 2008-09 allocation with the remainder from institutional funds to purchase this core system, which we believe will be sufficient to convince Dr. Hochberg to accept our offer of a permanent position. We would then plan to raise funds for the remainder of the system via a combination of foundations and federal instrumentation grants with $1 million matching from fiscal year 2010-11 IRT equipment funds, and Dr. Hochberg has enthusiastically agreed to lead that effort.

The presence of this facility will not only stimulate research in nanophotonics and nanomaterials at the UW, it will support start-up companies with needs for these expensive facilities, in a standard cost center mode. In addition, it will complement the nanotechnology capabilities at the Washington Technology Center, and the ongoing Nanotechnology Initiative at the WTC. The presence of Dr. Hochberg on campus will be catalytic, both in terms of basic research and in the development of and interactions with a nanophotonics IPZ. The IRT funds will provide the final piece of the package to convert his conditional acceptance of a position at UW to a permanent one.

The University of Washington also proposes to use $125,000 in fiscal year 2009 IRT funding to expand the Technology Gap Innovation Fund (applied research gap funding program) and LaunchPad business start-up programs. This investment will support commercialization of research products, assisting their development so that they can become candidates for private investment and technology licensing. The TGIF program provides applied research grants of up to $50,000, so this IRT investment would support about three additional research projects.

Use of IRT Resources in Future Biennia (FY 2010-2018)

In looking at the resources we currently have in place at our research institutions, what other competing states are investing in enhancing their research institution's capacity to support clusters, and the need to support Washington's industry clusters and their competitive position, **the University of Washington and Washington State University recommend a phased-in expansion of the IRT program from its current annual funding level of $1.2 million to $26 million per year, by 2016**.[9] Funding at this level would permit the hiring of 16 entrepreneurial researchers over the next 10 years (nine at WSU and seven at UW), a pace of hiring that is commensurate with economic demand and the need to expand the state's research capacity across the five research areas described in Table 4. Funding at this level would be comparable to the current (FY 2006) level of funding for the Georgia Research Alliance program. If one takes the time value of the funding into account, $26 million in 2016 is comparable to the current value of the Utah USTAR program funding level ($19 million in FY2006). In other words, if Washington were able to achieve $26 million in annual funding by 2016 (where Georgia is today), we should be at or about where we would expect Utah to be in that year, assuming they are able to increase their funding to keep pace with inflation.

If Washington took an alternative path of trying to meet the minimum goal stated in SHB 1091 of hiring 10 entrepreneurial researchers over 10 years, the universities estimate that funding would need to reach $16,250,000 by 2012. In this instance, each institution would hire five researchers, and it would take about two years to put each hiring package together and retain the recruit. The activities most likely to be significantly reduced in this lower funding scenario are resources for matching grant request for laboratory and equipment infrastructure, and support for research gap funding.

The table below shows the recruitment schedule based on the $26 million funding assumption.

[9] Institutional budget requests for the IRT program would go through the standard operating budget review process. This will give the Higher Education Coordinating Board an opportunity to review and comment on future-year IRT program budget requests.

Table 9: *Hiring Schedule Based on Annual Funding at $26 million by 2016*

Fiscal Year	WSU Recruitments	UW Recruitments
2008	Hire 1: Prof. Bioproducts (Tri-Cities)	Hire 1: Assist Prof Nanophotonics
2009	Hire 1 (Continued)	Hire 1 (continued): Assist Prof
2010	Hire 2: Prof. Biosciences (Spokane)	Hire 2: Molecular medicine (example: Sam Wickline)
2011	Hire 3: Veterinary Microbiology and Pathology, (Pullman)	Hire 2 (continued): Molecular medicine (e.g.: Sam Wickline)
2012	Hire 4	Hire 3: Assist Prof
2013	Hire 5	Hire 4: Assist Prof
2014	Hire 6	Hire 5: Assoc Prof
2015	Hire 7	Hire 6: Assoc Prof
2016	Hire 8	Hire 7: Full Prof
2017	Hire 9	Hire 7: Full Prof (continued)

Below is a description of how funds would be expended if the program received the recommended level of funding.

