External Review of Innovation and Entrepreneurship at WSU

Final Report by ERIE Team

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i. Preface: The Iterative Synergy Between Basic and Translational Applied Research

The purpose of the "External Review of Innovation and Entrepreneurship at WSU" is to assist in creating a supportive environment of innovation and entrepreneurship that embraces and integrates the importance of three fundamental academic values: (i) student education, (ii) exploratory basic research, and (iii) the land-grant mission to translate novel findings into beneficial products and services for the public. Recently, Dr. Paul Alivisatos, the Vice Chancellor of Research at the University of California at Berkeley, called attention to the importance of "Entrepreneurship as a path for societal engagement, undergraduate research, and discovery experiences." He referred to an essay on his research group's webpage in which he describes how his personal research scholarship has benefitted intellectually from his entrepreneurial activities: http://www.cchem.berkeley.edu/pagrp/entrepreneurship.html.

His conclusion in this essay is worth quoting, as it sets the stage for why this report is so critically important to WSU in terms of embracing a strong culture of innovation and entrepreneurship. Such a culture can embrace scholarship and education as part of creating important outcomes for society; in return, new research areas arise that stimulate further scholarship and discovery.

"As an academic scholar, a deep commitment to patient scholarship and careful foundational work is essential. Still, entrepreneurship has been an invaluable aid to my intellectual renewal, and it has helped me be at the forefront of new directions in my field. I still am looking for an opportunity of another foray into entrepreneurship with excitement…if I am careful, I can go even further in realizing my career-long dream of participating in the full journey, wherein my foundational academic research reaches out to make an important positive difference in the world."

In this review, we find Dr. Alivisatos' call for a robust connection between traditional scholarly academic research and the more risky forays into entrepreneurship and commercialization to be highly relevant to WSU's goal of fulfilling its land-grant mission. By embracing innovation and entrepreneurship as part of the core mission of the university, scholarship and education become a vehicle for achieving important outcomes that benefit society. Importantly, engagement with solving specific problems in the marketplace or in society can synergistically create new research areas and ideas that will require additional further scholarship and discovery. The positive feedback of this virtuous cycle connecting basic and translational research should be celebrated and recognized as a pre-existing feature of WSU's land-grant mission.

ii. Executive Summary and Recommended Actions

Introduction and Summary

WSU should develop a more robust culture that celebrates the translation of creative and scholarly discoveries of WSU faculty and students to products and works that improve people's lives. This aligns with President Kirk Schulz's "Drive to 25," and requires embracing innovation and entrepreneurship (I&E) as an integral part of WSU's land-grant mission. To this end, the Vice President for Research Chris Keane and the Office of Research Support and Operations (ORSO) commissioned an External Review of Innovation and Entrepreneurship (ERIE), to be led by Glenn Prestwich, Chancellor's Distinguished Visiting Professor at WSU and Presidential Professor of Medicinal Chemistry, and Special Presidential Assistant for Faculty Entrepreneurship at the University of Utah. Dr. Prestwich assembled a team composed of six experts and practitioners in technology commercialization and entrepreneurial activities by academics. This team assessed the opportunities, obstacles, and desired outcomes for WSU's activities in I&E, with the aid of a questionnaire titled "*Washington State University 2016 Survey of Innovation and Entrepreneurship*," administered to tenure and tenure-track faculty. The data, along with hundreds of voluntary comments by faculty members to open-ended questions, provided an incredibly rich source of perceptions and experiences from faculty involved with, or impacted by, commercialization policies and practices at WSU.

After receiving the results and analysis of the I&E survey, the ERIE team held site visits at the Pullman and Spokane campuses on November 7–9, 2016. A tightly scripted agenda allowed the team to query faculty, chairs, directors, deans, associate deans for research, associate deans for commercialization activities, Office of Commercialization staff, Conflict of Interest Committee members, Intellectual Property Committee members, Office of Research staff, and upper administrators. Over 118 participants from WSU, plus 8 community members, participated in the site visit interviews. A number of phone interviews were also conducted, and a selection of specific individual faculty members with commercialization experiences offered their perspectives.

The ERIE team considered all the data and identified a set of unrealized opportunities, insurmountable or readily removable obstacles, and clear action items that, if embraced by all faculty and administrators, would result in better commercialization outcomes at WSU. The six major recommended actions are summarized below.

Recommended Actions

The ERIE team proposes action items in six broad areas, with actions recommended at three levels: (i) top down (upper administration and college level); (ii) bottom up (grassroots, from within faculty and departments), and (iii) operational (improving processes to align with the shared goals). Under each of the six broad areas the review team has made both specific and general recommendations to encourage research engagement among faculty, students, businesses, non-profits, community groups, and startups. These recommendations will enable WSU to define for itself what success in improved I&E means, and to determine how best to achieve that success.

The six broad recommendation areas are:

1. Clarify and communicate the mission about the importance of I&E to support and grow engagement.

2. Support the mission by implementing a more coherent set of administrative and operational support structures to develop and diversify external engagement to enhance I&E.

3. Develop incentives and recognition and reward structures to support, encourage, and expand I&E.

4. Tighten the focus of the Office of Commercialization.

5. Overhaul the COI process.

6. Build on I&E momentum at WSU-Spokane to engage across the state.

A. Purpose and Overall Organization of the ERIE Process

A key component of Vision 2030 is creating a culture that celebrates the translation of creative and scholarly discoveries by WSU faculty and students to products and works that improve people's lives. As part of President Kirk Schulz's "Drive to 25," the Institution needs to align WSU's efforts in entrepreneurship and innovation with the land-grant mission and of its Grand Challenges efforts.

To this end, VPR Keane and the Office of Research Support and Operations (ORSO) commissioned an External Review of Innovation and Entrepreneurship (ERIE), to be led by Glenn Prestwich, Chancellor's Distinguished Visiting Professor at WSU and Presidential Professor of Medicinal Chemistry, and Special Presidential Assistant for Faculty Entrepreneurship at the University of Utah. Dr. Prestwich then assembled a team composed of six experts and practitioners in technology commercialization and entrepreneurial activities by academics. This team was tasked with assessing the opportunities, obstacles, and desired outcomes for WSU's activities in innovation and entrepreneurship (I&E). The team was contacted at the end of August 2016, and a date was then selected for a site visit by the team. The team was provided with a secure website on which to view all official university documents relevant to the review of I&E at WSU.

First, the ERIE team, working with the Entrepreneurial Faculty Ambassadors (EFA), college business development managers, and the Office of Research and the Office of Commercialization (OC), developed questions to assess perceptions of I&E by tenure and tenure-track faculty (inventors and non-inventors), including center directors, chairs, and deans. The draft questions were refined and developed into a self-contained survey by the Social and Economic Sciences Research Center (SESRC) at WSU.

Second, this questionnaire, titled "*Washington State University 2016 Survey of Innovation and Entrepreneurship,*" was administered by email to 1,889 tenure and tenure-track faculty, of which 1,799 were validated. An introductory email memo from VPR Keane was followed by an email invitation from SESRC to take the survey; two follow-up reminders were also sent. Over 638 full or partial responses were received for an extraordinarily high completion rate of 35.5%. Moreover, literally several hundreds of voluntary, often quite detailed, answers and comments to open-ended questions were provided. These written comments provided an incredibly rich source of perceptions and experiences from faculty involved with or impacted by commercialization policies and practices at WSU. Many of these comments are echoed in the recommended action items in **Section E**.

Third, the questionnaire, the tabulated and graphical results of the responses, an extensive analysis of the results by SESRC staff, and the complete text files of the responses to open questions were placed on the secure website for the ERIE team on October 30, 2016, one week before the site visit.

Fourth, the ERIE team participated in a site visit to the Pullman and Spokane campuses on November 7–9, 2016. A tightly scripted agenda allowed the team to query faculty, chairs, directors, deans, associate deans for research (ADR), associate deans for commercialization activities, and Office of Commercialization staff, Conflict of Interest Committee members, Intellectual Property Committee members, Office of Research staff. VPR Keane, President Schulz, and Chancellor Lisa Brown (WSU Spokane) also participated. Over 118 participants from WSU, plus 8 community members, participated in the site visit interviews. Phone interviews with Dr. Noel Schulz and Professor Yogi Gupta were also included. During the site visit, Dr. Brian Kraft, Director Of Business Development for the College of Arts and Sciences, oversaw recording the meetings and organizing note takers and summarizers.

Fifth, each ERIE team member was individually thanked, and each provided a short summary of major points observed that were—consistent with the questions in the charter—unrealized opportunities, insurmountable or readily removable obstacles, and clear action items that, if embraced by all faculty and administrators, would result in better commercialization outcomes at WSU.

Finally, Drs. Kraft and Prestwich set to organize the massive amount of data collected and conclusions reached into a cogent and concise form to create a Report of the ERIE Team. Both the survey and the site visit specifically addressed the questions of the charter; however, the data and formulated responses are organized as will be seen in the table of contents and following pages.

B. SESRC Survey of Tenure/Tenure-Track Faculty Regarding Perceptions of I&E at WSU

1. Introduction

The ERIE team, working with the Entrepreneurial Faculty Ambassadors, college business development managers, and the Office of Research and the Office of Commercialization, developed questions to assess perceptions of I&E by tenure and tenure-track faculty (inventors and non-inventors), including center directors, chairs, and deans. The draft questions were refined and developed into a self-contained survey by a highly competent and committed group of students and staff in the Social and Economic Sciences Research Center (SESRC) at WSU.

The "*Washington State University 2016 Survey of Innovation and Entrepreneurship*" was conducted to better understand the experiences and extent of WSU research faculty's interactions with the WSU Office of Commercialization and the current process for disclosing and advancing inventions within WSU. The survey sought to discover levels of satisfaction with the services and policies involved with the commercialization of research on campus and sought opinions regarding improvement of the processes and/or policies.

The survey was conducted on NetSurveyWork, the SESRC's in-house online survey platform, and was sent to all tenure or tenure-track research faculty at WSU as of the 2016 Fall Semester. A list of 1,889 faculty was provided by the WSU Office of Research for use in this survey endeavor. While the survey was administered to the entire list, 17 individuals were retired, and 6 no longer worked for the university or did not work in research. An additional 68 email addresses from the list bounced back as undeliverable. These 90 individuals were removed from the sample population, reducing the total to 1,799 individuals contacted. Of those on the list, 638 completed or partially completed the survey, resulting in a 35.5% rate of response. Given the complexity of the survey, the timing of the survey (midterms), the short 18-day timeline for response, and the email-only contact, the response rate indicated that the survey was well received by eligible faculty.

The WSU Office of Research sent an email to this population on October 17, 2016, informing them of the study. The SESRC sent an invitation email to the same list the following day. The invitation email described the study and gave instructions for how to complete the survey online. Over the course of the next two weeks, two follow-up emails were sent to those who had not responded. Response data used in this report includes all completed and partially completed surveys submitted online by Friday, October 28, 2016.

2. Summary of focus areas interrogated

Broadly, the survey sought to explore three areas. Each of these areas were explored during the site visit, and the majority of observations and conclusions derived from the survey were reinforced or dissected in more detail during the interviews that the ERIE team held with each of the stakeholder groups. The three main areas investigated and queried were:

a. **Awareness and Engagement.** The survey queried awareness of, levels of engagement with, and the relative faculty satisfaction with current infrastructure for I&E.

b. **Understanding and Satisfaction.** The survey queried faculty understanding and satisfaction levels with current WSU policies and practices that directly relate to activities relevant to I&E.

c. **Recognition and Reward.** The survey queried faculty perceptions regarding institutional support and recognition for I&E at multiple levels—central administration, college, and departmental—and the importance of efforts to improve the existing infrastructure.

3. Summary of responses

Each of these responses was scrutinized during the site visit, and the in-person interviews with stakeholder groups reinforced the results below and recommendations in **Section E**.

This report offers a distillation and summary of the key findings, augmented and integrated with suggestions and observations gleaned by the ERIE team during the site visit. Several key areas noted for improvement are given below:

a. **Untapped potential for I&E.** First, there is a significant untapped potential I&E at WSU. Support for this conclusion is found in the responses to a number of survey questions as well as information from the site visit interviews.

b. **Clear mission and support.** Second, there is critical need for a clearer and more coherent set of administrative and operational support structures that will aid in developing and diversifying external engagement to enhance I&E. Support for this is in the responses to a number of survey questions as well as information from the site visit interviews.

c. **Develop incentives.** Third, WSU leadership needs to develop recognition and reward structures to grow innovation and entrepreneurship. Support for this statement is found in the responses to a number of survey questions as well as information from the site visit interviews.

d. **Tighten the focus of the Office of Commercialization.** Fourth, while those engaged with the OC are generally satisfied with its function, there is a consensus that OC is spread too thin and is inadequately focused and staffed to carry out the scope and breadth of activities assigned to it. Support for this conclusion is found in the responses to a number of survey questions as well as information from the site visit interviews. Recommendations on improving technology-to-product transitions are made in this section. On the other hand, many faculty surveyed felt that OC was not relevant to them, and was too focused on technology licensing, thereby ignoring social sciences and creative arts and humanities. Recommendations to address these concerns will be made in the Mission and Support section.

e. **Overhaul the COI process.** Finally, there was a consensus that the COI process needs improvement. This would include streamlining and becoming more transparent, consistent, and faculty friendly. Concerns were identified with initial application, COIC composition, and creating and implementing COI management plans. Support for this is in survey responses as well as from site visit interviews.

C. Conduct of the External Review of I&E at WSU

1. Summary of the Charter for ERIE committee (see also Appendix 1)

Washington State University (WSU) President Kirk Schulz has proposed to the WSU community that the University set a goal of being "recognized as one of the nation's top 25 US public research institutions, preeminent in research and discovery, teaching, and engagement by 2030." Achieving this goal will require advancing the WSU research enterprise, including enhancing industrial research partnerships, entrepreneurial activity, and innovation. Enhancing WSU's entrepreneurial and innovation presence aligns with the University's land-grant mission: to advance, extend and apply knowledge in order to improve the quality of life and enhance the economy of the state and nation.

