ADVANCING RESEARCH, INNOVATION, AND CREATIVITY

120-DAY STUDY OF THE WSU RESEARCH ENTERPRISE

WASHINGTON STATE UNIVERSITY

officeofresearch.wsu.edu

Washington State University (WSU) is a leading land-grant university, preeminent in research, teaching, and community outreach. Our 2014-2019 strategic plan outlines three major themes for the university: exceptional research, innovation, and creativity. Building on WSU's well-recognized research strength areas, we aspire to expand our research accomplishments and reputation to a level competitive with members of the Association of American Universities (AAU).

Recognizing that a significant change in WSU's research strategy and priorities is needed to achieve this goal, our leadership commissioned a 120-day study to take a comprehensive look at WSU research and outline a vision, with associated specific recommendations, for advancing the WSU research enterprise. The study resulted in the identification of five "Grand Challenge" research themes. These themes will provide focus in university efforts to communicate research strengths and will serve as a basis for prioritization of major university research investment. The study also resulted in nineteen actionable recommendations; their implementation will be important to realizing our vision to foster and enhance WSU research. We thank the members of the WSU community who contributed to this report.

Seeing the level of engagement from faculty, students, and administration throughout this study, and knowing that there is tremendous support for WSU from stakeholders across the country, we have never been in a better position to strengthen and advance WSU research, scholarship, and creative activities. We look forward to implementing this plan and realizing these opportunities.

Christopher J. Keane
Vice President for Research

Daniel J. Bernardo
Provost & Executive Vice President

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Executive Summary

BUILDING ON WSU'S STRENGTHS

Background

Washington State University (WSU) is the state's land-grant research university. The University's vision is to be one of the nation's leading land grant universities, preeminent in research, education, and engagement. WSU developed a Five Year Strategic Plan (Appendix A) in 2014 to realize this vision. The Plan includes four themes, associated goals, and metrics for measuring performance. The latter includes Association of American Universities (AAU) membership indicators.

Theme 1 of the Strategic Plan focuses on enhancing research, innovation, and creativity at WSU. WSU research advanced significantly under the leadership of former President Elson S. Floyd and through the innovative and enterprising skills of WSU faculty and staff. Despite a deep recession and changes in University leadership, WSU substantially enhanced research expenditures, infrastructure, and capabilities since 2008. Indeed, WSU research surpassed the evaluative metrics set forth in earlier plans. The new Strategic Plan builds on this success.

The Provost and the Vice President for Research launched the "120-Day Study of the WSU Research Enterprise" in September 2014. The 120-Day Study is a comprehensive plan to achieve the research-related goals outlined in Theme 1 and other sections of the Strategic Plan. The specific goals of the 120-Day Study are:

- Defining a strategic research agenda for WSU through a set of "Grand Challenges" matched to current and emerging areas of University research excellence.
- Defining priorities that will guide major investments in research infrastructure and other critical elements of the WSU research enterprise.
- Examining the existing research enterprise and provide actionable recommendations to increase administrative efficiencies and create a culture of research excellence. The recommendations are structured to make results measurable so assumptions and progress can be assessed and validated.

The Vice President for Research will work with the WSU community to implement the 120-Day study and thereby advance the University's national and international stature in research and scholarship. Implementation of the 120-Day Study recommendations will enhance research expenditures and the quality, impact, visibility, reputation, and reach of the WSU research enterprise. Implementation of the 120-Day Study will also advance the University's education and outreach missions- indeed, the University's research, education, and outreach missions are strongly linked and mutually reinforcing. The 120-Day Study emphasizes the need to strengthen institutional systems that support research and encourage collaboration and effective communication both within WSU and with external partners and stakeholders.

120 DAY BEGINS

September 16, 2014
120-Day Study Kickoff

About the Study

Vice President for Research Dr. Christopher J. Keane and Provost Dr. Daniel J. Bernardo led the 120-Day Study, which was designed to be inclusive and comprehensive. WSU faculty, staff, and students from all of the WSU campuses, including Pullman, Spokane, Tri-Cities, Vancouver, the Global Campus, and WSU North Puget Sound at Everett, were encouraged to participate through attending meetings and online feedback. All were asked to share their perspectives and provide ideas, suggestions, and advice. External reviewers with expertise in high performance, high achieving academic research also provided comments and counsel.

The 120-Day Study work was largely executed by four faculty-led subgroups as follows:

RESEARCH THEMES

Chaired by **Dr. Don Bender**, director, Composite Materials and Engineering Center; and **Dr. Tom Spencer**, Department of Animal Sciences (18 members total)

RESEARCH INFRASTRUCTURE

Chaired by **Regents Professor Dr. Sue Clark**, Department of Chemistry; and **Dr. Steve Simasko**, chair, Integrative Physiology and Neuroscience (17 members total)

FACULTY AND STUDENT ENGAGEMENT AND PRODUCTIVITY

Chaired by **Dr. Rebecca Craft**, chair, Department of Psychology; and **Dr. Jonathan Jones**, director, School of Molecular Biosciences (17 members total)

OUTREACH, ENGAGEMENT, AND ECONOMIC DEVELOPMENT

Chaired by **Dr. Sita Pappu**, director, Office of Commercialization; and **Regents Professor Dr. Juming Tang**, associate chair, Department of Biological Systems Engineering (17 members total)

A Management and Integration (M&I) subgroup, consisting of the associate deans for research and representatives from WSU's urban campuses, guided the study. An executive review group, consisting of the WSU deans, selected senior faculty, and university leadership representing all WSU campuses, provided ongoing review and counsel. The broader university community was engaged through periodic updates, Town Hall meetings, and a public comment page on the 120-Day Study website.

The study proceeded through a mix of individual subgroup meetings and monthly large-group meetings of all study participants. Twenty-eight subgroup and large-group meetings were conducted. The University community contributed 141 comments, which were key to formulating study conclusions. The four faculty-led subgroups provided their recommendations at a large-group meeting held December 2, 2014. Two additional large-group meetings focused on Grand Challenges were held in January 2015 and facilitated by Academic Leadership Associates (ALA) Inc. The M&I subgroup, under the leadership of Dr. James Moyer and Dr. Paul Whitney, condensed the individual subgroup recommendations into a set of 19 recommendations listed below. The study formally concluded on January 30, 2015, with the completion of the first draft of this document.

Study Outcomes: Grand Challenges

The primary outcome of the study are five Grand Challenges that form the University's strategic research agenda, and an associated set of recommendations to advance the WSU research enterprise. The Grand Challenges are summarized below.