WSU IRT Plan in the Out-Years

By 2016, WSU would receive $10 million of the recommended $26 million annual funding level. The largest portion would go to grant matching resources for laboratory infrastructure and equipment ($5 million), followed by direct infrastructure investments ($3 million) that are part of the recruitment package, recruitment endowment ($1.5 million, to be matched by the institution) and gap funding ($500,000). WSU suggests that program funds allocated to include the following program elements:

1) Creation of a $3 million endowment for each eminent scholar. Half the funds for the endowment would be provided by the IRT program, leveraging equal amounts that the institution would raise from private philanthropic sources. We have designed this program much like the similar program operated by the Georgia Research Alliance (GRA). Discussions in Georgia, however, indicated that the $1.5 million endowment created by the GRA and the Georgia universities was beginning to have diminishing ability to serve as the magnet for attracting eminent scholars. In private conversations, personnel there suggested that a $3 million endowment would be much more likely to serve as the magnet for the desired caliber of scholars. We anticipate that one eminent scholar would be attracted each year for the next 10 years.
2) Infrastructure funds used to enable the creation of state-of-the-art laboratories equipped with the unique scientific research equipment and renovated to enable the IRT's maximum effectiveness. Both Utah and Georgia found that such infrastructure is an absolute necessity and have invested heavily in this area. We would propose that the IRT program invest $3 million each time an eminent scholar is hired. WSU will also, from philanthropic or institutional funds, invest in such infrastructure, ensuring that the impact of each IRT is maximized.
3) Funds for the Innovation Opportunity Fund. WSU would propose that the IRT program initially provide a small amount to enhance this existing program. However, as eminent scholars are hired and the institutional culture continues to change toward even more support of technology

commercialization, it is anticipated that the demand on this program will grow dramatically. Thus, we also request that the IRT program anticipate growth in this fund. Again, WSU plans to match funds provide by the IRT with equal amounts from institutional or philanthropic sources.

4) As the number of eminent scholars increases, the need for major equipment that supports the industry in associated IPZs and the demand for matching funds for federal grants will also grow. Recall that in Georgia, some $14 million, or more than half the Georgia Research Alliance funds, were used each for such purposes. Thus, WSU requests that funds be provided that can be used to meet these growing demands.

UW IRT Plan in the Out-Years

By 2016 when total program funding would reach $26 million per year, UW would receive $16 million of that amount. The single largest portion of annual funding would go to matching resources for laboratory infrastructure and equipment ($10 million), followed by recruitment funds ($5 million), $700,000 for gap funding and LaunchPad, and $300,000 for the new entrepreneur-in-residence program.

FY 2010-11—Opportunity in Molecular Medicine: The interface between bioengineering, imaging, and clinical medicine is the area of molecular medicine. Molecular medicine has profound applications in life sciences for diagnostics, monitoring, and treatment for a variety of disorders. The Prosperity Partnership has designated life sciences as one of the clusters for rapid growth and investment in the central Puget Sound region, and two of the first 11 IPZs recently announced are the South Lake Union Life Science Innovation Partnership Zone in Seattle and the Bothell Biomedical Manufacturing Corridor. As such, molecular medicine represents an outstanding opportunity for the IRT program to link directly to key industry clusters in the state. The UW is currently recruiting for a senior level "star" researcher in Molecular Medicine.