WSU has made progress. Licenses issued have increased more than five-fold since 2008, royalty revenue and invention disclosures have increased, and the University has funded new strategic research initiatives. However, challenges remain for WSU to achieve its full potential in translating its research excellence into economic impact for the state and for each of the campus communities. An external review of the WSU I&E program was timely. Vice President for Research Christopher Keane tasked Professor Glenn Prestwich to lead this external review by experts and practitioners in technology commercialization and entrepreneurial activities by academics. The ERIE team addressed the following questions, and herein proposes achievable goals.

- ***Opportunities****.* What opportunities and college-level programs exist that could support I&E by academics at WSU? Considering WSU's research strengths, facilities, capabilities, multiple campuses, and other key factors, what are the most promising general areas for growth in entrepreneurship by academics? Are these opportunities sufficiently compelling that they merit investment? How should they be prioritized for funding?
- ***Obstacles.*** Does WSU have the infrastructure, processes, support funding, and other factors necessary to realize these opportunities? What impediments exist that constrain realization of the opportunities? Evaluate key components required for success, including the overall university culture and attitude towards entrepreneurship, tenure and promotion guidelines, space and other physical infrastructure, and the health of the commercialization, conflict of interest, and related enabling internal processes. What disincentives exist and how can they be replaced with a reward system that encourages successful entrepreneurship? How important to success is developing a presence in western Washington, and if this is critical, how should it be done?
- ***Outcomes.*** If WSU takes steps to define and realize these opportunities, and takes steps to reduce obstacles and replace disincentives with rewards, how should success be measured? What are the most important, reasonable and achievable goals for the upcoming five-year period? How should WSU define relevant metrics for determining success, and what specific actions should WSU take to implement the committee's recommendations?

2. Membership of external review committee (see also Appendix 2)

Glenn Prestwich assembled a team of experts and practitioners in technology commercialization and entrepreneurial activities by academic faculty. The team represented a broad range of disciplines and expertise in licensing, navigating COI, starting and running companies, and working with faculty innovators. One member, Don Rose, literally wrote the book on this subject: *Research to Revenue*: *A Practical Guide to University Start-ups*. Brief biosketches are below, with details in **Appendix 2**.

Dr. Michael Cable, University of California, Berkeley

Mike is the Executive Director of the Berkeley Sensor and Actuator Center (BSAC). Before BSAC, he worked with early stage technology companies commercializing university-based research: (i) CEO of Matrix Sensors (MEMS-based biological and environmental sensors), (ii) CTO of Xenogen (preclinical bioluminescent imaging), and (iii) high level positions at Nanomix, Xradia, Fovi Optics and Quantum Dot. He worked at both Lawrence Livermore National

Laboratory (laser fusion) and Lawrence Berkeley National Laboratory (physical biosciences). Dr. Cable has over 40 patents and received his PhD in Nuclear Chemistry from the University of California, Berkeley and his BS from Iowa State University.

Dr. Bruce Gale, University of Utah

Bruce K. Gale is a Professor of Mechanical Engineering with expertise in microfluidics, sensors, and nanotechnology. He is Chief Science Officer at Wasatch Microfluidics, a company that was spun out of his laboratory in 2005. He has recently spun out two additional companies from his laboratory, Espira, Inc. and Guanine, Inc., which are still early stage. He also serves as Chair of the Conflict of Interest Committee.

Mr. Joe Giffels, University of Washington

Joe Giffels serves as the UW's point person for Research Administration and Integrity, including Compliance, and he coordinates the efforts of the many administrative and compliance operations campus-wide. He is the Institutional Official responsible for human research protections and his office manages the research financial conflicts of interest and faculty outside consulting processes. He came to the UW following several years as Assistant Vice President for Academic Affairs at the University of Maryland Baltimore and Director of that University's Research Integrity Office.

Dr. S. David Kimball, Rutgers University

Dr. Kimball's research career has focused on the discovery and development of small molecule treatments for human disease, spanning several therapeutic areas, including cardiovascular disease, metabolic disease, inflammation, oncology, neuroscience and pain. He is a cofounder of Z53 Therapeutics, where his current research interest is the most common genetic lesion in cancer, mutant p53. He was an Associate Member of Graduate Faculty, Rutgers University from 1989 to 2011, while serving in senior management roles at Lexicon Pharmaceuticals, Pharmacopeia, and Hydra Biosciences. David is now tasked with developing a faculty-friendly environment for translational research and research commercialization at Rutgers University.

Dr. Alyssa Panitch, University of California, Davis and Purdue University

Alyssa Panitch is now Chair of Biomedical Engineering at UC Davis, having recently moved from her position as Leslie A. Geddes Professor in Biomedical Engineering and Vice Provost for Faculty Affairs at Purdue University. Dr. Panitch also served as Associate Head of the Weldon School of Biomedical Engineering at Purdue from 2009 to 2013. Dr. Panitch's research focuses on designing biomimetic and synthetic materials for drug delivery and regenerative medicine. She has received the National Science Foundation Career Award, been named a Purdue Faculty Scholar, and is a Fellow of both the American Institute for Medical and Biological Engineering and the Biomedical Engineering Society. She was also elected Fellow of the National Academy of Inventors in the Class of 2015. She has co-founded three companies based on her biomaterials research, and serves as Chair of the Scientific Advisory Board for the most recent company, Symic Bio, Inc.

Dr. Don Rose, University of North Carolina

Don Rose is Director of UNC's KickStart Venture Services, an entrepreneurial technology commercialization program in the Office of Commercialization and Economic Development. He is also an Adjunct Professor at UNC's Kenan-Flagler Business School. He is the author of *Research to Revenue: A Practical Guide to University Start-ups* (UNC Press, 2016). In addition, Dr. Rose has written eight papers and two book chapters, and holds six U.S. patents. Don is a recognized business leader with expertise in both Fortune 500 companies and university start-ups. Before becoming director of Kickstart, he held senior leadership roles at life-science start-ups, including Metabolon in Research Triangle Park, Deerac Fluidics in Dublin, and DataCentric Automation in Nashville. Dr. Rose was a general partner with Catalysta Partners (now Hatteras Venture Partners), a seed-stage venture fund; co-founder and CEO of Phase Bioscience; and vice president of research and development for Cartesian Technologies.

Chaired by: Dr. Glenn D. Prestwich, University of Utah and Washington State University

Glenn D. Prestwich is Presidential Professor of Medicinal Chemistry and Presidential Special Assistant for Faculty Entrepreneurism at the University of Utah. He created and directs the Entrepreneurial Faculty Scholars program at Utah, and Chairs the Internal Commercialization Coordination Council. His research encompasses drug discovery in cell signaling, synthetic matrices for regenerative medicine, and glycosaminoglycan derivatives as anti-inflammatory agents. He co-founded nine companies, including Echelon Biosciences, Glycosan BioSystems, Sentrx Animal Care, GlycoMira Therapeutics, Metallosensors, and Deuteria Agrochemicals, and advises five other life science companies. In 2013, he became a Fellow of the National Academy of Inventors. His honors include the Utah Governor's Medal for Science and Technology for 2006, the 2008 Volwiler Research Award of the American Association of Colleges of Pharmacy, the 2010 University of Utah Distinguished Scholarly and Creative Research Award, and the 2014 U of Utah Distinguished Innovation and Impact Award.

3. VPR Memo of Invitation to the ERIE team

See **Appendix 3**.

4. Summary of the agenda for site visit (see also Appendix 4)

Planning for the site visit began in June 2016, through discussions with the Entrepreneurial Faculty Ambassadors, VPR Chris Keane, Associate Vice President of Research Dan Nordquist, and business development managers Brian Kraft and Travis Woodland at Pullman. We also worked with Chancellor Lisa Brown, Associate Dean of Medicine Chris Coppin, and WSU Innovation Center Director Mike Ebinger at Spokane to add and refine areas to interrogate. These discussions led to the key questions to be addressed. These included:

- Is it possible and desirable to *develop metrics* for each of the categories of the report topics below?
- Is the *commercialization infrastructure* appropriate? For example, does OC support and nurture and add value to technologies to mature them internally? What mechanisms are used, and are they effective?
- Are the *commercialization policies* for licensing, support, startup, disclosures, mentoring, WSU and faculty equity, etc. adequate and appropriate?
- Are there *recognition and reward or incentive structures for entrepreneurship, innovation, and commercialization*?
- What *factors enhance or inhibit innovation* on campus? Is there a process to identify these factors and improve the environment?
- Is there agreement and *alignment of I&E* goals by the various stakeholders (e.g., upper administration, faculty, OC)?
- What are the *COI policies and procedures*? How are management plans established? Is the COI process perceived as timely and fairly applied across all campuses and colleges?
- *Intellectual property policies*. What triggers WSU's claim of ownership on new faculty inventions?

As planning proceeded, the site visit needed to allow external reviewers to meet with many different groups of stakeholders in order to hear differences in perceptions with respect to these critical questions. Specifically, in person meetings were arranged at the main Pullman campus and the Spokane Health Sciences campus. For many meeting, Academic Media Services access brought in Vancouver, Everett, and Tri-Cities participants. While the SESRC Survey gathered anonymous faculty-wide perceptions for these questions regarding I&E at WSU, the site visits allowed the ERIE team to hone in on perceptions by specific stakeholder groups:

- Perceptions by upper administration (President, Vice Presidents, Chancellors and Vice Chancellors, Provost)
- Perceptions by Deans and Associate Deans for Research of Colleges
- Perception by Department Chairs and Directors of Schools, Centers, and Institutes

- Perception by tenured and untenured faculty
- Perception by COI committee members
- Perception by staff at OC
- Perception by business communities in Pullman and Spokane
- Perception by local economic development groups in Pullman and Spokane

The details of the agenda may be found in **Appendix 4**.

5. Summary of documents provided to the ERIE team (See Appendix 5)

Dan Nordquist and Sammy Rodriguez of ORSO collected WSU and Washington state documents relevant to commercialization, IP policy, significant financial interest and conflict of interest disclosures, OC programs, and much more. A detailed list of documents is provided in **Appendix 5**: Summary of Documents on Secure Website for ERIE team and on the website itself.

D. Examples of Commercialization Efforts with WSU Technologies

1. Introduction

As part of this report, the ERIE team identified a variety of commercialization efforts that could highlight what has worked and where problems have arisen. Each profile was based on a template and was completed jointly by the faculty entrepreneur working with the review team. A sampling of those companies or commercialization efforts that faculty members agreed could be shared publicly are listed below, and the profiles of the associated companies can be found in **Appendix 6**.

It is said that one often learns more from one's failures than from one's successes—the team felt that both are important and instructive. Several technologies faced early problems inexperience of both the faculty and the Office of Research. Other problems arose from inadequate infrastructure on and off campus, lack of management talent for startups, lack of funding, and other difficulties. It is also important to reiterate that the examples are based on faculty perceptions and opinions.

2. *Selected observations from companies profiled*

a. ***The service center model.*** The Veterinary Clinical Pharmacology Laboratory is a WSU service center with four employees, directed by Dr. Katrina Mealey (CVM), that performs genetic testing for MDR1 variants. The innovation is based on IP for composition of matter and methods of use. The service center allows the faculty inventor to be in charge of the facility, while minimizing COI concerns. Royalty and licensing fee percentages flow to both the College and to the inventor. The main learning for the ERIE team from this example is that the service center model appears to be a highly successful model within the WSU system, and other service centers have been started or contemplated. These offer new mechanisms by which WSU can fulfill its land-grant mission.

b. ***The startup with WSU and industry support and little direct faculty involvement in the business.*** 915 Labs designed and manufactures microwave heating systems for sterilization of pre-packaged ready to eat meals, and has strong IP protection for the 915-MHz single-mode cavity and for methods and temperature sensors, all facilitated by WSU. Food companies (for retail) and the military are customers. In many ways, 915 Labs is now a poster-child for how WSU can effectively fulfill its land-grant mission. The company is headquartered in Denver and has 14 employees, and has subcontracts for manufacturing commercial systems to MMT LLC in Knoxville, Tennessee. The current 915 Labs acquired Food Chain Safety LLC in Washington that licensed WSU technologies, facilitated by Kevin Peterson now VP of Business Development. The faculty inventor, Dr. Juming Tang, felt that use of the WSU engineering shop for design and prototype development was critically important for maturing the technology and highly educational—more than ten predoctoral students whose publishable research ultimately enabled commercialization and regulatory filings. Dr. Tang felt that WSU—including OC, ORSO, CAHNRS/ARC—were all highly supportive. In addition, direct participation by food industry and technology leaders supported and facilitated the growth of the WSU Microwave consortium with matching funds; this augmented strong DOD and USDA funding of $12 million for the past 16 years. While the remoteness of Pullman was a major drawback for the visibility of the company and its access to private capital for scale-up, this was overcome through partnerships at the business level. The primary learning for the ERIE team from this example is that the faculty inventor, Dr. Tang, was not directly involved in the company side. Rather, he maintained his role as the academic innovator whose research directions were synergistically influenced by the potential and successes of the technologies in the marketplace.

c. ***The small startup model.*** Klar Scientific LLC is a Washington LLC with 1–2 employees in Pullman Research Park, and is developing digital confocal optical profile microscopy under IP licensed from WSU. Richard Lytel is the CEO and faculty inventor Dr. Matt McCluskey is the CTO; both are physics PhDs and Lytel has significant start-up experience. WSU assisted with I-Corps, IP, and CGF funds. Dr. McCluskey felt that the WSU COI process was cumbersome and confusing. In his view, a single point of contact and a more streamlined process are needed. He

also felt that paperwork for use of the McCluskey laboratory space was unnecessarily complex. The primarily learning for the ERIE team from this example is that faculty startups in which the faculty retains a technical leadership role in the business is workable with a separate CEO and proper COI management plan, but the systems to support these activities are underdeveloped and need simplification.