Sustaining Health: The Uncompromising Pursuit of Healthier People and Communities

Understanding the fundamental bases of health, wellness, and disease and applying that knowledge to promote the well-being of people and communities. Key elements include:

- Understanding health and the onset and progression of disease
- Changing the course of disease
- Promoting individual health and wellness
- Promoting healthy communities and populations

Sustainable Resources for Society: Food, Energy, and Water

Pursuing solutions to the challenge of providing abundant high quality food, sufficient fresh water supplies, and renewable energy systems that safeguard the environment. Key elements include:

- Food: Enhancement of production systems and products
- Energy: Meeting needs while protecting the environment
- Water: Safety and sustainability
- Societal perspectives and government policy relating to sustainability

Advancing Opportunity and Equity

Building deep knowledge of the factors that promote an informed and equitable society and that expand individual opportunity and promote social justice. Key elements include:

- Examining the causes and consequences of inequality of opportunity
- Promoting equity for individuals and communities
- Furthering economic, educational, and social policies that impact opportunity, societal cohesion, and engagement
- Improving formal and informal education throughout the lifespan

Improving Quality of Life through Smart Systems

Developing transformative and adaptive technologies (smart systems) that will drive economic growth, improve quality of life, optimize the use of dwindling resources, enable self-sufficiency, and provide security for future generations. Key elements include:

- Smart and sustainable systems
- Foundational and emergent materials
- Computing, data, and information
- Economic, social, and policy dimensions of information

Fundamental Research in Support of National Security

Performing a wide variety of fundamental research that improves the human condition, secures the U.S. military advantage, and propels the U.S. economy. Key elements include:

- The study of matter at extreme conditions and its application to fundamental science and support of U.S. nuclear security
- Advancing nuclear nonproliferation and nuclear safeguard goals through basic research
- Increasing quality of life in underdeveloped countries through a community-based approach to development of agriculture and education
- Disease detection, prevention, and response in underdeveloped areas to promote global health security

WSU will use the Grand Challenges to define and focus the institution's strategic research agenda, and appropriately communicate this agenda with internal and external constituents and stakeholders. The Grand Challenges provide an opportunity for faculty to be involved in large-team, multidisciplinary research focused on problems of societal interest, and thus complement individual investigator efforts. The Grand Challenges will also be used to prioritize major internal WSU research investments. Seed grants, workshops, and other support will be implemented to further develop specific research topics within the challenges and align them with needs of sponsors and other key stakeholders.

Study Outcomes: Recommendations to Advance the WSU Research Enterprise

The 120-Day Study subgroups examined the University-wide research enterprise and identified opportunities as well as barriers to advancing research at WSU. Each subgroup developed specific recommendations in response to a charter provided by study leadership. The M&I subgroup integrated these subgroup recommendations into a final set of 19 study recommendations to advance research, scholarship, and creativity. These recommendations are listed below.

BE STRATEGIC

Implementing a WSU Research Strategy

1. Integrate WSU Grand Challenges into WSU research strategies.
2. Align faculty recruitment with WSU research aspirations.
3. Ensure colleges' and campuses' strategic plans, including multi-year and cluster hiring plans, are aligned with WSU's Strategic Plan and research strategic plans.
4. Offer competitive faculty salary and start-up packages, and consider space, computing, and administrative impacts of hires in planning and recruitment.
5. Target resources to the hiring of mid-career and prestigious faculty in areas of importance to achieve progress on the Grand Challenges.
6. Pursue excellence in recruitment and retention of research trainees.
7. Create and charge a standing University Research Infrastructure Committee (URIC) to increase efficiency and impact of research infrastructure investments.
8. Develop and implement a community-based approach to institutional research computing that is responsive to the needs of the scientific and data-intensive computing community.
9. Address small and/or non-equipment infrastructure needs and make recommendations for targeted investments.
10. Enhance and coordinate training and support systems for sponsored projects.

BE COLLABORATIVE

Enhancing Research Collaborations

11. Create effective information systems for tracking faculty and trainee activities to enhance opportunities for collaboration and improve program coordination and communication between individuals and units.
12. Create physical spaces that facilitate interdisciplinary discussion and faculty engagement.
13. Reduce barriers to collaborative research and creative activities caused by WSU's geographic location and leverage the advantages of WSU's multi-campus presence across the state.
14. Increase opportunities to develop industrial research partnerships.

Enhancing the Visibility of WSU Research

15. Enhance and coordinate mentoring for prestigious fellowships and awards.
16. Encourage faculty, at all stages of careers, to participate in activities that raise visibility or deepen partnerships with external partners in both the public and private sector.
17. Enhance coordination and support for international collaboration across the university.
18. Improve pathways for WSU research and creative activities to be communicated to the public.
19. Clearly define WSU's message to communicate Grand Challenges and research strengths with consistency.

Path Forward and Implementation

The WSU Office of Research is working with University faculty, staff, administration, and key external stakeholders to implement the Grand Challenges and 120-Day Study recommendations. Faculty leadership teams have been formed for each of the Grand Challenges. These teams are developing specific objectives and associated opportunities for research, scholarship, and creativity, which will undergo peer review. This peer-reviewed set of objectives and opportunities will be the basis for further University action to advance the Grand Challenges, including seed grants and the development of large multidisciplinary proposals.

The Office of Research has assembled a 120-Day Study Implementation Plan to track implementation actions and associated metrics for the Grand Challenges and the 19 recommendations discussed above. A subset of these metrics are used to track progress on Theme 1 of the WSU Strategic Plan. The vice president for research oversees implementation of both the 120-Day Study and Theme 1 of the WSU Strategic Plan, and will ensure these activities remain coordinated and self-consistent.

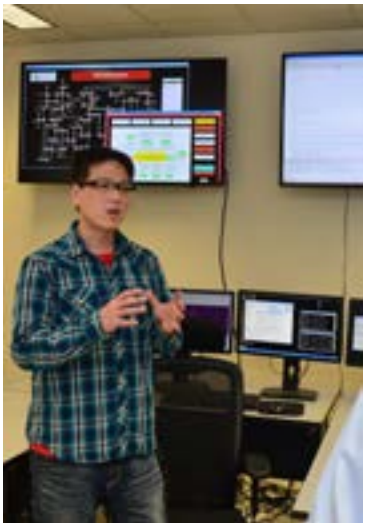
The vice president for research has restructured the Office of Research to support implementation of the Grand Challenges and 120-Day Study recommendations. In particular, the vice president for research has instituted a new Office of Research Advancement. This office will work with WSU faculty and staff to improve WSU proposal submissions, with emphasis on developing quality large, multidisciplinary proposals. This office and others units of the Office of Research will work closely with WSU faculty, staff, leadership, and key external stakeholders to develop a corresponding federal, state, and private sector agenda that advances the WSU research enterprise and realizes related commercialization and other economic development opportunities.

Grand Challenges

BUILDING ON STRENGTHS

Why Grand Challenges?