The type of person we are hoping to recruit is exemplified by Dr. Samuel Wickline at Washington University in St. Louis. Dr. Wickline is internationally renowned in translational medicine, coupling non-invasive imaging techniques to breakthroughs in healthcare. He has a long history of success in this area and of working closely with both engineering companies, including Philips (which has major facility in Bothell), and the pharmaceutical industry. He has a large externally funded research program, on the order of $6 million per year, supporting 50 researchers, and he also directs a Nanocancer Center at Washington University in St. Louis. He has the potential at the UW to collaborate with groups that could compete for large centers ($7-10 million per year range) from the U.S. Department of Defense, NIH, and private foundations. Recruitment costs for Dr. Wickline, which would be typical for someone of this caliber, would be expected at the minimum to include two faculty positions for colleagues he would bring with him as part of his team, $4-5 million in facility renovation costs to improve research space for his group, and $5-7 million for major instrumentation and discretionary research support. In addition, he would expect matching funds to be available for future equipment proposals to federal agencies and foundations.

The UW would need to use $10 million of IRT recruitment funds in the fiscal year 2010-11 biennium to ensure a competitive recruitment package for this position. As noted above, for this type of recruitment

it would be a much more attractive package to supply the recruitment funds over a period of five years with the potential to renew for five more years based on IRT-specific criteria involving work with one or more IPZs.

Future Biennia (FY 2012-17). In future biennia, the UW proposes to recruit in one of the areas noted in the earlier section of this report. The actual area will depend on the funding available, the makeup of our IPZ partners, as well as opportunities that arise with regard to outstanding individuals.

The UW would expect to recruit a total of five faculty in fiscal year 2012-2017. The first four hires are expected to be junior faculty in the category of Michael Hochberg and mid-career faculty at the associate professor or newly promoted full professor level, while the final one would be a senior full professor in the category of Samuel Wickline. For the mid-career level, UW would recruit faculty with a proven track record who are clearly poised to make transformational breakthroughs with the appropriate colleagues and facilities around them. An example of the type of mid-career researcher we would target would be Yoky Matsuoko in Computer Science and Engineering (mentioned in the Opportunity Analysis), who works on prosthetic hands with an interface to the nervous system, and who recently won a MacArthur "genius" award. With this scenario, as opportunities arose, the UW could potentially recruit more senior faculty instead of the more junior faculty, if additional funding were available from private, foundation, or federal sources that would leverage the IRT funding.

Program Administration and Oversight

The legislation authorizing the Innovation Research Team program calls for the Higher Education Coordinating Board to implement this plan "in conjunction with the publicly funded research institutions." Funding in the current biennium ($430,000 in fiscal year 2008 and $1.935 million in fiscal year2009) for the program was (according to the budget proviso) "provided solely for the economic development commission to work with the higher education coordinating board and research institutions to: (a) Develop a plan for recruitment of ten significant entrepreneurial researchers over the next ten years to lead innovation research teams, which plan shall be implemented by the higher education coordinating board; and (b) develop comprehensive entrepreneurial programs at research institutions to accelerate the commercialization process."

To administer the program in accordance with these legislative requirements, and ensure proper fiscal and program accountability, it will be important for the HECB to take a lead role in planning coordination and the distribution of program funds. The HECB should develop a Memorandum of Agreement with the Washington Economic Development Commission detailing their role and responsibilities for fiscal and program oversight and coordination. This should include the transfer of appropriated funds to the HECB for distribution to the research institutions. It should also include the development and monitoring of annual expenditure plans. The specific roles and responsibilities for the HECB that could be included in such a Memorandum of Agreement include:

- Coordination and development of an annual IRT program and financial which describes how previous year funds were expended and assessment of program results and

progress to date, the program activities to be implemented in the coming fiscal year, and the allocation of appropriated funds to support those activities.

- Allocation of funds to endowments and reimbursement of program expenditures incurred by research institutions, in accordance with the annual program and expenditure plan.
- Collection of data and information about the IRT program and use of IRT funding by research institutions, for dissemination to the Economic Development Commission, the State Legislature, the governor, and other interested parties.
- Policy and program support for the Economic Development Commission in meeting their legislative requirement to develop performance measures, to be used in evaluating IRTs, and assistance in implementation of the performance measurement system.
- Serving as a conduit of information to Innovation Research Teams and university technology transfer offices, to help ensure their activities are linked to Innovation Partnership Zones, other identified industry clusters, and Economic Development Commission policies and initiatives.