d. ***The multi-site startup with growing pains.*** Phytelligence, Inc., based on technologies disclosed by Amit Dhingra in the Department of Horticulture of CAHNRS, is now a production-scale company of 57 with facilities in Seattle, Burien, Portland, and Pullman. Phytelligence is also an exemplar of how WSU can fulfill its land-grant mission. The company now has a strong management team, and it has licensed six trade secrets in plant propagation and two patents for control ripening of fruits and vegetables. Phytelligence serves propagation and harvesting industries by translating novel research technologies into products and services, and is able to make use of WSU alumni, graduates from Dr. Dhingra's program, and WSU connectivity to the agriculture industry to its advantage. In early stages of the company, Dr. Dhingra felt that his efforts as founder were unnecessarily difficult and not fully supported within his department and college. He was concerned that college, department, and faculty inventor goals were not well aligned. The primarily learning for the ERIE team was that a number of misunderstandings, misalignments, and missteps appear to have moderated the pace of business maturation. Several of our recommendations are directed at mitigating factors that were perceived to have slowed progress, while adding mechanisms to enhance progress for WSU technologies in startups.

e. ***Overcoming challenges of being too early.*** M3 Biotechnology, based on technology from Joe Harding (CAS) and Jay Wright (CVM), is now a clinical stage company with an Alzheimer's drug in development. It is located in Seattle with 11 employees and $13 million of capital raised. WSU provided laboratories, students in early stages, patent support, and strong support at college and department levels. Life Sciences Discovery Fund (LSDF) and Michael J. Fox Foundation have validated the potential. Drs. Harding and Wright noted that early challenges prior to 2005 involved an unsuccessful company (Pacific Northwest Biotechnology), and that inexperience by WSU in managing COI delayed development. Additional delays were related to accessing lab facilities in Pullman at WSU. Drs. Harding and Wright felt that commercialization was not fully supported at WSU prior to 2005. Ultimately, with changes in laws in Washington, with improved commercialization attitudes and infrastructure at WSU, and with identifying the right CEO—ultimately a former post-doc from Dr. Harding's laboratory with the interest and appetite to take the technology forward—the company began to realize its potential for success as a start-up biotech company. The primary learning for the ERIE team was that WSU should learn from past inexperience, but focus its current actions on installing policies and procedures that build on the positive factors that have facilitated growth and maturation in recent years.

f. ***Facing the bench to bedside challenges.*** Cancer Targeted Technology, LLC (CTT) was formed in 2006 with multiple patents licensed from WSU and from San Francisco State University. CTT's management includes faculty inventor Dr. Berkman as CSO, and Dr. Beatrice Langton-Webster as the CEO. Dr. Langton-Webster has strong technical credentials and is qualified to be PI on SBIR and other grants submitted by CTT. Currently, CTT has a lead product in Phase I clinical trials for imaging prostate tumors. This product is based on a peptidomimetic inhibitor of PSMA, and a companion therapeutic agent currently in development under an NIH contract; an IND submission is anticipated in approximately 1 year. Dr. Berkman felt that the greatest challenges were long delays in formalizing access to WSU laboratory facilities and in subcontracting research work from CTT back to WSU. The lack of wet laboratory space in the Pullman-Moscow area was also a major drawback. Ideally, at the early stage of spin-off technology, it is desirable to locate the spin-off operations within close proximity to its source. In the end, the brick-and-mortar operation of CTT was established initially in Bothell, WA. Overall, faculty inventor Dr. Berkman felt that WSU policies for faculty and their startups were neither clear nor consistent

during the 2006–2016 decade. As with M3 Biotechnology, the primary learning for the ERIE team was that WSU should focus its current actions on clarifying and implementing policies and procedures that build on the positive factors that can better facilitate growth and maturation of faculty startups with licenses to WSU technologies.

g. ***A tale of two companies: the need for clarifying roles and responsibilities and creating a positive environment.*** For 8 years, Dr. Diane Cook, Aaron Crandall, and Larry Holder (VCEA) had developed and disclosed technologies that extract activity patterns from multi-point sensor data. WSU was supportive for code refinement, and for facilitating access to LSDF funding that led to the company launch. Thus, in 2015, the faculty inventors co-founded Behaviometrics to commercialize in-home applications of the technology. In 2016, Adaptelligence was launched to commercialize uses of the technology for mobile applications. The faculty inventors experienced a lack of clarity on issues related to COI, which delayed a Behaviometrics SBIR application for some 9 months. The faculty inventors felt that WSU created a confusing and unsupportive environment for innovation and entrepreneurship that tempered their interest in further engaging in commercialization activities. The primary learnings for the ERIE team were: (i) there should be clearly articulated mechanisms to manage COI; and (ii) there should be simple and clearly articulated rules and bounds for faculty seeking to make software-based inventions available to the public.

h. ***A missed opportunity in gene therapy.*** AAVogen, Inc. was co-founded by faculty inventor Dr. Buel "Dan" Rodgers (CAHNRS) in 2015 to develop a novel gene therapy for muscle wasting diseases. The company was based on IP from Rodgers and a co-inventor from Baker IDI. Dr. Rodgers also created and directs a large multi-disciplinary, multi-institutional center, Washington Center for Muscle Biology, giving both the research and business sides a strong WSU connection and advantage. Dr. Rodgers recruited a CEO, CSO, and other outstanding management to address a market of 70 million patients, first targeting a smaller subset of cancer cachexia patients. He was in the process of trying to secure non-WSU and Seattle resources (SBIR, DOD/USAMRCMC, NIH/CRADA) for preclinical work leading to clinical trials. However, Dr. Rodgers felt stymied in his requests to move forward on the regulatory and preclinical/early clinical development pathway. He felt that the college and COI committee were unsupportive in achieving a timely submission of an SBIR/STTR application. Initially, identifying a laboratory location and a CEO were challenging in Pullman. Retention efforts for Dr. Rodger and AAVogen either in Pullman or Spokane were ultimately unsuccessful. The primary learnings for the ERIE team were that early attention to COI and a college and departmental environment supportive of I&E among its faculty are critically important. Proactive, not reactive, policies and procedures in support of I&E will be crucial to retain innovative faculty and their teams.

i. ***Helping students become entrepreneurs in energy innovation.*** In May 2015, Dr. Jacob Leachman (VCEA) co-founded Protium Technologies LLC with three student inventors (Patrick Adam, Ian Richardson, and Eli Shoemaker). The discoveries developed in the Leachman laboratory would allow creation of small, local hydrogen liquefaction facilities with novel cryocompression technology that is now being licensed to Protium. Protium now has an SBIR in review, and a Washington state clean energy fund application is being prepared. The technology has incredible promise in meeting WSU's Grand Challenges and in fulfilling the land-grant mission. Unfortunately, Dr. Leachman's interactions with COIC were negative and adversarial, and did not lead to a resolution that enabled him to continue as a founder and shareholder in Protium. As with several other examples, the primary learnings for the ERIE team were that early attention to COI, clear policies for COI involving student entrepreneurs, and a college and departmental environment supportive faculty and student I&E activities were important for improving the path forward. This is reflected in the ERIE recommendations in making needed changes in COI to create a process that is routine, seamless, and faculty/student friendly rather than adversarial.

3. Conclusion

The companies profiled herein span a tremendous landscape of technologies, disciplines, colleges, locations, and faculty phenotypes. They also illustrate a few examples of commercialization efforts that were successful because of thoughtful planning, a few examples of struggling to cope with inexperience, space unavailability, or unclear reporting pathways, and too many examples of poor communication and unrecognized personal and/or internal (institutional) COIs. While embedded in specific individual perceptions and opinions, these examples echo broader patterns that were recognized in both the survey and site visit: There is a broad interest to embrace the land-grant mission but a need to better communicate and support both the mission and the pathways for faculty trying to bring their work into the non-academic world.

WSU has been improving. As the perspectives outlined above, and their associated company profiles in **Appendix 6** suggest, the door may still be open to further improve both the interactions with WSU and outcomes for the stakeholders. The action items recommended below in **Section E** provide a roadmap to address the complex and often counterproductive difficulties plaguing I&E at WSU. Importantly, the recommendations also offer pathways to enhance—through a virtuous cycle—those already productive activities in which WSU is engaged.

E. Summary of Recommendations for Action Items to Achieve Desired Outcomes

In the paragraphs below, the ERIE team proposes action items in six broad areas, with actions recommended at three levels: (i) top down (upper administration and college level); (ii) bottom up (grassroots, from within faculty and departments), and (iii) operational (improving processes to align with the shared goals). We have made both specific and general recommendations; it is the team's intention to encourage research engagement among faculty, students, businesses, non-profits, community groups, and start-ups. Specific recommendations offer incentives and opportunities for improvement on these activities; general recommendations will require collaboration within WSU to determine how best to support these end goals.

Moreover, the Outcomes section of the Charter provided the following guidance: If WSU takes steps to define and realize these opportunities, and takes steps to reduce obstacles and replace disincentives with rewards, how should success be measured? What are the most important, reasonable and achievable goals for the upcoming five-year period? How should WSU define relevant metrics for determining success, and what specific actions should WSU take to implement the committee's recommendations?

The team believes that we cannot dictate specific guidance and metrics to WSU. Rather, we believe that our recommendations will enable and incentivize WSU to begin the dialogues on campus, and to define for the campus what success in improved I&E means, and how to achieve that success.

1. **Clarify and communicate the mission.** A clear and consistent message about the importance of I&E is required to support and grow engagement.

a. ***The committee recommends the President clearly articulate that I&E is important to WSU.*** The President should extol why I&E is important to WSU's land-grant mission. He should thereby encourage the faculty to participate in the land-grant mission and to recognize the important role WSU innovations have played in the lives of people in Washingtonian, nationally, and worldwide. Examples: (i) Presidential involvement in EFA director change announcement and EFA mission broadening to be inclusive and trans-disciplinary across campus, and (ii) Connect I&E at every opportunity to Grand Challenges and to Drive to 25.

b. ***Establish an I&E colloquium series.*** The monthly or quarterly colloquium would feature prominent WSU alumni and land-grant college faculty from across the US. At least one presentation per year would be by a WSU faculty innovator. These high profile, campus-wide events should encourage student engagement and help define how I&E can enhance scholarship in research, education, and service by WSU faculty and students. By showcasing what success looks like, WSU can lead by example.

c. **WSU should prioritize, by college and department, the specific meaning and relative importance of impact of I&E for its faculty.** This requires in essence a bottom-up approach to defining the clarity of purpose for each unit. In addition, a top-down "broad stroke" initiative provides motivation for units to undertake the bottom-up actions.

d. **Leadership at all levels need to publicly and regularly draw attention to the importance of WSU's research in improving people's lives**. WSU's technological innovations enhance the economic, educational, research, and high-tech manufacturing base in Washington state. The "Drive to 25" means first codifying WSU's leadership in the Inland Northwest but then transcending and remaking WSU as a regional attractor for business, education, research, and economic development.

e. **The committee recommends the President sponsor a Town Hall meeting on college and department level support for I&E.** Led by the VPR and Provost, the Deans and Chairs should meet with faculty in each college regarding support for I&E. A clear consensus is needed for a common and coherent message uniformly applied across institution regarding I&E activities, particularly for infrastructural support, non-dilutive funding, recognition, and incentives. In addition, the groups should discuss and define what success would be in I&E, including what metrics or outcomes correspond to their view of success in meeting WSU's land-grant mission.

This would clarify how WSU values academic-industry engagement locally, regionally, nationally, and internationally.

2. **Support the mission.** A more coherent set of administrative and operational support structures is required to develop and diversify external engagement to enhance I&E.

a. ***Add specific central support for external engagement.*** Add a function that is specifically charged with refining, developing, diversifying, and propagating faculty external engagement. This function should both grow and diversify current offerings to include non-commercial and pre-IP activities. This central support should be augmented with college or departmental local support to coordinate central investment with local strategy.

b. ***Engage WSU development and WSU alumni organizations.*** Active involvement of the development office and alumni organizations is needed to create networks of angel investors, business advisors, entrepreneurs-in-residence, and industry partners that support the translational I&E initiatives.

c. ***Expand and broaden the Entrepreneurial Faculty Ambassador program***. The current core EFA group should pivot and expand the concept of I&E to encompass all disciplines and all aspects of the land-grant mission by adding individuals with a track record of community outreach, efforts in extension, innovations in education and excellence in the fine arts. EFA mentoring should increase, and an EFA-led community of faculty innovators should be expanded. Recruitment of knowledgeable and experienced part-time staff to manage the entrepreneurial activities is needed.

d. ***Involve and encourage student entrepreneurs at every opportunity.*** A focus on faculty entrepreneurs as mentors for student entrepreneurs brings I&E back to core academic mission and values. This should be a prominent part of WSU's message in donor development contacts. Endowments for student entrepreneur scholarships across many disciplines should be sought and faculty mentoring opportunities should be created for student entrepreneurs as scholarly activities. In addition, include community partners and industry partners to cement the full spectrum of student-faculty-community interactions. This could be a complementary component to the student success proposal in CAS and CAHNRS.

e. ***Create industrial internship opportunities for students.*** Partner with companies to have undergraduate or graduate students spend from one to three 6-month internships working in an industrial environment as part of their education, following the successful example of Northeastern University. This creates better industrial connections—regional, national, and international—for WSU, while providing better job opportunities for students after graduation.

f. ***Create opportunities for WSU campuses to connect with local industries for R&D.*** An outcome-agnostic, pre-IP partnering function would allow building new industry external interactions with WSU faculty. One example would be a "reverse-pitch" program for regional industries to express their needs and problems to be addressed and resolved to faculty (and student) groups, and then solicit proposed research to find practical solutions. This would develop local partnerships with targeted, industry sponsored research opportunities to benefit students and the community. This should provide mechanisms to better support and connect faculty researchers with local businesses, e.g., sponsored research and design, paid internships, etc. This recommendation applies broadly and inclusively to the Vancouver, Everett, Tri-Cities, and Spokane campuses as well as the Pullman campus.

g. Create clear policies for student involvement in industry-sponsored research. While support is required and valuable for student engagement, clear "red lines" are needed to balance preservation of academic values and protection of students, protection of IP and publication of scholarly work.