Grand Challenges serve to provide sharp focus to pull together the assets of researchers, scientific/technological innovators, educators, government, business, social entrepreneurs, philanthropists, and the public to advance solutions to critical societal issues. The concept is uniquely aligned with the mission of land-grant universities whose purpose includes improving the quality of life for society.



Grand Challenges that are built on our existing and emerging areas of research strength and are inclusive of multiple disciplines will:

- Bring together the best minds from multiple disciplines under a shared vision to tackle problems with a broader scope and to maximize impact by capitalizing on fundamental and applied research strengths across disciplines.
- Target strategic investment in Grand Challenge areas that will advance WSU research nationally and internationally.
- Establish clear messaging for more effective communication and marketing plans to strengthen WSU's brand and increase awareness of WSU as a major research institution.
- Consolidate a shared mission and increased engagement with the public. Framing research in the context of grand challenges is inherently motivating and inspiring. As a public university, being responsive and accountable to our stakeholders regarding our research enterprise is key.

See Definition and Characteristics of a Grand Challenge documents in Appendix C.

"Grand Challenges are ambitious but achievable goals that harness the research, scholarly, and creative capability of WSU and its partners to solve important national or global problems and that have the potential to capture the public's imagination."[1]

The Value of 'Curiosity-Driven' Research

Coordinating WSU efforts around societal challenges is not intended to reduce WSU's support for fundamental curiosity-driven research, but to increase its societal impact. Darwin did not study the natural world to understand the genome with the purpose of developing the field of genetic engineering. Einstein did not study the curvature of space-time and the eerie condensation of particles called bosons to develop the GPS system or to invent the laser. Instead, these scientists were driven by curiosity and an intense thirst to unlock the mysteries of life, matter, and space-time. The practical applications of their research, which have fundamentally transformed the fabric of our lives, came about as a byproduct of their relentless pursuit of understanding. WSU must and will continue to hold a public commitment to, and financially invest in, fundamental research; not only for the sake of expanding human knowledge as an end to itself, but also because basic research can lead to breakthroughs that shift scientific paradigms and enable novel applications that leapfrog existing technologies. Strong support for continued hiring of bright and energetic basic researchers at WSU should continue, as it invigorates existing research areas, attracts the best and brightest students, and increases the visibility of our research and the reputation of our institution. Basic research is the foundation on which new innovation and solutions to WSU's Grand Challenges and other societal challenges are built.

[1] *Adapted from the White House Office of Science and Technology Policy definition of a Grand Challenge.*

Creating the Grand Challenge Themes

After cross referencing suggested themes with identified college strengths, the Research Themes Subcommittee created a preliminary list of potential themes for the Management and Integration (M&I) Group to move forward through an evaluative process (Figure 1). The M&I Group and subcommittee chairs discussed, refined, and focused the preliminary list of themes and aligned strengths at an initial meeting facilitated by Academic Leadership Associates (ALA) facilitators, Dr. Mark Robison and Dr. Mike Diamond, in December 2014. After that meeting, a study leader was assigned to each Grand Challenge and, with input from others in multiple disciplines, produced an initial narrative description and an analysis of the WSU research strengths which could contribute to each Grand Challenge area. In January 2015, a second ALA-facilitated meeting was held, which included participation from the Executive Review and the M&I Groups, and the 120-Day study subcommittee chairs (see Subcommittee Rosters in Appendix B). The Grand Challenges proposed below are a culmination of that process.

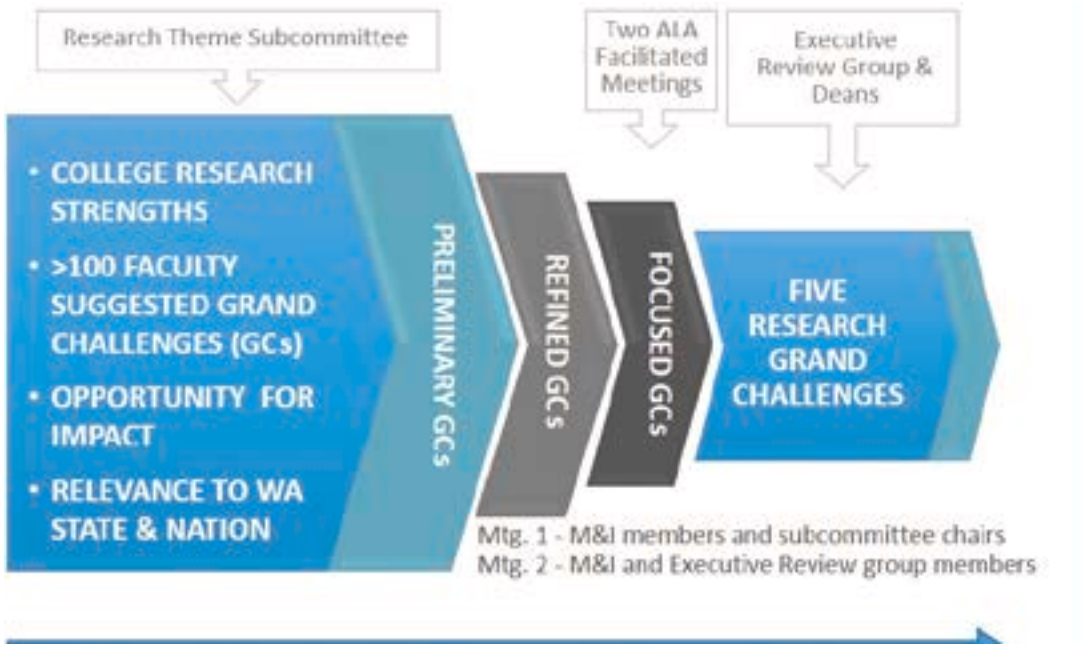


Figure 1: Grand Challenge Evaluative Process

The Path Forward

The process of fully developing WSU's Grand Challenges will continue after the close of this 120-Day study. As described in the Final Study Recommendation section of this document, a faculty team will be identified to lead in the final development of each of the Grand Challenges. Each Grand Challenge Team will create a series of workshops around their theme to define issues and brainstorm opportunities as they align with WSU areas of strength. Ultimately, these groups will propose a strategic path forward and work with a university infrastructure subcommittee, the vice president for research, and the provost to identify critical investments to move work forward in each Grand Challenge area.

Additionally, this approach involves identifying critical barriers holding back progress in theme areas and provides a platform for developing and implementing strategies to overcome those barriers to place WSU researchers in a position to address pressing challenges facing the region, the nation, and the world.

HEALTH

Pursuing a sustained state where all people and communities are healthy and well.