Annual Planning Process

It is anticipated that it will be necessary to conduct an annual planning process to allow the program to adjust to changing opportunities and economic needs and conditions, and to ensure that performance measures are regularly being collected, analyzed, and used to identify implementation issues that require correction. The annual planning process would be conducted each spring and would determine how funds will be allocated during the coming fiscal year (beginning July 1).

The annual plans would also allow the HECB and the research institutions to quickly respond to any funding or policy changes or revised program goals established by the Economic Development Commission, the Legislature, and/or the governor. The annual plans would include:

- An description of how previous year funds were expended;
- A discussion and examination of any new policy goals, industry/economic needs, and economic development opportunities that arose over the last year that may have implications for the use of IRT resources in the coming year;
- An assessment of program results and progress to date, based on the performance measurement system for IRTs established by the Economic Development Commission;
- The next year's program activities to be implemented by the research institutions;
- Performance measure targets for the next fiscal year, based on the planned activities and progress to date; and,
- The allocation of appropriated funds to institutions and individual program activities.

Table 10, below, provides a rough schedule for the development and implementation of annual program and expenditure plans:

Table 10: *Development of Annual IRT Program and Expenditure Plans*

Planning Activity	Due Date
WEDC Identifies program goals for the next fiscal year and transmits them to the HECB	March 15
HECB transmits program planning guide to the research institution identifying elements to be included in institution plans	March 31
Research institutions submit institution-level plans to HECB	May 1
HECB submits comprehensive draft state plan to the WEDC	May 15
WEDC submits comments to HECB on comprehensive draft plan	June 1
WEDC and HECB work jointly to complete the final plan	June 15
HECB and research institutions implement the plan	July 1-June 30

Contact Information

Many individuals contributed to the development of this document. Among them are:

John Lederer, Ed.D.
Associate Director, Academic Affairs
Higher Education Coordinating Board
Tel: 360-753-7822
Email: johnle@hecb.wa.gov

Mary Lidstrom, Ph.D.
Vice Provost for Research
University of Washington
Tel: 206-685-7641
Email: lidstrom@u.washington.edu

James Severson, Ph.D.
Vice Provost, Technology Transfer
University of Washington
Tel: 206-543-0905
Email: jasever@u.washington.edu

John Gardner, Ph.D.
Vice President, Economic Development and Extension
Washington State University
Tel: 206-448-1330
Email: gardnerj@wsu.edu

James Petersen, Ph.D.
Vice Provost, Research
Washington State University
Tel: 509-335-9141
Email: jn_petersen@wsu.edu

RESOLUTION NO. 07-24

WHEREAS, SHB 1091 requires the Higher Education Coordinating Board and Washington's research institutions to assist the Washington Economic Development Commission in developing an innovation opportunity analysis and Innovation Research Team Implementation plan; and

WHEREAS, The Washington Economic Development Commission is required by legislation to submit these documents to the Governor and the Legislature by December 31, 2007, and the Higher Education Coordinating Board and the state's public research institutions are responsible for implementation of the Commission's Innovation Research Team plan; and

WHEREAS, The Higher Education Coordinating Board and Washington State University and the University of Washington have developed the *Innovation Opportunity Analysis and Innovation Research Team Draft State Implementation Plan*; and

WHEREAS, The Higher Education Coordinating Board has reviewed the document and supports its major findings and recommendations; and

THEREFORE, BE IT RESOLVED, That the Higher Education Coordinating Board approves the document for transmittal to the Washington Economic Development Commission.

Adopted:

December 13, 2007

Attest:

_____

Bill Grinstein, Chair

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Betti Sheldon, Secretary