3. **Develop incentives**. WSU leadership needs to develop recognition and reward structures to support, encourage, and expand I&E.

a. ***Create a Presidential Entrepreneurship Award, based on innovation and impact.*** The award would recognize outstanding faculty innovators whose contributions have directly or indirectly impacted and improved the lives of people, and had a measurable benefit to society. Eligible faculty encompass all academic disciplines, including health care, energy, environment, business, public policy, communications, technology, or the arts. We recommend that two award be made provided each year that recognize innovation and impact across distinct and diverse disciplines.

b. ***The committee recommends the President host an inaugural dinner for the Entrepreneurial Faculty Ambassadors*****.** The dinner should include up to ten additional prominent faculty innovators/inventors and successful recent alumni. This event sends a campus-wide message that I&E is important to the president and that it includes all the WSU family.

c. ***Create a Presidential task force to examine how to incentivize I&E at WSU.*** The task force should examine and solicit feedback, make recommendations, and design implementation strategies for how best to specifically support and incentivize entrepreneurial, commercialization and community outreach activities. This examination should explore options including (but not limited to): (i) mechanisms and methods for recognition of entrepreneurial productivity in the appointment, promotion, and tenure process decisions, (ii) the creation of new "professors in practice" or "translational professor function" into the faculty designations at WSU (that may or may not be tenured), (iii) the development of enabling leave policies that facilitate external engagement, (iv) the development of policies on the internal allocation of royalty revenue, (v) the development of mechanisms for special or temporary appointments, and/or (vi) the development of specific scholarships to fund and support I&E by students working with faculty entrepreneurs.

d. ***Create Translational Postdoctoral Scholarships*****.** Up to two translational scholars per year would be supported by WSU to translate their academic work in a faculty innovator's laboratory into the private sector. Such a model encourages and recognizes the importance of student participation in I&E and the creation of new companies and positions locally that can commercialize WSU technologies. Such a program would provide students/postdocs with gap funding support to work for WSU-spin out companies. Ideally, this would be funded by donations that create named, endowed scholarships, which would integrate educational, research, and commercialization missions of the University that impact the wider community.

4. **Tighten the focus of the Office of Commercialization.** While faculty clients of OC are generally satisfied with its performance, the faculty and ERIE conclude that OC is spread too thin, and is inadequately focused and resourced to carry out the scope and breadth of activities within its assigned mission. However, most faculty are not clients of OC. This is addressed in **Sections E.1** and **E.2** above.

a. ***Create technical expert panels for technical evaluation of technologies to inform patenting decisions****.* Two or three independent technical assessment panels could cover most technologies; faculty value and have more confidence in feedback from faculty peers and independent technical experts. This allows the OC to manage patents exclusively for commercial outcomes. It improves capital efficiency but retains respect for faculty innovators.

b. ***Consider adding a senior or emeritus faculty member as a part-time employee of OC to regularize and enhance faculty engagement.*** Identifying a successful faculty innovator who may soon or has transitioned out of a full-time academic role would give add gravitas to OC and provide much-needed interconnections between the academic and business worlds. In addition, recruitment of a retired executive with management or business development expertise would also be beneficial.

c. ***Create an Industry Advisory Board (IAB).*** Identify participants from the business community and interested and successful WSU alumni to help OC identify the true value and market potential of a given technology. The IAB would infuse fresh ideas and could include industry

professionals from a broad geographical region, focused on the Intermountain West and Pacific Northwest. The IAB would (i) advise on approaches for collaboration on commercialization with industry, (ii) inform the university about practical problems in need of solutions from WSU, and (iii) keep the university aware of evolving workforce needs so it can rebalance its educational programs accordingly. This would require recruiting a new *Commercialization Program Manager* to manage this board as well as the faculty peer review groups.

d. ***Increase and reorganize OC programs to add value to disclosed technologies*****.** The OC needs to develop a new mechanism to provide rapid, incremental, milestone-gated development or "gap" funds to assist the transition from basic research to prototype development and testing. This would replace the existing Commercialization Gap Funding program. Such incremental, value-creation targeted funding would address many existing problems and concerns expressed during the ERIE process. Decisions for such a new program would involve the OC, the external commercialization advisors, and successful alumni.

e. ***Explore options to set up temporary companies within an LLC Holding Company held by WSU (or the WSU Foundation) that would facilitate and expedite SBIR/STTR submissions.*** Such an LLC could be funded by and staffed by successful alumni. This alleviates initial complications and delays for the faculty inventor for COI, SFI, etc. Once an SBIR/STTR award is made, the company would be reorganized and appropriate management put into place, with appropriate COI and SFI disclosures. The strategy still requires a technically qualified PI for the application, which could be new graduates such as the Translational Postdoctoral Scholars.

f. ***Create a council tasked with coordination of all activities in innovation, commercialization, impact, and outreach.*** The current archipelago of poorly connect islands of effort outlined in Appendix 9 need a single council of stakeholders to improve communication, allow coordination, and streamline implementation.

5. **Overhaul the COI process**. There was a consensus that the COI process needs considerable improvement. This would include streamlining and becoming more transparent, consistent, and faculty friendly. Concerns were identified with the initial application, COIC composition, and creating and implementing COI management plans.

a. ***Streamline COI and enable rather than impede faculty entrepreneurs*****.** Companies and faculty lose interest if the overall COI process is cumbersome, overly conservative, and based on suspicion rather than trust and respect.

b. **Redefine the role of the COI Committee (COIC).** The COIC should serve primarily a support and oversight function, not a policing or enforcement function. COIC should work with faculty to recognize potential COIs and work collaboratively and proactively to manage those potential COIs.

c. ***Add a full-time Compliance Officer to serve as both a faculty advocate and problem solver for COI matters*****.** The CO should coordinate the COIC, which would meet regularly and be primarily in an advisory role. A half-time administrative assistant would also be required.

d. ***Revisit and review the policies for selection of COIC members and COIC chair***. Term limits for members should be instituted, and at least one-third of committee should be faculty entrepreneurs with active COI management plans. The committee makeup and leadership should be selected to encourage I&E within legal and academically appropriate guidelines. Treating faculty with respect rather than suspicion will better promote the desired entrepreneurial efforts.

e. ***Incorporate discussions of I&E and COI at new faculty orientation***. The time to provide relevant information on I&E is right at the beginning of the careers of new faculty.

f. ***Establish an acceptable level of risk.*** We recommend that the President, VPR, and attorney general have a discussion to establish the appropriate level of risk, and the COIC should advise the Compliance Officer on how to implement this policy, rather than making policy ad hoc on a case-by-case basis.

g. ***Establish policies and procedures for identifying and managing potential internal conflicts of interest (ICOI).*** The ERIE team noticed a few areas of concern where there are

perceived internal (institutional) conflicts of interest. In areas of commercialization and external engagement, the team noticed several scenarios in which the economic and/or administrative interests of one unit competed with, or were are potentially at odds with, the economic administrative interests of another unit or faculty member. The ERIE team recommends that clear policies and practices are developed to identify, address, and navigate any such potential ICOI.

h. ***Gifts to WSU need to be subject to clear policies and practices.*** Gifts, when they should be grants for industrial-sponsored research, can circumvent both COI and sponsored projects. Some issues appear to have occurred in the past, and the ERIE team recommends revisiting and revising the policies and practices.

6. **Build on I&E momentum at WSU-Spokane to engage across the state.** The new Health Sciences campus is located in a regional economic hub and the state's second largest city. Enabling Spokane to become a test bed and flagship in I&E activities would benefit health and wellness research at all campuses within WSU as the institution aims to engage statewide. Efforts on the Spokane campus could serve to test and demonstrate functional models that could be replicated on the other campuses in Everett, Tri-Cities, and Vancouver. Such efforts would be beneficial in helping WSU become more broadly connected to its regional constituencies statewide. This would both meet WSU's land-grant mission and expand WSU's influence and network statewide. It also facilitates development and active involvement of successful WSU alumni in a WSU-wide I&E network. See **Box 3** for additional information.

a. ***Support the Spokane campus in becoming an agile driver of I&E and regional economic development.*** WSU-Spokane is well integrated with the University District, Greater Spokane Inc., and all local hospitals and clinics. Opportunities for medical school education and training, research partnership development, clinical trial development, health care outreach to underserved communities, and regional health care service innovations are already in place. Faculty and leadership, including the Chancellor, Deans, and Associate Deans are actively engaged in creating partnerships that would further enhance the I&E ecosystem in Spokane.

b. ***Consider enhancing regional alliances.*** Each campus has the potential for improving its R&D income and industry engagement through regional alliances. Spokane and Pullman could join forces with University of Idaho in both the Pullman-Moscow and Spokane-Coeur d'Alene axes. Similar alliances could be built across the state, to further enhance WSU's footprint in central Washington and on the west side of the state. These alliances would provide greater access to new company startup space, management talent, entrepreneurs in residence, successful alumni, investment capital, and creation of jobs for WSU graduates.

c. ***Produce a high-profile, annual Translational Medicine Symposium in Spokane.*** Such an event would be co-hosted and co-sponsored by WSU-S and Health Sciences & Services Authority of Spokane (HSSA), with participation by regional hospitals and clinics, GSI, University District, Lee & Hayes law firm, Avista, Numira Credit Union, and many other key stakeholders. It is important to make this a regional event to draw to multi-county participation from the greater Inland Northwest, including Pullman, Moscow, and Coeur d'Alene.

d. ***Launch additional graduate programs at WSU-Spokane.*** Administration, faculty and community input underscore an urgent need to attract, educate, retain, and grow a locally trained and regionally loyal technical workforce in the greater Spokane region.

e. ***Recognize I&E activities by faculty.*** The College of Medicine should encourage discussions by deans and department chairs on how to recognize and incentivize I&E activities by faculty in promotion and tenure decisions in policies currently being drafted.

F. Appendices

- Appendix 1: Charter for ERIE team from Chris Keane, Vice President for Research
- Appendix 2: Biographical sketches of ERIE team members
- Appendix 3: VPR Memo of Invitation to ERIE team
- Appendix 4: Agenda for site visits at Pullman and Spokane
- Appendix 5: Summary of documents on secure website for ERIE team
- Appendix 6: Examples of commercialization efforts with WSU technologies
- Appendix 7: Cosmic Crisp™ 38: A Case Study in Commercialization
- Appendix 8. The archipelago of external engagement at WSU

G. Informational Highlight Boxes

- Box 1: Perceptions on Commercialization at WSU by Dr. Yogendra Gupta
- Box 2: Conversation with Dr. Noel Schulz: Increase I&E to enhance research and education
- Box 3: WSU-Spokane Health Sciences Campus: A hub for health sciences innovation and economic development in Eastern Washington

Appendix 1: Charter for ERIE team from Chris Keane, Vice President for Research

Charter for
External Review of Innovation and Entrepreneurship at Washington State University

Washington State University (WSU) President Kirk Schulz has proposed to the WSU community that the University set a goal of being "recognized as one of the nation's top 25 US public research institutions, preeminent in research and discovery, teaching, and engagement by 2030." Achievement of this goal will require advancing the WSU research enterprise, including enhancing industrial research partnerships, entrepreneurial activity, and innovation directed to the betterment of the people of the state and the nation. Enhancing WSU's entrepreneurial and innovation presence aligns with the University's land-grant mission: to advance, extend and apply knowledge in order to improve the quality of life and enhance the economy of the state and nation.

WSU has made progress in this area. Licenses issued have increased more than five-fold since 2008, royalty revenue and invention disclosures have increased in the past few years, and the University has announced the funding of several new strategic research initiatives. However, challenges remain for WSU to achieve its full potential in translating its research excellence into economic impact for the state and for each of the campus communities. To this end, an external review of the WSU innovation and entrepreneurship program is now timely. Vice President for Research Christopher Keane has tasked Professor Glenn Prestwich of the University of Utah to lead this external review by experts and practitioners in technology commercialization and entrepreneurial activities by academics. Prof. Prestwich's team will address the following questions, and will propose achievable goals:

1. ***Opportunities***. What opportunities and college-level programs exist that could support innovation and entrepreneurship by academics at WSU? Considering WSU's research strengths, facilities, capabilities, multiple campuses, and other key factors, what are the most promising general areas for growth in entrepreneurship by academics? Are these opportunities sufficiently compelling that they merit investment? How should they be prioritized for funding?
2. ***Obstacles.*** Does WSU have the infrastructure, processes, support funding, and other factors necessary to realize these opportunities? What impediments exist that constrain realization of the opportunities? Evaluate key components required for success, including the overall university culture and attitude towards entrepreneurship, tenure and promotion guidelines, space and other physical infrastructure, and the health of the commercialization, conflict of interest, and related enabling internal processes. What disincentives exist and how can they be replaced with a reward system that encourages successful entrepreneurship? How important to success is developing a presence in western WA, and if this is critical, how should it be done?
3. ***Outcomes.*** If WSU takes steps to define and realize these opportunities, and takes steps to reduce obstacles and replace disincentives with rewards, how should success be measured? What are the most important, reasonable and achievable goals for the upcoming five-year period? How should WSU define relevant metrics for determining success, and what specific actions should WSU take to implement the committee's recommendations?

Daniel Nordquist, Associate VP for Research, will serve as the point-of-contact for the Committee regarding logistics and gathering of necessary information. The Committee should take a system-wide approach, and hold at least one meeting at WSU to interview WSU faculty and staff involved in the innovation, commercialization, and entrepreneurial enterprise. The final Committee report should include specific recommendations for improvement, and be delivered to the Vice President for Research by December 31, 2016.

Appendix 2: Biographical sketches of ERIE team members

External Review of Innovation and Entrepreneurship
at Washington State University
Profiles of External Reviewer Team Members
24 August 2016

Note: Each individual below has been contacted and has agreed to serve as a member of the external review team.

Dr. Michael Cable, University of California, Berkeley

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Before coming to BSAC, Dr. Cable worked at a number of early stage technology companies commercializing university-based research. These include CEO of Matrix Sensors (MEMS based biological and environmental sensors), CTO Xenogen (preclinical bioluminescent imaging), and high level positions at Nanomix, Xradia, Fovi Optics and Quantum Dot. He has also worked at both Lawrence Livermore National Laboratory (laser fusion) and Lawrence Berkeley National Laboratory (physical biosciences). Dr. Cable has over 40 patents and received his Ph.D. in Nuclear Chemistry from the University of California, Berkeley and his B.S. from Iowa State University.

Dr. Bruce Gale, University of Utah

Bruce K. Gale
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Bruce K. Gale is Professor of Mechanical Engineering with expertise in microfluidics, sensors, and nanotechnology. He is Chief Science Officer at Wasatch Microfluidics, a company that was spun out of his lab in 2005. He has recently spun out two additional companies from his lab, Espira, Inc. and Guanine, Inc., which are still early stage. He also serves as Chair of the Conflict of Interest Committee.