SUSTAINING HEALTH: THE UNCOMPROMISING PURSUIT OF HEALTHIER PEOPLE AND COMMUNITIES

Defining the Challenge

There is nothing more fundamental to life itself than the pursuit of a sustained state in which all people and communities are healthy and well. This pursuit requires understanding the fundamental bases of health, wellness, and disease and the application of that knowledge to promote the well-being of people and communities. Importantly, this grand challenge spans both physical and mental health and requires considering social, cultural, and environmental determinants of health and well-being. Advances made over the past century related to health have resulted in an unprecedented increase in human longevity, but these advances have been accompanied by increasing challenges related to chronic health problems and skyrocketing costs. During this time health science research has become increasingly technical, fast paced, and multidisciplinary. Continued progress depends on collaboration among basic, applied, and clinical scholars from a broad array of disciplines combined with science-driven outreach and translation to effective interventions and policy, with a goal of improving the quality of life for all.

WSU's Role in the Solution

Washington State University is exceptionally positioned to effectively tackle many aspects of the challenge to improve and sustain health and well-being. The University's land-grant mission supports a critical mass of highly productive faculty and staff committed to improving health through better production of healthful and safe foods, and the sharing of acquired knowledge to important stakeholders. WSU's state-wide campuses are also home to an impressive contingent of basic scientists and clinicians actively engaged in both fundamental and applied health research, including a developing emphasis on public health both domestically and globally. Having a faculty presence in several medically-underserved communities across Washington state allows WSU to train and engage with health care providers embedded in these communities, optimizing health care delivery in these at-risk regions of the state. Specifically, the research done in the WSU College of Nursing works to transform health care to be affordable and accessible for all, starting with underserved communities in the state.

WSU is also positioned to optimize human health by advancing knowledge of the natural, social, and built environments to improve the air we breathe, the water we drink, the creative arts we enjoy, and the communities and buildings in which we work and live. Collaboration and synergy across a wide array of strengths—for example, anthropology, economics, nutrition, fundamental cell and molecular biology, and both basic and applied infectious disease research and epidemiology—allows programs such as the Allen School for Global Animal Health to add vital and unique dimensions to WSU's impact by providing an unparalleled interface among animal agriculture, human health, and economic security on a global scale. In these and other ways, the collective potential for WSU faculty to creatively and collaboratively advance and sustain human health and well-being is not only vibrant, comprehensive, and holistic but also unique within the state of Washington.

Key Research Themes

- Understanding health and the onset and progression of disease
  - The fundamental biology of life
  - The molecular and cellular bases of disease
  - From brain to behavior
  - Advanced materials and health
- Changing the course of disease
  - Novel therapeutic strategies
  - Pharmacogenomics and individualized therapies
  - Innovative solutions to infectious disease
- Promoting individual health and wellness
  - Healthful foods and nutrition
  - Recuperative sleep
  - Quality exercise
  - Health literacy
  - Behavioral, social, and cultural influencers of health
- Promoting healthy communities and populations
  - Interventions to improve public health and wellness outcomes
  - Health care access in rural and underserved areas
  - Food safety and biosecurity
  - Reproductive sciences
  - Global animal health

Descriptive Sentences of Each Key Research Theme

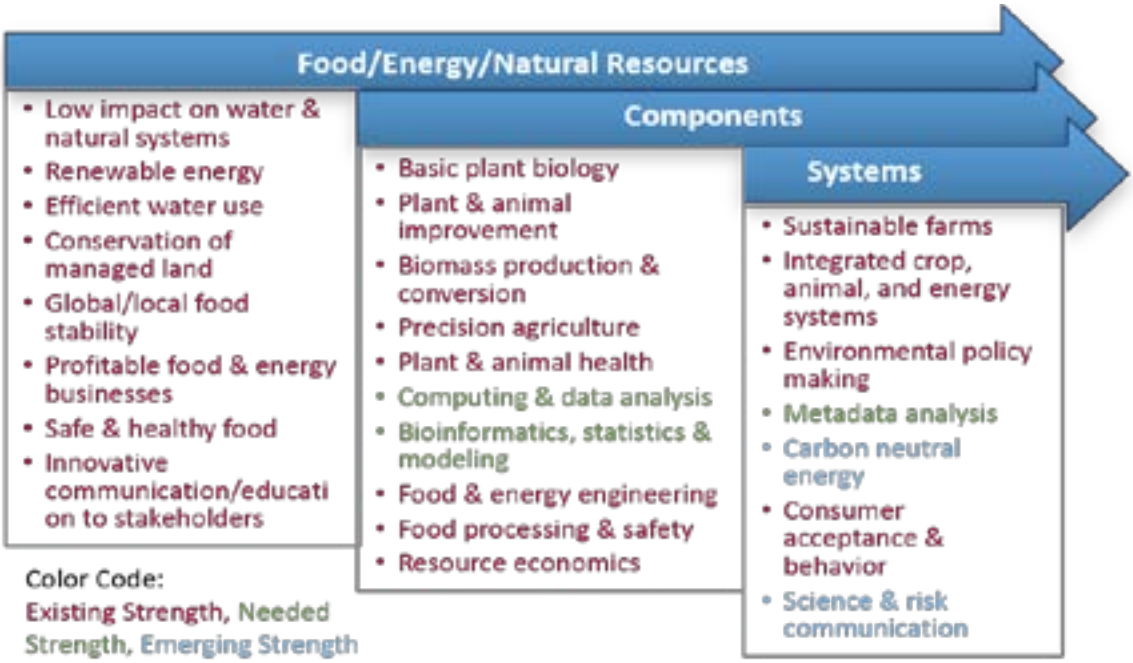
1. **Understanding health and the onset and progression of disease.** Basic research aimed at investigating human and animal health and disease at the molecular, cellular, and organismal levels is fundamental and essential to determining avenues leading to health promotion and disease prevention and treatment across the lifespan. These research programs span myriad approaches including those utilizing mathematical modeling, molecular and cellular systems, animal models, and clinical and other intervention trials.
2. **Changing the course of disease.** Translating cutting-edge basic science knowledge into health care practice and delivery is needed to change the course of disease. Fundamental knowledge applied to the discovery and development of novel therapies and vaccines remains a critical strategy to improving health and well-being. With advancing understanding of the differences in the fundamental biological makeup of individuals, these therapies can be tailored to maximum benefit with minimal ill effects.

3. **Promoting individual health and wellness.** Effective communication and outreach to deliver evidence-based information to people, families, and communities regarding the biological, environmental, social, and behavioral influencers of health is essential for improving and sustaining individual health. In addition, optimizing the biological and social factors underpinning the production, processing, and distribution of sustainable, adequate amounts of safe plant- and animal-based foods is crucial for sustaining human health and well-being.
4. **Promoting healthy communities and populations.** Promoting and sustaining healthy communities and populations requires population-based translation of many of the same factors required to promote and sustain the health of individuals, including a safe and abundant food supply, reproductive health, and innovative solutions to infectious disease. In addition to what can be learned from basic biomedical science, physical and mental health and well-being are determined in part by the complex interactions we have with other people as well as with our natural, creative, and built environments. Successful integration across these many dimensions of health is required to develop, test, and implement effective interventions to sustain public health, and especially to reduce disparities in and increase the effectiveness of health care delivery to benefit all people, specifically those in underserved communities.