Mr. Joe Giffels, University of Washington

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Joe Giffels serves as the University's point person for Research Administration and Integrity, including Compliance, working to coordinate the efforts of the many administrative and compliance operations campus-wide, encouraging increased communication and integration of activities intended to promote research integrity. He serves as the Institutional Official responsible for human research protections and his office manages the research financial conflicts of interest and faculty outside consulting processes. He came to the UW following several years as Assistant Vice President for Academic Affairs at the University of Maryland Baltimore and Director of that University's Research Integrity Office

Dr. David Kimball, Rutgers University

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Dr. Kimball's research career has focused on the discovery and development of small molecule treatments for human disease, spanning several therapeutic areas, including cardiovascular disease, metabolic disease, inflammation, oncology, neuroscience and pain. He is a cofounder of Z53 Therapeutics, where his current research interest is the most common genetic lesion in cancer, mutant p53. He has been an Associate Member of Graduate Faculty, Rutgers University from1989-2011, while serving in senior management roles at Lexicon Pharmaceuticals, Pharmacopeia, and Hydra Biosciences. David is now tasked with developing a faculty-friendly environment for translational research and research commercialization at Rutgers University.

Dr. Alyssa Panitch, University of California Davis and Purdue University

Alyssa Panitch
Edward Teller Professor
Chair, Biomedical Engineering
University of California, Davis
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Alyssa Panitch is now Chair of Biomedical Engineering at UC Davis, having recently moved from her position as Leslie A. Geddes Professor in Biomedical Engineering and Vice Provost for Faculty Affairs at Purdue University. Dr. Panitch also served as Associate Head of the Weldon School of Biomedical Engineering at Purdue from 2009 to 2013. Dr. Panitch's research focuses on designing biomimetic and synthetic materials for drug delivery and regenerative medicine. She has received the National Science Foundation Career Award, been named a Purdue Faculty Scholar, and is a Fellow of both the American Institute for Medical and Biological Engineering and the Biomedical Engineering Society. She was also elected Fellow of the National Academy of Inventors in the Class of 2015. She has co-founded three companies based on her biomaterials research, and serves as Chair of the Scientific Advisory Board for the most recent company, Symic Bio, Inc.

Dr. Don Rose, University of North Carolina

Don Rose, Ph.D.
Director, KickStart Venture Services
Office of Commercialization and Economic Development
University of North Carolina at Chapel Hill
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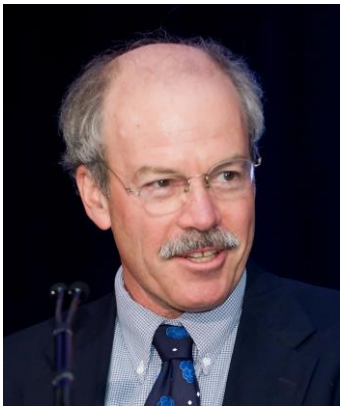
Website: Carolina KickStart

Don Rose is Director of UNC's KickStart Venture Services, an entrepreneurial technology commercialization program in the Office of Commercialization and Economic Development. He is also an Adjunct Professor at UNC's Kenan-Flagler Business School. He is the author of *Research to Revenue: A Practical Guide to University Start-ups* (UNC Press, 2016). In addition, Dr. Rose has written eight papers and two book chapters, and holds six U.S. patents. Don is a recognized business leader with expertise in both Fortune 500 companies and university start-ups. Before becoming director of Kickstart, he held senior leadership roles at life-science startups, including Metabolon in Research Triangle Park, Deerac Fluidics in Dublin and DataCentric Automation in Nashville. Dr. Rose

was a general partner with Catalysta Partners (now Hatteras Venture Partners), a seed-stage venture fund; co-founder and CEO of Phase Bioscience; and vice president of research and development for Cartesian Technologies.

Chaired by: Glenn D. Prestwich, University of Utah and Washington State University



Glenn D. Prestwich
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Glenn D. Prestwich, PhD
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Glenn D. Prestwich is Presidential Professor of Medicinal Chemistry and Presidential Special Assistant for Faculty Entrepreneurism at the University of Utah. He created and directs the Entrepreneurial Faculty Scholars program at Utah, and Chairs the Internal Commercialization Coordination Council. His research encompasses drug discovery in cell signaling, synthetic matrices for regenerative medicine, and glycosaminoglycan derivatives as anti-inflammatory agents. He co-founded nine companies, including Echelon Biosciences, Glycosan BioSystems, Sentrx Animal Care, GlycoMira Therapeutics, Metallosensors, and Deuteria Agrochemicals, and advises five other life science companies. In 2013, he was inducted as a Fellow of the National Academy of Inventors. His honors include the Utah Governor’s Medal for Science and Technology for 2006, the 2008 Volwiler Research Award of the American Association of Colleges of Pharmacy, the 2010 University of Utah Distinguished Scholarly and Creative Research Award, and the 2014 U of Utah Distinguished Innovation and Impact Award.

Appendix 3: VPR Memo of Invitation to ERIE Team

WASHINGTON STATE UNIVERSITY | Office of Research

TO: Glenn Prestwich, University of Utah and Washington State University, Review Committee Chair
Michael Cable, University of California, Berkeley
Bruce K. Gale, University of Utah
Joe Giffels, University of Washington
David Kimball, Rutgers University
Alyssa Panitch, University of California, Davis
Don Rose, University of North Carolina

FROM: Dr. Christopher Keane
Vice President for Research
Professor of Physics

DATE: August 31, 2016

SUBJECT: Charter for External Review of Innovation and Entrepreneurship at Washington State University

Thank you for agreeing to serve on the External Review Team of Innovation and Entrepreneurship at Washington State University (WSU). The Charter for External Review of Innovation and Entrepreneurship at WSU (attached) describes the scope of the review team's goals and activities. Please work together with the other members of this committee (member profiles attached) in order to execute the charter. These activities will be coordinated through Dan Nordquist, Associate Vice President for the Office of Research Support and Operations (ORSO). Dan will schedule an initial organizational call in the near future to map out the time frame and actions for the team to accomplish its goals.

Travel arrangements for your visit to Pullman and Spokane will be handled by Sammy Rodriguez in ORSO. You may contact him at samuel_rodriguez@wsu.edu / 509-335-3796 for assistance.

We greatly appreciate your service on this important project and look forward to your participation and feedback. Please direct any questions you may have to Glenn Prestwich (glenn.prestwich@wsu.edu).

cc: Dan Nordquist, Washington State University

Appendix 4: Agenda for site visits at Pullman and Spokane

Campus Visit

November 7-9, 2016
Washington State University

External Review of Innovation & Entrepreneurship (ERIE)

Michael Cable Exec. Dir., Berkeley Sensor & Actuator Center (BSAC), UC-Berkeley

Bruce Gale Prof. Mechanical Engineering – Dir., State of Utah Center of Excellence for Biomedical Microfluids – Executive Dir., College of Engineering Nanofrabrication Facility – Chair, University COI Committee, U of Utah

Joe Giffels Assoc. Vice Provost, Research Administration & Integrity, Office of Research, U of Washington

David Kimball Assoc. Vice President, Research Commercialization & Translational Sciences, Research & Economic Development, Rutgers U

Alyssa Panitch Edward Teller Professor – Chair, Biomedical Engineering, UC-Davis

Don Rose Dir., KickStart Venture Services, Commercialization & Economic Development, U of North Carolina - Chapel Hill

Glenn Prestwich (Chair) Presidential Professor of Medicinal Chemistry, U of Utah – Chancellor's Distinguished Visiting Professor, WSU

Agenda

Time	Activity	Participants	Location
Monday, November 7 - Washington State University Arrival into Spokane and Pullman by air and by car. The team will meet at 7:15pm in the lobby of the Residence Inn, Pullman for a short drive to the Banyans restaurant. The details of the arrival (and departure) of each ERIE team member, and the details for transportation are on the final page of the agenda.			
7:30 pm	*Dinner*	**ERIE Team** and **Cristopher Keane**, VPR	Banyans
Tuesday, November 8 - Washington State University - Pullman Team arrives at Lighty 280			
8:30-9:15 am	*Meeting with Deans*	**Don Bender** (VCEA), **Daryll DeWald** (CAS), **Paul Pitre*** (Everett), **Bryan Slinker** (CVM), **Michael Trevisan** (COE), **Laura Lavine** (CAHNRS)	Lighty 280 Conference Room **Everett:** GWH-105
9:20-10:20 am	*Meeting with Associate Deans for Research and Business Development Assistant Directors*	**Dave Field** (ADR VCEA), **Paul Whitney** (ADR CAS), **Bob Mealey** (CVM), **Amy Roth-McDuffie** (ADR COE), **Akram Hossain*** (WSUTC), **Christine Portfors*** (WSUV), **Travis Woodland** (VCEA), **Brian Kraft** (CAS), **Albert Tsui** (CAHNRS)	Lighty 280 Conference Room **WSUTC:** West 209 **WSUV:** VDEN 301 Tower Room

10:25- 11:25 am	*Meeting with Select Chairs/Directors*	**Kirk Peterson** (CAS), **Steve Simasko** (CVM), **John Browse** (CRB, CVM), **Juming Tang** (CAHNRS), **Greg Yasinitsky** (CAS), **Sandip Roy** (VCEA), **Larry Hufford*** (CAS)	Lighty 280 Conference Room
11:30 am-12:30 pm	*Working Lunch with Office of Commercialization (OC)*	**Sita Pappu—**Joe Giffels, Don Rose & Glenn Prestwich **Scott Steiger**—Bruce Gale & Michael Cable **Asa Brown**—David Kimball **Zeinab Abouissa**—Alyssa Panitch	Lighty 280 Q Lighty 280 J Lighty 280 M Lighty 286 F
12:30-12:45 pm. Fifteen minute break.			
12:45-1:30 pm	*Meeting with Intellectual Property Committee (Faculty Senate)*	**Donald Bender** (VCEA, IP Committee Chair), **Cliff Berkman** (CAS), **Greg Yasinitsky** (CAS), **Rick Knowles*** (CAHNRS), **Katrina Mealey** (VCM), **Hakan Gurocak** (VCEA), **Chip Hunter** (CCB)	Lighty 280 Conference Room **WSUV:** VECS 105
1:35-2:20 pm	*Meeting with Entrepreneurial Faculty Ambassadors (EFAs)*	**ERIE Team & EFA**: **Cliff Berkman** (CAS), **Allison Coffin** (WSUV), **Clint Cole*** (VCEA), **Amit Dhingra** (CAHNRS), **Joe Harding** (VCM), **M. Grant Norton** (VCEA), **Katrina Mealey** (CVM), **Jay Wright*** (Emeritus)	Lighty 280 Conference Room **WSUV:** VMMC 102Q
2:25-3:25 pm	*Individual Meetings with 12 Select Faculty (Non-EFA)*	*2:25* **Brendan Walker** (CVM), **Jacob Leachman** (VCEA), **Amit Bandyopadhyay** (VCEA), **Karl Englund** (VCEA), **Diane Cook** (VCEA), **Boel Fransson** (CVM) *2:55* **Rick Knowles** (CAHNRS), **Jessica Smith-Kaprossy** (ORSO) **Ian Burke*** (CAHNRS)	Lighty 280 Conference Room; Lighty 280 AG; Lighty 280 G; Lighty 280 W; Lighty 280 Z; Lighty 286 C
2:25-3:25 pm	*Joe Giffels Meeting with COIC Admin. Team*	**Dan Nordquist**, AVPR, **Derek Brown**, Research Operations Admin., **Sammy Rodriguez**, Research Support & Operations Admin.	Lighty 280 AE
3:30-4:00 pm	*Meeting with President Schulz*	**ERIE Team and President Kirk Schulz**	Lighty 280 Conference Room
4:00-5:00 pm	*Meeting with COIC Members*	**Laura Lavine** (COIC Chair), **Mike Kluzik** (ORA), **Ursula Mazur** (CAS), **Katrina Mealey** (CVM), **Sita Pappu** (OC)	Lighty 280 Conference Room
6-6:45 pm	*Reception with Community Members*	**ERIE Team**, **Brian Kraft** (CAS), **Chris Keane** (VPR), **Velle & Judy Kolde** (Armory), **Paul Kimmel** (Avista), **Joe Poire** (Port of Whitman), **Francis Benjamin** (Pullman City Council/Palouse Knowledge Corridor Representative), **Glenn Johnson** (Pullman Mayor), **Brian Kristjansson*** (Desimone Consulting Group), **Leen Kawas*** (WSU-IPN), **Dave Whitehead** (Schweitzer Engineering)	Etsi Bravo
7:00 pm	*Working Dinner*	**ERIE Team only**	The Black Cypress

Lodging at Marriott Residence Inn, Pullman			
Wednesday, November 9 - Washington State University - Spokane			
Drive to Spokane: Team Departs at 7:30 am. Estimated Spokane Campus Arrival Time: 9:00 am			
9:30-10:15 am	*Meeting with Acting Vice Chancellor and Assistant Vice President for Research Clinical Health Sciences*	**Cindy Corbett** (Nursing) & **Andrea Lazarus** (Pharmacy)	Spokane Academic Center Building (SAC) 501
10:15-11:00 am	*Meeting with Innovation Leaders & Spokane OC Representative*	**Chris Coppin** & **Andrew Richards** (Medicine), **Dennis Crain** (Nursing), **Linda Garrelts MacLean** (Pharmacy), **Heidi Medford** (OC)	SAC 501
11:00-11:45 am	*Meeting with Entrepreneurs and EFA Representative*	**Sterling McPherson** & **Mike McDonell** (Medicine), **Kim Johnson** (SBIRs w/Sterling; Ringful Health), **Phil Lazarus** (Pharmacy), **Mark VanDam** (EFA)	SAC 501
11:45 am-12:30 pm	*Working Lunch and Overview of Afternoon Plans*	**Lisa Brown** (Chancellor), **Luisita Francis** (Medicine & Smart City Initiative), **Kim Kentz** (SmartCity Initiative)	SAC 501
12:30-12:45 pm. Break and Walk to Innovation Center/Ignite NW			
12:45-1:30 pm	*Meeting with Local Innovation/Accelerator Support*	**Bill Savitz** (Ignite NW), **Mike Ebinger** (WSU Innovation Center), **Danielle McCulloch** (Fuentek), **Susan Ashe** (HSSA)	Ignite NW Building, Room 202
1:30-2:15 pm	*Offsite Visit to Local Entrepreneurs*	**Dave Vashon** (Iasis/Novion), **Lisa Shaffer** (Paw Print Genetics), **Marcello Morales** (Hollister-Stier, Celere LLC, A4 Ventures), **Patrick Tennican** (Hyprotek)	Ignite NW Building, Room 202
2:15-3:00 pm	*Offsite visit to Sleep & Performance Research Center*	**Hans VanDongen**, **Lois James**, **Steve James**	Ctr. Clinical Research & Simulation Building (fka South Campus)
3:00-3:15 pm. Walk to SAC 501			
3:15-3:45 pm	*Meeting with Academic Deans*	**John Roll** (Medicine), **John Tomkowiak*** (Medicine), **Joyce Griffin-Sobel** (Nursing)	SAC 501
4:00 pm Departures. See last page for individual ERIE Team member details.			