SUSTAINABLE RESOURCES FOR SOCIETY: FOOD, ENERGY, AND WATER

Defining the Challenge

The challenges of providing abundant high quality food and sufficient fresh water supplies for the next generations are inextricably linked to the development of renewable energy systems that safeguard the environment and health. The demands on our arable land to produce more food for a growing population are exacerbated by competing needs for diminishing supplies of fresh water as well as for bioenergy and biomaterials. Although most current energy production systems produce greenhouse gasses that intensify climatic changes and uncertainties, reliable production, storage, and transmission of energy are defining characteristics of an energy-secure and sustainable America. Washington State University is uniquely situated in the inland northwest, enabling its scholars to leverage the natural renewable resources and historic legacy sites within this region to learn from our natural environment and develop and communicate strategies that link optimized agricultural practices, water management, and energy production.



RESOURCES

Providing abundant food, fresh water, clean air, and sustainable energy for the future.

WSU's Role in the Solution

WSU scholars pursue solutions at the nexus of agricultural, water, and energy challenges. WSU provides leadership in fundamental genetics, metabolism, physiology, and pathology of plants and animals that underlie future improvements in food production efficiency with limited resources. Further expertise in sustainable food production systems, crop improvement, mechanization, food processing, and pest management will safeguard the security of food, energy, and water resources. WSU is home to one of the National Institutes for Water Resources and has a strong presence in integrative research, accounting for physical, biological, and social aspects of water science and water management and utilization across competing uses. WSU is also a recognized leader in next generation energy production technologies, with an established infrastructure and invaluable expertise in materials development and process management across these renewable energy domains. In this context, WSU research in materials and device development has led to pioneering programs in biologically inspired storage strategies, advanced battery materials, and alternative fuels that will ensure a secure, reliable energy future.

WSU is making advances in disciplines ranging from traditional energy resource generation to wind, solar, and bioenergy. WSU has an established infrastructure and uncommon expertise in materials development and process management that spans these renewable energy domains. Strategic partnerships, such as a productive relationship with Pacific Northwest National Laboratory and collaborations with utilities throughout the region (Avista Utilities, Puget Sound Energy, Tacoma Public Utilities, and many others), position WSU as an energy research leader. WSU faculty programs are also leveraged by one of the nation's largest concentrations of USDA Agricultural Research Service (ARS) scientists, who are seamlessly integrated into the WSU faculty structure. By engaging researchers at its urban campuses, four Research and Extension Centers, and rural Extension facilities, which are present in every county of the state, WSU ensures that the "translational component" of meeting the Grand Challenges can be met through region-specific communication and education. Moreover, WSU has strengths in the entire supply chain of programmatic areas from discovery through development and translational efforts that ensure our fundamental research efforts will have impact in addressing these Grand Challenges.

Key Research Themes

- Food: Enhancement of production systems and products
  - Optimized agricultural practices
  - Improved crop varieties and animal breeds
  - Available and affordable food
  - Nutritious and safe foods
- Energy: Meeting needs while protecting the environment
  - Efficient and sustainable energy production
  - Available and affordable energy
  - Development of renewable sources of energy
  - Healthy environments and energy production
- Water: Safety and sustainability
  - Safe and abundant water supply
  - Effective water management
  - Water use and healthy environments
  - Aquatic ecosystems
- Societal perspectives and government policy relating to sustainability
  - Political engagement and public policy development
  - Effective communication and education
  - Production incentives and stewardship
  - Rational economic approaches to sustainability

Descriptive Sentences of Each Key Research Theme

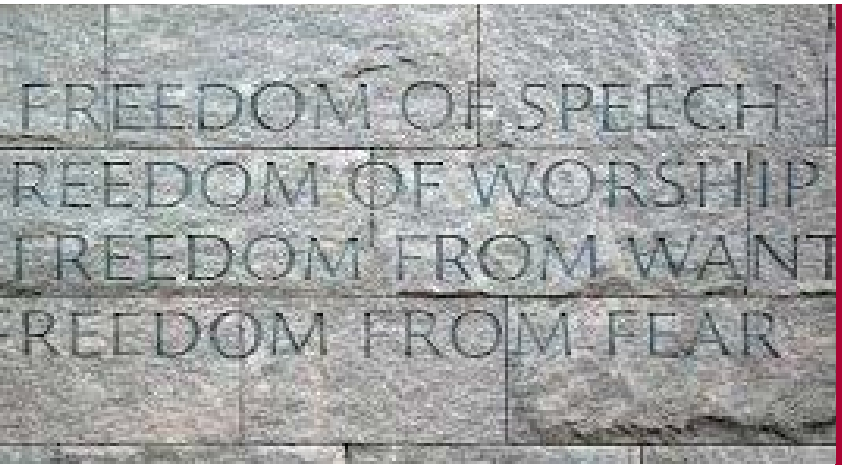
1. **Food: Enhancement of production systems and products.** Research in plant and animal genetics, metabolism, physiology, pathology, and food science is critical to improve the quality, quantity, and sustainability of food production. Applied research built upon these basic understandings will transform food production systems to increase productivity and quality, increase safety and security, and minimize environmental impacts.

2. **Energy: Meeting needs while protecting the environment.** Robust energy production systems, such as bio-, hydro-, nuclear, and wind energy, must be developed to reduce reliance on fossil fuels while minimizing impacts on water quality, biodiversity, and greenhouse gas production. Reliable and efficient energy storage and transmission are also key aspects of a sustainable energy future.
3. **Water: Safety and sustainability.** To ensure a safe and abundant water supply, while safeguarding a sustainable food and energy supply, systems must be developed that maximize food and energy production while minimizing use or degradation of natural resources such as water, soil, forests, and wildlife habitat. Advances will be made by increasing efficiencies in existing systems and creating novel systems, informed by life cycle and economic analyses.
4. **Societal perspectives and government policy relating to sustainability.** Understanding the perspectives and actions of the public, industry stakeholders, and policy makers is essential if advances from research will be adopted and translated into sustainable food, energy, and water production systems. Connecting the basic and applied science of food, energy, and water systems with an understanding of the economic, social, and policy barriers to change, and accurately communicating the science to non-expert stakeholders, is critical to securing a sustainable future.