*Participants who are tentative or pending confirmation

Appendix 5: Summary of documents on secure website for ERIE team

ERIE Faculty Survey Documents:

- Fall 2016 Survey of Innovation and Entrepreneurship Data Report
- ERIE Survey Results (Information which could potentially identify a respondent has been redacted)
- 2016 Survey of Innovation and Entrepreneurship Powerpoint Slides

Federal, State, and WSU Regulations, Policies, Procedures:

- Federal regulations

42 CFR Part 50 and 45 CFR Part 94 (PHS and NSF Conflict of Interest Regulations)

- State of Washington Ethics Laws

RCW 42.52

- WSU Policies

Executive Policy #27
ORSO Guideline #9
BPPM 60.44 (Compensated Outside Service and Extended Professional Activities by Faculty)
BPPM 95.05 (Travel Authority)
WSU Faculty Manual (Section IV – F, G, and H)
Recently Approved Section G Revisions
Recently Approved Section H Revisions
BPPM 35 – Intellectual Property
DRAFT EP on Intellectual Property (In Review)
DRAFT Policy on Intellectual Property ownership/inventorship dispute resolution (going through Faculty Senate)
DRAFT IP Committee By-Laws

Relevant WSU websites:

- Office of Research
- Office of Economic Development
- OR, Office of Commercialization
- Entrepreneurial Faculty Ambassadors
- Washington Small Business Development Centers
- OR/ORSO, COI website
- WSU Intellectual Property Committee
- CAHNRS Intellectual Property Site website
- Developing and Online Course
- WSU Innovation Corps (I-Corps)

Relevant Documents:

- Invention Disclosure – see OC website
- COI Forms – see COI website
- WSU Standard Option/License terms for Industry Sponsored Projects
- Commercialization Gap Fund Guide
- Inventor Guide
- WSU Start-Ups list
- Guidance to faculty creating start-ups
- OC-EFA Interface graphic
- OC Info 2013–2016

OC Metrics Table FY12–FY16
New Partnerships entered into (DOE, Access innovation, Accelerator Corporation Seattle, AgTechAccelerator, Kerafast, Cayman Chemical)
New Initiatives: How-To Seminars, CGF, OC Store, Service Centers, Express Licensing)

- Presentation materials from Sept. 19, 2016 “How To…” series training

Technology Transfer and Managing the Conflict of Interest
Conflict of Interest, Ethics, and Commercialization: The Conflict of Interest Committee (COIC)
- Presentation materials from Other OC-sponsored "How To…" series trainings

How To Commercialize University Research – 9/3/15
How To Protect Intellectual Property – 10/6/15
Corporate Structure Formation for Start-ups – 11/5/15
Developing a Business Plan – 12/3/15
Financing Options – 1/14/16
Evaluating Industry Market and Competition – 2/4/16
How to Successfully Commercialize – 3/3/16
How to Commercialize in the WSU Online Portal – 4/7/16

Interesting Sites:
- Food, Plant Breeding & Intellectual Property Rights
- Washington State Magazine
- WSU Libraries – Technological and Entrepreneurial Resources – BE 410/ENTRP 496: Intellectual Property

National Sites:
- Association of University Technology Managers

National Reports:
1. Quick links to high-level research reports

New Industry Research Awards >= $100K (From 7/1/15):
- Amit Bandyopahyay, School of Mechanical and Materials Engineering: SpaceX – Materials research with SpaceX
- Darryl Duvall, College of Nursing: Merck & Co. – Improving Neuromuscular Monitoring Rates: A Local and Regional Approach
- Kimberly McKeirnan, Pharmacotherapy: Pfizer, Inc. – Improving Pneumococcal Vaccination Rates in Older Adults Through Enhanced Academic Detailing: Medicine, Nursing and Pharmacy Partnerships
- Carl Hauser, School of Electrical Engineering and Computer Science: NY Power Authority – Cloud Data Sharing Platform
- John Stark, Washington Stormwater Center: Boeing – Scrap FRP Composites for Reinforcing Pervious Pavements
- Juming Tang, Biological Systems Engineering: Tata Industries – Special Testing Agreement regarding development of MATS processing
- Juming Tang, Biological Systems Engineering: 915 Labs, LLC – Special Testing Agreement with 915Labs – for SATS work

Meijun Zhu, School of Food Science: ILSI North America – *Listeria monocytogenes* Thermal Resistance in Low Moisture Foods: Role of Water Activity or Food Matrix

Appendix 6: Examples of commercialization efforts with WSU technologies

The company profiles included below were prepared by faculty inventors based on a template provided to them; profiles were edited for the purposes of this report. Several technologies faced early problems related to inexperience, inadequate infrastructure on and off campus, lack of recruitable management talent, lack of funding, and other problems. Some of these problems were resolved at a later stage in the company's development. These companies are only selected as representatives from a larger number of technologies that span the complete spectrum, from never-started to growth and a hugely successful acquisition. **Section D** above summarizes major lessons learned based on these company profiles.

1. Veterinary Clinical Pharmacology Laboratory (Katrina Mealey, CVM)
2. 915 Labs, Inc. (Juming Tang, CAHNRS)
3. Klar Scientific LLC (Matt McCluskey, CAS)
4. Phytelligence, Inc. (Amit Dhingra, CAHNRS)
5. M3 Biotechnology, Inc. (Joe Harding and Jay Wright, CVM/CAS)
6. Cancer Targeted Therapeutics, LLC (Cliff Berkman, CAS)
7. Behaviometrics and Adaptelligence LLC (Diane Cook, Aaron Crandall, and Larry Holder, VCEA)
8. AAVogen, Inc. (B. Daniel Rodgers, CAHNRS)
9. Protium Technologies LLC (Jake Leachman, VCEA)

Company Profile – Veterinary Clinical Pharmacology Laboratory

Faculty inventor

- Katrina Mealey

Department and college

- Veterinary Clinical Sciences; College of Veterinary Medicine

Disclosed technology; dates of disclosures

- MDR1 variants and methods for their use; 2001–2004

Company name; date of formation

- Service Center: Veterinary Clinical Pharmacology Laboratory; established 2004

Current company status (employees, location, milestones set, milestones met)

- 1 full-time, 3 part-time employees in addition to 15% effort from faculty member; royalty and licensing fees

Current (and past) management

- Managed by faculty member with 15% salary paid by service center

Most significant sources of funding

- WSU Start up; Pfizer, Inc; NIH

Company Profile – 915 Labs

Faculty inventor
- Juming Tang

Department and college
- Biological Systems Engineering, CAHNRS

Disclosed technology; date of disclosures
- Design of 915 MHz single-mode microwave heating cavities/systems for sterilization of pre-packaged ready-to-eat meals; ~2004.
- Method for measuring temperature in food packages during microwave-assisted thermal processes using remote sensors; ~2011.
- Design of microwave-assisted thermal sterilization (MATS) and pasteurization (MAPS) systems for prepackaged foods based on 915 MHz single-mode cavities; ~2015.
- The new technologies provide food companies new means to produce high-quality, safe meals for military and retail markets. Compared to traditional canning, the technologies offer the advantages of reduced processing times (cut by ¾), increased energy efficiency, high level of automation, and reduced water waste, in addition to high quality and better nutrition.
- WSU has executed a world-wide exclusive license to 915 Labs for these technologies.

Company name; date of formation
- 915 Labs; formed in 2012

Current company status (employees, location, milestones set, milestones met)
- About 14 employees in the company, headquartered in Denver, CO. 915 Labs has subcontracts to MMT, LLC (Knoxville, TN) as sole manufacturer of pilot and commercial systems. MMT has about 10 employees.
- Milestones set: develop and commercialize pilot and production systems for food companies worldwide.
- Milestones met: (1) designed and manufactured pilot-scale units (MATS-B); sold and installed in three companies in USA, one in India, one in South Korea, and one in Singapore; in process of manufacturing one pilot unit for Australia military; (2) in process of designing small to medium throughput (MATS-15 and 30) production systems.

Current (and past) management
- Michael Locatis, CEO
- Mathew Raider, COO
- David Behringer, CTO
- Kevin Peterson VP, Business Development. Kevin was previously founder of Food Chain Safety, LLC; based in Maple Valley, WA that held exclusive licenses of WSU technologies. Food Chain Safety was bought by 915 Labs in 2012

Most significant sources of funding
- DoD, USDA NIFA, private companies, DoE

Company Profile – Klar Scientific LLC

Faculty inventor

- Matt McCluskey (

Department and college

- Physics & Astronomy, College of Arts and Sciences

Disclosed technology; date of disclosure

- Digital Confocal Optical Profile (COP) Microscopy
- Provisional patent application filed September 12, 2012
- Patent application filed September 5, 2013

Company name; date of formation

- Klar Scientific is a Washington limited liability company formed in 2016

Current company status (employees, location, milestones set, milestones met)

- Klar has one employee and will hire a second employee in June 2017
- Location: WSU Research and Technology Park
    - 1615 NE Eastgate Blvd.
    - Unit G, Suite 7W
    - Pullman, WA 99163
- Milestone #1 (met): obtain SBIR funding
- Milestone #2 (set): find many customers and test their samples (Jan-July 2017)
- Milestone #3 (set): submit a Phase 2 SBIR grant in August 2017

Current (and past) management

- Richard Lytel, PhD, Chief Executive Officer (CEO)
- Matthew McCluskey, PhD, Chief Technology Officer (CTO)

Most significant sources of funding

- SBIR

Company Profile – Phytelligence, Inc.

Faculty inventor

- Amit Dhingra, Ph.D.

Department and college

- Department of Horticulture, College of Agriculture, Human, and Natural Resource Sciences

Disclosed technology; date of disclosure

- Licensed Trade Secrets - WSU Case Numbers 1218, 1219, 1220, 1221, 1222, and 1228
- Licensed patents:
  - US patent # **8,901,039**: WSU Case 1175: Use of photosynthetic stabilizing chemicals to regulate ripening and quality in all fruits and vegetables
  - US patent application # **20140121110**: WSU Case 1302: Control of ripening and senescence in pre-harvest and post-harvest plant organs

Company name; date of formation

- Phytelligence, Inc.; Incorporated in Washington in 2012

Current company status (employees, location, milestones set, milestones met)

- Employees: 57
- Locations: Headquarters in Seattle, WA; Greenhouses in Burien, WA; Production facility in Portland, OR, and R&D, Pullman, WA
- Validation done, product being sold in market place, currently scaling operations

Current management

- **Ken Hunt, JD, MBA (CEO)**
  - 23+ years track record of success building, growing, and managing businesses
  - Past CEO of Anawah; past EVP of Marketing, Strategy and Business Development for Paradigm Genetics; Director at Monsanto
- **Dr. Amit Dhingra, Founder (CSO)**
  - 20+ years of innovating in genomics and plant biotech
  - Tenured Associate Professor and head of research program at Washington State University
- **Tom Virgin, CPA, MBA (CFO)**
  - 35+ years in finance and operations converting early revenue companies into industry leaders
  - A leader for patient safety software and equipment company that sold 19x ROI within 3 years
- **Tim O'Brien, MSc (CRO)**
  - 15+ years of business development and marketing; horticulture, soil science expertise
- **Holly Gray**, **CHRO**
  - 25+ years of strategic HR/OD leadership
  - Built start-up and high growth companies at Hay Group, Arthur Andersen, Moss Adams
  - Held Executive HR positions with Clarisonic, Cellnetix, Anawah, and Produxs
- **Tyler Spurgeon (COO)**
  - 13+ years of greenhouses and lab operations in the agricultural biotechnology industry
  - Site leader for Dow AgroSciences and Exelixis Plant Sciences
- **Jim Johnston, Chief Legal Counsel**
  - 25+ years legal counselling to corporations for business contracts and M&A
  - CPA, BBA Accounting/Finance, Gonzaga; JD, Seattle University
- **Most significant sources of funding**
  - Agricultural industry sponsored research; angel funding
    - Commodity grants, gift grants, USDA, WSDA at WSU laboratory to develop technology platform

Company Profile –M3 Biotechnology, Inc.

Faculty Inventor
- Joe Harding
- John (Jay) Wright

Department and college
- Harding: Integrative Physiology and Neuroscience, College of Veterinary Medicine
- Wright: Psychology, College of Arts & Science

Disclosed technology; date of disclosure
- Novel small molecule modulators of large growth factor proteins with multiple therapeutic applications ranging from neurodegenerative diseases to cancer to wound healing to congestive heart failure.
- First disclosure: 1992 with many since

Company name; date of formation
- M3 Biotechnology, Inc formed in spring of 2011 is a Delaware corporation.
- An earlier company, Pacific Northwest Biotechnology, LLC, was formed in 2005

Current company status (employees, location, milestones set, milestones met)
- M3, which is located in Seattle with 11 employees and many additional contractors, has raised over 13 million dollars
- A clinical trial for a “first-in-class” Alzheimer’s drug is scheduled to start in July 2017 in Los Angeles, CA
- Lead compounds for the treatment of pancreatic cancer, congestive heart failure, and enhanced wound repair are available and are being developed
- Others are developing M3 compounds as therapeutics for additional clinical indications

Current (and past) management
- Lewis Rumpler: 2011–2013
- Leen Kawas: 2013–present

Most significant sources of funding
- Initial funding was from personal money, SBIR, MJFF, LSDF, and ADDF grants, and Angels.
- Current funding is from grants and a Seed round constructed of Super Angels.