ADVANCING OPPORTUNITY AND EQUITY

Defining the Challenge

Knowledge is the cornerstone of democracy and opportunity. The vitality of our society depends on an informed citizenry and skilled workforce, yet opportunity disparities in education, health, and employment continue to limit human capital. Research is needed to build deep knowledge of the factors that promote an informed and equitable society and to expand individual opportunity and promote social justice. WSU research relevant to this Grand Challenge addresses long-standing as well as new challenges to equality and opportunity, ranging from limited numbers of people from historically underrepresented groups and women entering STEM disciplines to inequities associated with the digital divide, health care, and fragmentation of the political landscape. Building an educated society with opportunities for all requires research across the spectrum of society itself, from political science to business, from communication to psychology, and from the humanities to the arts. It involves big data, culturally sensitive qualitative research, and an examination of pedagogical practices at every level and component of our nation's educational systems.



OPPORTUNITY FOR ALL

Building an informed and equitable society by expanding individual opportunity and promoting justice.

WSU's Role in the Solution

WSU has significant research capacity to investigate the causes and consequences of inequality of access and opportunity in education, economic opportunity, and access to health care and information. Faculty members from a broad range of disciplines contribute to our understanding of how economic, health, and social conditions impact opportunity. Humanists and artists explore past and present dimensions of society that help us better understand our humanity. Faculty in social sciences, economics, statistics, and education conduct important research crucial to exploring, evaluating, and modeling educational, economic, and other societal outcomes. Researchers across multiple colleges study the digital divide, media and politics, and the role of information access in ameliorating health disparities. Several unique centers, such as the Social and Economic Sciences Research Center; Center for Environmental Research, Education, and Outreach; IMPACT Center; and Center for Social and Environmental Justice, conduct and disseminate research addressing environmental justice issues that impact social and economic opportunities in a diverse citizenry. The Thomas S. Foley Institute for Public Policy and Public Service examines issues such as the role of civility in American politics. The Learning and Performance Research Center studies the malleable factors related to success in work and learning environments, develops and evaluates statistical and methodological innovations, and provides evidence-based meta-analyses to evaluate program interventions. Over 100 WSU researchers conduct collaborative STEM education research from early grades to graduate school, a vital aspect of social and economic opportunity. A key feature of this work is research that focuses on clinical education. Faculty in nursing, veterinary medicine, pharmacy, human medicine, and nutrition and exercise science conduct research that informs clinical education modalities. As a result, students receive state-of-the-art instruction that inspires, elevates confidence, and readies them to save lives. Across WSU, the combined efforts of social science and clinical science faculty toward addressing inequality, information access, health and education outcomes, and education practice and policy, illustrate how WSU is working to create opportunity and make a better life for all in Washington and beyond.

Key Research Themes

- Examining the causes and consequences of inequality of opportunity
  - Causes and consequences of injustice and inequality
  - Understand history and its relevance to contemporary society
  - Social and cultural context of science and technology
  - Media's influence in shaping societal and political discourse
  - Cultural studies in education
- Promoting equity for individuals and communities
  - Understand gender, race, and culture through artistic expression and critical inquiry
  - Understand diversity from genetic through cultural levels of analysis
  - Injustice and inequality
  - Distribution of resources
  - Educational access
- Furthering economic, educational, and social policies that impact opportunity, societal cohesion, and engagement
  - Robust analytic and modeling strategies
  - Democratization of information and digital access
  - Global competition and its impact on the United States and world economies
  - Media psychology and communication processes and effects
- Improving formal and informal education throughout the lifespan
  - STEM education and educational pipelines
  - Cultural studies in education
  - Neuroscience and neuropsychology of education
  - Community public health
  - The role of technology in education

Descriptive Sentences of Each Key Research Theme

1. **Examining the causes and consequences of inequality of opportunity.** The historical narrative of the United States shapes the social and economic justice landscape of today. Political, social, economic, and educational policies serve to improve or limit opportunities available in society. Beyond these societal factors within the United States, the impacts of globalization and other multinational meta-trends infuse further complexity into efforts to promote social justice.

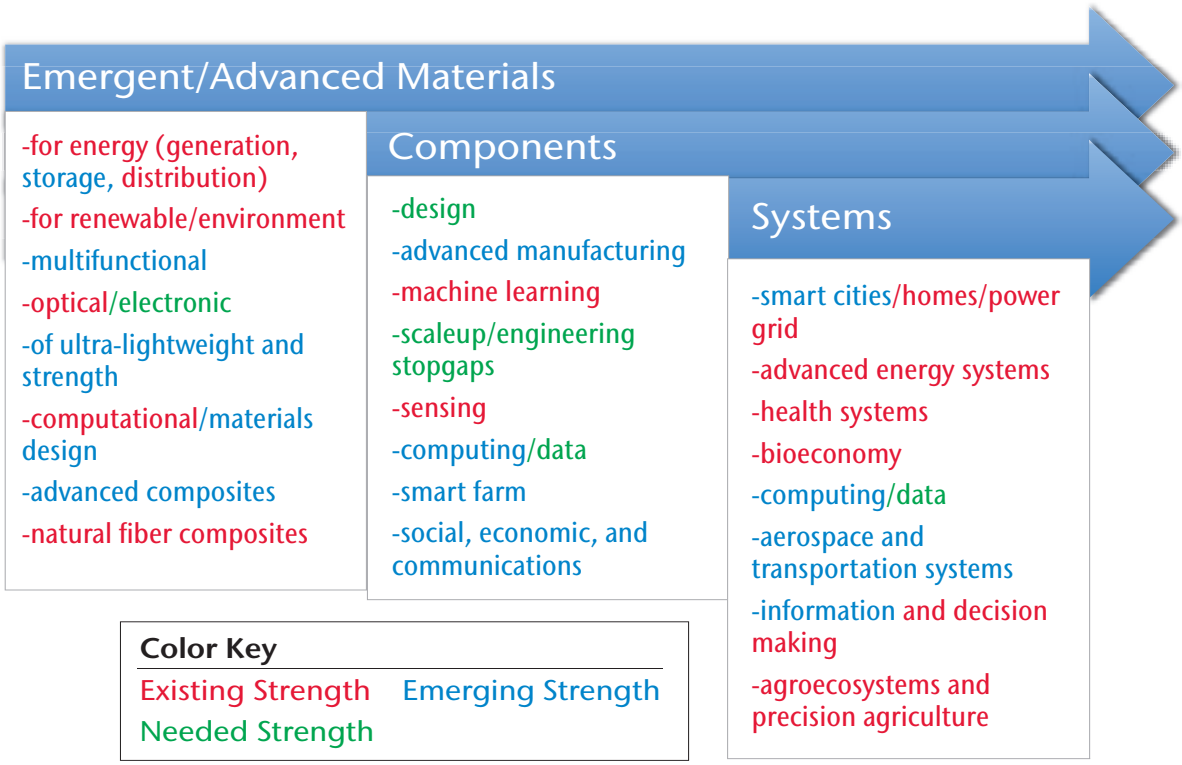
ADVANCING OPPORTUNITY AND EQUITY continued