Company Profile – Cancer Targeted Technology, LLC (CTT)

Faculty inventor
- Cliff Berkman

Department and college
- Chemistry, College of Arts & Sciences

Disclosed technology; date of disclosure
- Peptidomimetic inhibitor of prostate-specific membrane antigen (PSMA) developed at his prior institution ~2006
- Core structure is a targeting agent for prostate cancer diagnostics and therapeutics.
- Multiple subsequent, related invention since coming to WSU.

Company Name; Date of formation
- Cancer Targeted Technology (CTT), a Washington LLC formed in 2006, with multiple patents licensed from WSU and Cliff's prior institution, San Francisco State University

Current Company Status (employees, location, milestones set, milestones met)
- Lead diagnostic product (CTT-1057), a PET imaging agent based on the inhibitor scaffold, is in Phase-I clinical trials for the detection of prostate cancer (https://clinicaltrials.gov/ct2/show/NCT02916537)
- Lead radiotherapeutic product (CTT-1403) is in preclinical development under an NIH contract and slated for an IND filing within 18 months

Current (and past) management
- Beatrice Langton-Webster, PhD, Chief Executive Officer and Director
- Clifford Berkman, PhD, CSO, Founder and Director
- John Dugan, Founder and Director

Most significant sources of funding
- SBIR, LSDF

Company Profile – Behaviometrics and Adaptelligence

Faculty inventors

- Diane Cook, Aaron Crandall and Larry Holder

Department and college

- Electrical Engineering and Computer Science
- Voiland College of Engineering and Architecture

Disclosed technology; date of disclosure

- Multiple disclosures on methods to extract activity patterns from fixed-point and mobile phone derived motion sensor data.
- The dates of the disclosures range from 2007 through 2015.

Company name; date of formation

- Two companies are involved, both formed in 2015/2016
    - Behaviometrics – focused on in-home applications
    - Adaptelligence – focused on mobile applications

Current company status (employees, location, milestones set, milestones met)

- Behaviometrics – inactive/on hold
- Adaptelligence – active

Current (and past) management

- Behaviometrics:
    - Aaron Crandall, CEO
    - Brian Thomas, CTO
    - Krish Gopalan, COO
- Adaptelligence:
    - Larry Holder, CEO
    - Diane Cook, CTO

Most significant sources of funding

- LSDF and NIH, neither company has received funding directly

Company Profile – AAVogen, Inc.

Faculty inventor

- Buel “Dan” Rodgers, PhD

Department and college (and other units)

- Department of Animal Sciences, CAHNRS
- Washington Center for Muscle Biology

Disclosed technology; date of disclosure

- Novel gene therapeutic for muscle wasting diseases, including muscular dystrophies and cancer cachexia; provisional patent application April 2015; PCT April 2016; Inventors B.D. Rodgers (WSU) and P. Gregorevic (Baker IDI)
- Blocks myostatin action only inside muscle; avoids problems of ligand traps
- Reverses/prevents muscle wasting; restores muscle mass; reduces cardiac wasting from cachexia

Company Name; date of formation

1. AAVogen, Inc., a Delaware c-corp, with licenses from WSU and Baker IDI, formed 2015.

Current company status (employees, location, milestones set, milestones met)

- Product (AVGN7) overall market for 70 million patients with muscle wasting disorders ($550 billion)
- Cancer cachexia has no current treatments, occurring in 31–85% of all cancer patients, total market $80 billion cancer treatment industry

Current (and past) management

- Jade Brown CEO; B. D. Rodgers, CSO and project leader; Dir. Regulatory Affairs, Jeff Fellows; Dir. PK/ADME, Peter Korytko; Dir Clinical Affairs, Rick Stead
- Five-person star SAB from Baker IDI, UW, and Ohio State University

Most significant sources of funding

- Rodgers had acquired GAP funding; other sources were in planning stages when his decision to leave WSU was made, under strong pressure from his college administration; he is currently negotiating a collaborative license deal with a biotech company out of Boston

Company Profile – Protium Technologies LLC

Faculty inventor

- Jacob Leachman

Department and college

- Mechanical Engineering, Voiland College of Engineering and Architecture

Disclosed technology; date of disclosure

- 3D Printed Liquid Hydrogen Tank, Cryogenic Vortex tube, novel cryocompression hydrogen station
- 2012–present

Company name; date of formation

- Protium Innovations LLC, May 2015

Current company status (employees, location, milestones set, milestones met)

- 3 members, Pullman, WA
- SBIR application in review
- WA state Clean Energy Fund application in preparation

Current (and past) management

- Patrick Adam, Ian Richardson, Eli Shoemaker (co-Founders, all WSU PhD students)
- Jacob Leachman is no longer involved due to WSU COI committee requirement

Most significant sources of funding

- Pending SBIR

Appendix 7: Cosmic Crisp™ 38: A Case Study in Commercialization

WASHINGTON STATE UNIVERSITY

COSMIC CRISP™ WA 38

A Case Study in Commercialization

OVERVIEW

As the first crop of more than 600,000 WA 38 trees are being readied for growers, Washington State University is working to protect the state's new apple, both at home and abroad.

The newest product of WSU's tree fruit breeding program, WA 38, is under the COSMIC CRISP™ brand. Trees will be released to the first group of Washington growers in spring 2017. Additionally, over 5 million trees are budded for contracts for delivery in 2018.

The pathway to commercialization was a textbook case of University-industry collaboration. WSU and the WTFRC established advisory committees to inform each step of the supply chain. It all began with the Cultivar Licensing Committee that guided propagation and distribution efforts and valuable advice for the remainder of the effort. Proprietary Variety Management (PVM) was engaged to interface IP management between the University and licensees. They also created a marketing advisory committee composed of any marketing desk in Washington that desires to participate as well as a marketing standards committee composed of representatives of growers and the marketing desks.

While sales of WA 38 trees are limited to Washington growers for at least the first decade, WSU is already taking steps to protect the new variety in International markets.

PROTECTING WA 38 IN THE U.S. AND INTERNATIONALLY

WSU currently holds a *U.S. Patent* for the WA 38 apple as well as the fruit tree itself. U.S. patents are a form of intellectual property (IP), which allow for 20 years of exclusive rights in the U.S. before the invention becomes freely available to the public. The COSMIC CRISP™ trademark is the brand associated with WA 38 apples, trees, and other related apples products. Trademarks don't expire so long as the brand is continually used.

"IP rights protect your investment," said Albert Tsui, a patent attorney and business development specialist with the College of Agricultural, Human and Natural Resource Sciences at WSU. "Without IP protection, the owner loses the ability to manage the quality and marketing of the variety in domestic and foreign markets," added Tsui.

IP laws vary throughout the world and the U.S. does not have the authority to regulate the use of US issued patents on an international scale. To safeguard WA 38 against unauthorized international use, WSU must seek IP in the form of trademarks, patents, and Plant Breeders Rights in foreign countries as well as the U.S.
Importantly, applications for these protections *must* be in place within 6 years of the first offer of sale. WSU has until 2020 to seek foreign IP protection. "That doesn't give us a lot of time, given quarantine requirements for international importation, and the possibility of setbacks such as disease or bad weather," Tsui said.

PROCESS OF SECURING INTERNATIONAL IP

To obtain international IP rights for WA 38, several requirements must be met, including quarantine hurdles, establishing growth characteristics in native soils, and navigating the regulatory process for commercialization.

This past summer, the University began this lengthy process by submitting cuttings (a total of ten buds) from COSMIC CRISP™ in a European plant health center for quarantine. These trees will be tested for their ability to grow in various soils and environments as well as resistance to native diseases – data that are a critical aspect of the process for filing foreign patents and trademarks.

"We are sending budwood, not trees," said Tsui, who also noted that the plant health center is not a commercial entity and barred from selling fruit. "By taking these initial steps for IP protection, we can say proudly, this is Washington's apple, and that consumers will get a product that's recognizable and has consistent quality throughout the world; ultimately, it's something growers can be proud of."

PROTECTING GROWERS IN WASHINGTON STATE

Tsui reminds Washington growers that they are still very much first in line to buy WA 38 trees. The 10 year exclusive rights for growers in North America is firmly in place. Furthermore, any meaningful foreign production is not expected to be commercially viable until around 2025. "Even if a Washington grower wasn't selected in the initial drawing, they're still going to be able to buy WA 38 trees years before a grower in the foreign market," he said.

In addition to time requirements, there will be territorial restrictions with foreign licensees that dictate where the fruit can be exported. Presently, there are no plans for allowing *any* importation into North America. Future considerations would only be contemplated after full consultation with the Washington State Marketing Advisory Committee.

Another significant question relates to enforcing licenses in the United States and abroad. Each variety has a unique, DNA sequence or genetic footprint. A leaf sample can be collected and "fingerprinted" in a matter of days. This allows for rapid identification of leaf trees suspected of being in violation of a license.

SALIENT POINTS

As the process of securing international protections for WA 38 moves forward, it is important to remember:

- IP protection must be secured in individual countries; they are not covered by U.S. law.
- Must fulfill foreign Patent filings by 2020.
- The consequence of not seeking foreign IP protection: WA 38 will become public domain (free) material in the foreign jurisdictions.
- Without brand protections, COSMIC CRISP™ could vary widely from grower-to-grower, losing uniformity, flavor, texture and market appeal.

For More Information, Contact: Albert Tsui, (509) 335-4563 or albert.tsui@wsu.edu

Appendix 8. The archipelago of external engagement at WSU

There is an enthusiastic interest in connecting to the private sector within WSU. This was reflected in both the survey results and consistently expressed during the site visit across all organizational levels in both Pullman and Spokane. The broad interest to grow connectivity expressed in these forums warrants an overview of how WSU currently engages externally. This review is not intended to be comprehensive, rather it aims to outline the constellation, or archipelago, of offices and functional activities that might have a role in developing new structures and activities to enhance, encourage, and support innovation and entrepreneurship at WSU. Web links are included for each office; additional information may be obtained by contacting each organization directly.

1. The Office of Commercialization: https://commercialization.wsu.edu/About/

> *"Our mission is to ensure that innovations and discoveries by WSU researchers are evaluated, protected where possible, and prepared for potential licensing by third parties. Our staff supports this goal of translating research discoveries into innovations for the marketplace."*

This unit reports to the Vice President for Research.

2. The Office of Research Support and Operations: http://orso.or.wsu.edu/mission.asp

> *"WSU's Office of Research Support and Operations (ORSO) was established in 1972 with the mission of assisting the university's faculty and graduate students in securing extramural support for their scholarly, research, teaching, and community service activities. ORSO promotes and facilitates the procurement of grant and contract funding."*

This unit reports to the Vice President for Research.

3. Extension: http://extension.wsu.edu/about-extension/

> *"With 39 locations throughout the state, WSU Extension is the front door to the University. Extension builds the capacity of individuals, organizations, businesses and communities, empowering them to find solutions for local issues and to improve their quality of life. Extension collaborates with communities to create a culture of life-long learning and is recognized for its accessible, learner-centered, relevant, high-quality, unbiased educational programs."*

This unit reports to the Director of Washington State Extension within the College of Agriculture, Human, and Natural Resource Sciences.

4. Government Relations and External Affairs: https://governmentrelations.wsu.edu

This office reports directly to the President.

5. WSU Foundation: https://foundation.wsu.edu/about/

> *"The mission of the Washington State University Foundation is to promote, accept, and maximize private support for programs, initiatives, and properties of Washington State University and its regional campuses. The WSU Foundation also prudently manages, invests, and stewards the assets entrusted to it by WSU and its alumni, friends, and donors."*

This unit reports to the President.

6. The Office of Corporate Relations: https://foundation.wsu.edu/corporate-relations/

> "*The Office of Corporate Relations supports the implementation of Washington State University's Strategic Plan and its research and education mission by serving as the system-wide steward of its engagement with public and private companies and their industries.*"

This unit reports to the Provost with an informal reporting line to the CEO of the WSU Foundation.

7. The Academic Success and Career Center (ASCC): https://ascc.wsu.edu https://ascc.wsu.edu/career-services/

This unit provides (among other things) academic advising, career counseling, career development courses for credit, career fairs, and associated events for graduate and undergraduate students across campus. They routinely bring human resource professionals to campus to engage students and participate in career fairs, interviews and mock interviews. They provide in-person and electronic services that help connect employers to future and recent graduates, and engage students through industry tours, internships, externships, and career employment. The ASCC is administratively under the Provost within the Office of Undergraduate Education.

8. Center for Entrepreneurial Studies: https://business.wsu.edu/research-faculty/centers/entrepreneurial-studies/

"*Center for Entrepreneurial Studies in the Carson College of Business enables students to learn the hands-on skills and teamwork necessary to go from creating a prototype to developing a business plan to ultimately launching a commercially viable product and business. Students learn by doing–building analytical and leadership skills so that they're ready for success in existing companies and new ventures alike.*"

This center is within the Carson College of Business (CCoB) and reports to the Dean of CCoB.

9. Harold Frank Engineering Entrepreneurship Institute: https://vcea.wsu.edu/entrepreneurship/

"*The institute offers a unique opportunity to experience how innovation moves from idea to sustainable realization, and gives you the tools to pursue your ideas. Working in interdisciplinary teams, you will learn to manage uncertainty, design, perfect your presentation skills, work with real fiscal and technical constraints, and develop technologies to solve real problems. The Harold Frank Engineering Entrepreneurial Institute has an international reputation and is recognized with the prestigious Kauffman award.*"

This institute is administratively housed in the Voiland College of Engineering and Architecture (VCEA) and reports to the Dean of VCEA.