2. **Promoting equity for individuals and communities.** By diagnosing political, social, economic, and educational inequality and opportunity, scholars can offer evidence-based solutions to redress historical and contemporary inequities. This research involves analyzing the global dimensions of business, examining the impact of STEM education on access and achievement, studying the behavioral aspects of social systems, and using data sciences and modeling to study human and natural systems. This line of research also focuses on the relative importance of traditional education, the role of digital access, the impact of media, and the more informal means of communication.
3. **Furthering economic, educational, and social policies that impact opportunity, societal cohesion, and engagement.** The policy environment plays a critical role in both problems and solutions. This research theme addresses a wide range of policy analyses including the impact of financial and economic policies on economic opportunity, the social and cultural context of science and technology, the effectiveness of educational pedagogy and technology in economic advancement, the impact of corporate structures and behaviors on societal well-being, the flow of information, and the ways in which historical and global perspectives shape views on contemporary issues.
4. **Improving formal and informal education throughout the lifespan.** Research in this area focuses on identifying variables that impact student outcomes, developing theories that explain learning principles, investigating interventions (e.g., curriculum, technology, practices) in educational settings, and developing and exploring methods of teaching that are responsive to cultural, linguistic, and other individual differences. This area of inquiry includes every aspect of the human lifespan from early childhood through K-12 schooling, higher education, career, and retirement—and the many different modes of delivery and styles of learning people require throughout their lives to fulfill their personal and professional goals.

IMPROVING QUALITY OF LIFE THROUGH SMART SYSTEMS

Defining the Challenge

Advancing societies depend upon technological innovations that improve the quality of life by driving economic growth, optimizing the use of dwindling resources, enabling self-sufficiency, and providing security for future generations. Resulting from major advances in multifunctional and smart materials and the consequential disruptive new technologies in communications and devices, and fueled by unprecedented computing power and data mining capabilities, smart systems are a transformational vehicle for enhancing well-being. Smart systems are comprised of a variety of components—an interwoven network of sensors, communications devices, automated device controls, and computational elements for pattern recognition, prediction, and decision-making. Thus advances in both materials development and computational sciences are essential to smart system



SMART SYSTEMS

Improving quality of life and driving economic growth.

innovation and will enable us to live, work, and play more comfortably and efficiently in our environments. These advances are accompanied by the "Internet of Things"—the network of sensors, devices, electronics, software, and connectivity—that will generate massive amounts of data, requiring new approaches in data science and analytics to convert data into actionable information. The chart on the previous page shows the fundamental materials, components, and resultant systems that must be improved to be successful in this area. The flow of the chart goes from basic building blocks for advanced and emergent materials on the left side, to components in the center, and systems on the right.

WSU's Role in the Solution

Washington State University is well-positioned to take on this challenge, building on our research strengths in smart systems, materials science, computational sciences, design disciplines, and social sciences. The power engineering program at WSU, in collaboration with local and national industry, Battelle, and the U.S. Department of Energy, developed the region's first Smart Grid community in Pullman, demonstrating how smart grid technology can promote the safety, security, reliability, and efficiency of energy delivery. As distributed and intermittent energy sources are incorporated into the grid, the smart grid work is critical for maintaining reliability and is dependent upon foundational research in state-of-the-art materials for energy production and storage. As applied to industrial complexes or entire cities and regions, in collaboration with the design disciplines and social sciences, smart environments will allow individuals to be more productive and self-sufficient, buildings to be more energy efficient, communities to be more connected, and infrastructure to be more sustainable and secure. An example of this is how WSU researchers are designing smart environments technologies that provide automated health monitoring and assistance for older adults and those with disabilities, allowing them to "age in place." WSU faculty researchers develop novel machine learning methods, reliable sensor networks, and innovative new materials that drive sustainable infrastructure development and monitoring of these systems. As the quantity and complexity of "Internet of Things" data grows exponentially, gleaning actionable information requires collaborative, multifaceted, and innovative involvement from the fields of design, materials, computer science, math, statistics, operation and management, economics, sociology, psychology, and public policy. WSU faculty working in data science and data analytics, along with their allied collaborators, will assist makers of public policy in comprehension of these highly complex issues.

IMPROVING QUALITY OF LIFE THROUGH SMART SYSTEMS continued

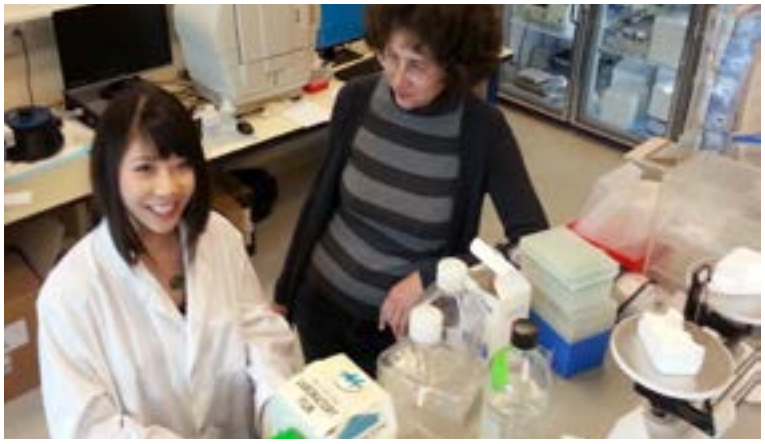
Key Research Themes

- Smart and sustainable systems
  - Next generation smart and sustainable buildings
  - Transforming the U.S. power grid
  - Enhancing performance and well-being in cities via digital technologies
  - The Internet of Things
- Foundational and emergent materials
  - Multifunctional, multiphysics, and smart materials
  - Sensors and wide bandgap semiconductors
  - Bio-based materials and green manufacturing
  - Computational materials science
- Computing, data, and information
  - Data-driven decision making
  - Systems analytics
  - Computational design
- Economic, social, and policy dimensions of technology
  - Public policy
  - Communications
  - Economic models and impacts
  - Ethics

IMPROVING QUALITY OF LIFE THROUGH SMART SYSTEMS continued

Descriptive Sentences of Each Key Research Theme

1. **Smart and sustainable systems.** "Smart" systems are complex networks based on a variety of components. As these systems become more sophisticated, going beyond machine-to-machine communications, smart environments and smart systems hold the possibility of automation in practically all fields. Advanced applications of smart systems are evolving all around us including smart homes, smart cars, smart manufacturing facilities, smart farms and food production systems, smart power grids, and smart cities.
2. **Foundational and emergent materials.** Materials that optimize resource management, are environmentally friendly, and provide enhanced performance provide the foundation of advanced infrastructures that will improve the quality of life. These may include emergent materials, whose essential physical properties may be more than the sum of their components, and which provide a basis for new materials design strategies that leverage basic physics and chemistry in tandem with computational design.