10. *College of Medicine Technology Incubator*: https://medicine.wsu.edu/research/dcp/technology-incubator/

"The Technology Incubator helps to rapidly develop and deploy technologies that strengthen the ability of health care providers to care for patients. This unique resource forges partnerships with patients, providers, industry experts, and technologists who can translate innovative ideas into real-world tools, technologies, and processes. It fuels medical technology startup companies. It empowers innovators to mastermind solutions that help better serve patients and communities."

This unit is administratively located in the College of Medicine and reports to the Dean.

11. *WSU University Center for Innovation:* https://spokane.wsu.edu/about/university-center-for-innovation/

The WSU University Center for Innovation on the Spokane campus is funded through the Economic Development Administration's University Center program and is one of about 60 Centers nationwide. The main goal of the Center for Innovation is to provide technical assistance and applied research to individuals and groups seeking to develop businesses or companies based on innovative ideas. The Center caters to the needs of the public and private sectors and is also open for WSU faculty, staff, and students to use.

This center reports directly to the chancellor of the Spokane campus.

12. *Small Business Development Center* (SBDC): http://wsbdc.org

SBDC primary services include customized one-on-one advising designed to assist and inform business owners and managers to help them make better informed business decisions to grow and sustain their businesses. Other services of the SBDC include customized and nationally recognized training and advisor assisted gathering of critical market intelligence.

SBDC advisors are distributed in offices across the state, and this unit reports to the Vice President for Research.

G. Informational Highlight Boxes

Box 1: Perceptions on Commercialization at WSU by Dr. Yogendra Gupta

Dr. Yogendra (Yogi) Gupta is a quintessential example of a pure academic researcher whose research has strong connections to achieving practical outcomes, but remains focused on research excellence. Yogi is a Regents Professor in the Department of Physics and Astronomy, and the Director and Creighton Distinguished Professor in the Institute for Shock Physics (ISP) at WSU. ISP emphasizes scientific creativity and excellence, and integrates three research efforts: (1) the ISP combines research innovations with rigorous education, (2) the Applied Sciences Laboratory (ASL) transforms science into practical solutions, and (3) the Dynamic Compression Sector (DCS) at Argonne National Laboratory is a unique worldwide user facility.

In the context of the ERIE review, one could argue that Yogi is a non-commercial academic entrepreneur—he has built a thriving, well-funded research organization within WSU and spun out technologies without ever starting a company.

Although unable to attend the site visit, his crucial connection to Innovation and Entrepreneurship (I&E) at WSU was recognized, and his perceptions were solicited in a telephone call that included Yogi, Brian Kraft, Don Rose (ERIE member from UNC), and Glenn Prestwich. This informational box summarizes key aspects of Dr. Gupta's comments and recommendations.

Overall, Dr. Gupta felt that the ERIE committee should have been chartered to focus primarily on outcomes and on providing advice for developing actions for WSU to follow. In his opinion, the focus should be the future of the university, not its past. He felt that WSU should avoid top-down mandates that could misdirect faculty efforts and potentially curb their creativity and flexibility. To this end, he articulated his preferred set of outcomes. Interestingly, Dr. Gupta and the ERIE team had converged on many of the same outcomes.

- WSU should articulate the importance of I&E within its overall mission, and then identify specific outcomes that it desires and potential routes to achieve those desired outcomes.
- If monetization is the goal, then the OC must be reorganized to have experienced business people "with scars and bruises" to help direct the process specifically in that direction.
- Reward true outcomes of financial success (grants, royalties, license fees etc.), not patents. Patents cost money; products make money. Patents are not equivalent to commercial success.
- Tenure and promotion policies should not consider I&E as metrics. You don't want a faculty comprised of failed entrepreneurs. Dr. Gupta noted that, "Entrepreneurship should be fostered but not mandated." While innovation-friendly policies for I&E activities are important, in his opinion T&P should remain true to its core educational and basic discovery missions.
- WSU needs to define what it means by success in I&E. What specifically does WSU think it means to have impact through I&E?
- WSU should prioritize, by college and department, the importance of I&E impact for its faculty. This requires in essence a bottom-up approach to defining the clarity of purpose for each unit. In addition, a top-down "broad stroke" initiative provides motivation for units to undertake the bottom-up actions.
- WSU should establish an *"Innovation and Entrepreneurship Colloquium Series*" that features exemplary land-grant college faculty from across the US, as well as I&E-active WSU faculty. This Colloquium Series should be a campus-wide, high-profile, faculty-student interactive event. By showcasing what success looks like, WSU can lead by example.

In summary, Dr. Gupta made the following insightful observations:

> ***"What you have taken on is a challenging, multifaceted undertaking with few right or wrong answers. The role of the administration is to serve the faculty and students by creating an atmosphere that promotes and nurtures intellectual curiosity, creativity, innovation, entrepreneurship, honesty, accountability, and academic freedom. Because of the diversity of disciplines in an academic institution, no one size fits all."***

Box 2: Conversation with Dr. Noel Schulz: Increase I&E to Enhance Research and Education

Dr. Noel Schulz is Professor of Electrical Engineering in the Voiland College of Engineering and Architecture, and a nationally recognized expert in power systems engineering. She directed the Engineering Experiment Station and the Electrical Power Affiliates Program, and was Associate Dean for Research in Engineering at Kansas State University. At KSU, Noel was very involved with getting faculty to be more engaged in disclosing and protecting potential new intellectual property, with working more actively with the commercialization office, and in facilitating faculty interactions with industry.

While only at WSU a short time, Noel has heard folks say that the messaging about innovation and entrepreneurship (I&E) hasn't been extensive in the past. Focusing on companies and commercialization can turn academics off, as it seems to diverge from the main academic missions of research and teaching. She advocates the Schulz administration developing a clearer message that emphasizes how scholarship can positively affects people's lives by getting research discoveries into business sector.

Dr. Noel Schulz noted that in the Drive to 25, funding is the largest challenge as federal funds dwindle and competition increases. WSU should consider looking more to industry partnerships and sponsorships for research funding. However, her initial observations after less than 6 months at WSU is that the culture does not yet support, encourage, and reward I&E; she would like to WSU to be more engaged with I&E.

CAHNRS has succeeded in conveying a strong message about the importance of research for improving agriculture. For example, the agricultural Commodity Commissions are important sources of revenue for WSU for varietal licenses. Engineering, science, and health sciences have not been as active or successful at engaging with industry, in part due to Pullman's isolation in Eastern Washington. Noel plans to actively engage with Schweitzer Engineering Laboratories, Pullman's premiere engineering company, which has a bona fide culture of innovation.

Noel's concept is that changes in attitudes towards I&E will occur most readily and most naturally with early stage faculty. They are more likely to have worked on recent projects targeting unmet needs in graduate or postdoctoral work, and have learned how to select and identify economically relevant research problems from their previous mentors.

However, junior faculty need to keep their primary focus on their academic duties, and on meeting the tenure and promotion standards common to all academics. Still, making optional I&E information modules available, and mentoring in intellectual property, management, financing, and business practices would be beneficial. In general, faculty are very savvy about the concepts of science and engineering, but are less well acquainted with the business of science. Although most faculty are trained to be independent contractors, they need to develop new skills to become better collaborators, team players, team builders, and team leaders. Such training will have positive outcomes in research group and research team management as well as in translating discoveries into the business world.

Finally, Dr. Schulz articulated her notion that faculty interest in commercialization is distributed in a Gaussian fashion: 20% reluctant, 20% early adopters, and 60% unsure what to do and when to do it. She advocates targeting our message to the middle 60%, particularly by showing faculty benefits by working with their students as in the SKILD and i-Corps programs.

Box 3: WSU-Spokane Health Sciences Campus: A hub for health sciences innovation and economic development in Eastern Washington

The ERIE Team spent most of its second day at WSU-Spokane. They were impressed with how thoroughly and passionately this campus had embraced I&E as an integral part of its mission. The support was at all levels, from Chancellor to Deans, Associate Deans, and faculty. This Box explores some key features of the I&E ecosystem in Spokane. The ERIE team opined that supporting I&E at the WSU-Spokane ecosystem would enable, inform, and improve WSU's campus-wide efforts in I&E. This is also reflected in the Action Items in **Section F** of this report, and is highlighted with six points below.

First, WSU-Spokane has a unique environment that can be leveraged to accelerate improvements in I&E in health sciences for all campuses of WSU. The campus recently competed for a federal Economic Development Administration (EDA) call for proposals to develop the *Spokane Regional Healthcare Innovation Cluster*. The Spokane, WA-Coeur d'Alene, ID area is a regional hub for healthcare in Eastern Washington and North Idaho. It holds the largest cluster of hospitals, clinics, healthcare providers, and life sciences research facilities between Seattle, Salt Lake City, and Minneapolis. The Spokane area health care industry is a significant employer. According to a 2015 study commissioned by the Spokane Area Workforce Development Council, the area's healthcare industry accounted for 48,730 jobs—roughly 20 percent of the area's jobs—and generated an estimated $6.5 billion in business revenues in 2013. One noteworthy non-hospital employer and innovation supporter is Pathology Associates Medical Laboratory (PAML). The area is home to five universities that prepare students for careers in the life sciences, namely WSU-Spokane, Gonzaga University, Eastern Washington University, and Whitworth University in Washington State, and the University of Idaho in Coeur d'Alene and Moscow, Idaho. The new Elson S. Floyd College of Medicine (ESFCOM) at WSU will expand medical education and research to meet patient needs regionally and nationally. In addition, prioritized hiring across WSU's campus system has attracted many faculty with research interests aligned with life science commercialization.

Second, In addition to the strong health care industry, a growing entrepreneurial ecosystem connects the various counties, local governments, chambers of commerce, and research institutions. While this ecosystem has traditionally spawned primarily consumer goods and tech-based companies, WSU-Spokane will catalyze expansion of I&E in life sciences and healthcare. One such effort was the launch of the Spokane Innovator Network (SINE), created by WSU-Spokane's Entrepreneurial Faculty Ambassador Mark VanDam, with the hosting of the inaugural SINE Function on 29 September 2016. Two other such efforts are the proposal to the EDA referenced above, and the planned Translational Medicine Symposium mentioned in **Section F**.

Third, it is important to note the strong commitments of each of the colleges at WSU-S to I&E. The campus recently added a dedicated representative of the Office of Commercialization (OC) in Spokane (Heidi Medford). ESFCOM recently added Dr. Chris Coppin, Associate Dean for Technology Development and Commercialization and also Chief Business Development Officer, whose experience in the medical device industry will be essential for I&E activities in the college. Chris is joined by Andrew Richards, a technology & IT guru and investor from Portland, who directs the college's Technology Incubator. Dr. Dennis Crain is a former Microsoft technology expert now serving as Vice Dean for Technology Innovation and Commercialization in the College of Nursing, and Linda Garrelts-McClean, who has run retail pharmacies in the past, is Associate Dean for Research in the College of Pharmacy. Finally, Dr. Mike Ebinger is the director of the WSU Center for Innovation, which is already a funded EDA University Center based at WSU-Spokane.

Fourth, Chancellor Lisa Brown convenes quarterly meetings of her presidentially appointed WSU-Spokane Advisory Council (AC), composed of influential leaders in finance, healthcare, utilities, law, policy, and economic development. The AC's primary mission is to foster closer ties between WSU Spokane, its alumni, the community, the region, and the state. Expanding I&E in Spokane is a top priority for the AC. In addition, Chancellor Brown has created a new advisory group, the Innovation, Commercialization, and Entrepreneurship Advocates (ICE-A), a grassroots organization of WSU-S and community members, which meets monthly to identify and act on opportunities in a coordinated fashion.

Fifth, a key stakeholder is Greater Spokane, Incorporated (GSI), the region's Chamber of Commerce and Economic Development organization. GSI has selected health care-based growth as the centerpiece of its Vision 2030 roadmap for economic development. GSI also co-commissioned an economic analysis for the Spokane region by the Tripp Umbaugh group in 2015. This extensive analysis of the Spokane ecosystem concluded that health care and medical informatics would become major economic drivers for the region. GSI has committed to providing the community leadership to achieve the vision of building a comprehensive, world-class, center of academic life sciences, medical education, and life sciences research and commercialization, resulting in robust life sciences industry growth with unprecedented economic impact to the Spokane region. GSI works with many additional committed and interconnected entities in Spokane, including:

- Avista, a local utility, invested in the growing entrepreneurial ecosystem and the smart cities infrastructure expansion initiatives out of WSU-Spokane.
- Numerica Credit Union, a partner for University District, supporter of Vision 2030, and the first sponsor for the SINE network launched by WSU.
- Spokane Teaching Health Clinic, a partnership forged in 2013 by WSU Spokane, Providence Health Care, and Empire Health Foundation to train medical residents in eastern Washington.
- Health Sciences & Services Authority of Spokane (HSSA), which funds educational and research initiatives to create to a nationally competitive health care cluster in Spokane County for sustainable economic diversification.
- Ignite Northwest is a business accelerator that is dedicated to assisting technology and bioscience businesses to move beyond the startup phase.
- Hospitals and healthcare providers including Providence Health Services, Inland Northwest Health Services, St. Luke's Rehabilitation Institute, Kootenai Health, and Empire Health Services.
- University District – WSU is an anchor stakeholder for the new bridge and connectivity between refurbishing and renovations in the growth of this regional economic development site.
- Startup Spokane – WSU is a founding member of Startup Spokane.

Finally, the proposed *Spokane Regional Healthcare Innovation Cluster* will be a perfect fit for Vision 2030. The cluster will maximize the anticipated growth in the region's healthcare industry and life sciences sector by creating opportunities among all stakeholders, including healthcare providers, academic and industry researchers, investors, developers, and city leaders. The cluster will promote frequent interactions among stakeholders to discuss potential collaborations and/or to develop new ideas around disease prevention, healthcare access and delivery, diagnostics, and treatments. The proposed effort will guide entrepreneurs, researchers, and healthcare providers in the targeted, market-driven innovation of products and services, to maximize the likelihood of commercial success and economic growth. This is an important hallmark of organic growth, in which innovations from within WSU and other Spokane stakeholders build the region outwards, rather than the necessity of importing external talent and industry. Overall, the expansion of human and physical resources for life sciences research has been met with enthusiasm in the community. The next steps toward impacting the economic development of the region are to expand the culture of innovation, enhance the entrepreneurial infrastructure, and attract investment.