3. **Computing, data, and information.** The "Internet of Things," as well as advances in high performance computing, are generating copious amounts of data, whether from sensor networks or computing calculations. Computational effort is required in designing materials and systems, as well as in operating smart environments. Computers, through strategic data analytics, must be able to recognize actions and respond accordingly.
4. **Economic, social, and policy dimensions of technology.** Public acceptance of new technologies like smart systems is imperative, as is the ability to incorporate such systems into our lives in a way that is economically viable. As we begin to adopt smart systems, there are strong components of design, human behavior, society, and public policy that must be addressed concomitant with technological advances.

FUNDAMENTAL RESEARCH IN SUPPORT OF NATIONAL SECURITY

Defining the Challenge

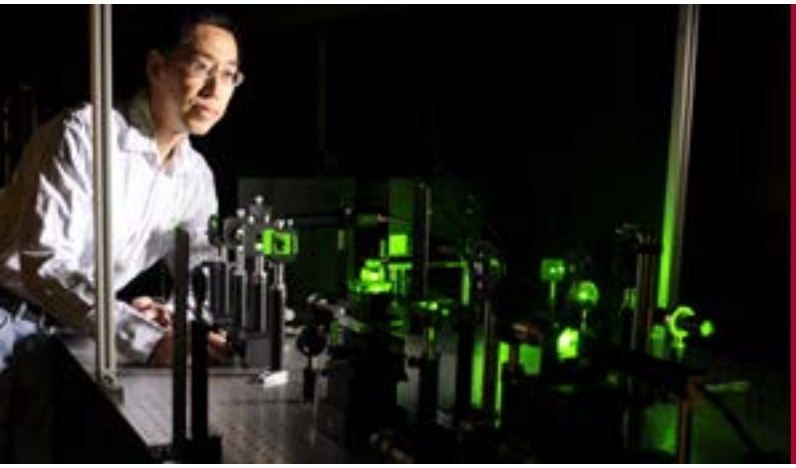
Fundamental research in a wide variety of areas provides the United States with a competitive edge that improves the human condition, secures our military advantage, and propels our economy. The 2015 U.S. National Security Strategy lays out the vision to protect U.S. interests in an uncertain world. This vision includes advancing a strong, innovative and growing U.S. economy in an open and highly competitive economic system, promoting respect for universal values at home and around the world, and fostering an international order that promotes peace, security, and opportunity through stronger cooperation. Achieving this vision involves addressing a wide range of multidisciplinary challenges. WSU brings world-class expertise and the necessary multidisciplinary approach to a number of particular challenges identified in the U.S. National Security Strategy, including:

- Preserving strategic stability via a safe, secure, and effective nuclear deterrent, and preventing the spread of weapons of mass destruction.
- Strengthening the security and resilience of U.S. critical Infrastructure.
- Reducing hunger through investment in nutrition, agricultural capacity, and sustainable development.
- Developing a global capacity to prevent, detect, and rapidly respond to biological threats through the Global Health Security Agenda.

Strong research partnerships between universities, government, and the private sector, including international partnerships, will be necessary in today's increasingly interconnected world to address these and other elements of the U.S. National Security Strategy.

WSU's Role in the Solution

WSU is exceptionally well positioned to address the specific issues above, with strong scientific capabilities and a multidisciplinary approach that enables the full range of technical, economic, biologic, behavioral, social, and cultural issues to be addressed. WSU houses the Department of Energy (DOE) National Nuclear Security Administration (NNSA) Institute for Shock Physics, one of the world's premier university laboratories for the study of matter at extreme conditions. The university has a leading program in nuclear science and technology, including a 1 MW research nuclear reactor and strong collaborations with the DOE national laboratories.



FUNDAMENTAL RESEARCH

Providing the United States with a competitive edge to improve the human condition, secure our military advantage, and propel our economy.

The WSU International Research and Agricultural Development program, funded via the U.S. Agency for International Development and other sponsors, has a long and distinguished track record of supporting agricultural and community development in Asia, the Middle East, Africa, and South America. The Paul G. Allen School for Global Animal Health provides innovative solutions to infectious disease challenges through research, education, global outreach, and application of disease surveillance and control at the human–animal interface, positioning WSU as a leader in addressing the national global health security agenda. In addition to these specialized capabilities, research conducted in support of each of the other WSU Grand Challenges will also help advance the specific issues identified above, as well as national security more broadly.

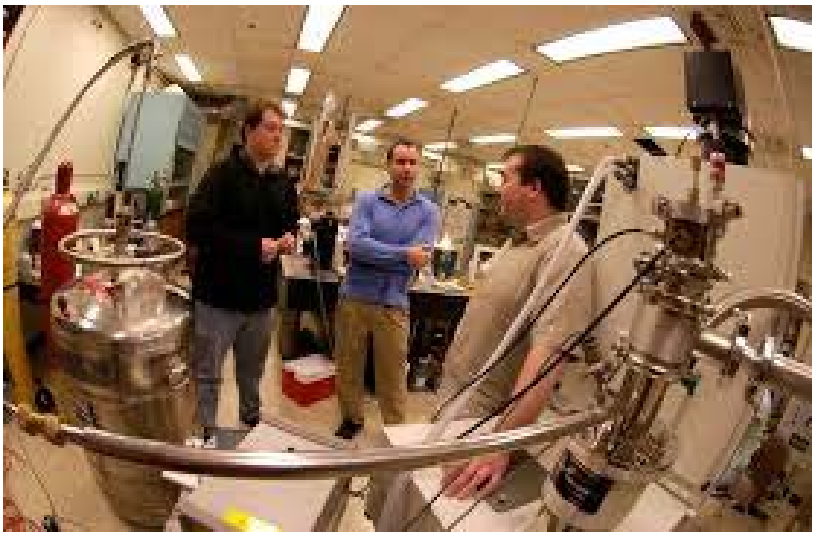
Key Research Themes

- The study of matter at extreme conditions and its application to fundamental science and support of U.S. nuclear security
  - Fundamental material properties at extremes of temperature and pressure
  - Computational materials science
  - Advancing nuclear nonproliferation and nuclear safeguard goals through basic research
- Advancing nuclear nonproliferation and nuclear safeguard goals through basic research
  - Actinide science
  - Radioanalytical methods for nuclear forensics and treaty verification
- Increasing quality of life in underdeveloped countries through a community based approach to development of agriculture and education
  - Agricultural extension projects
  - Reforestation
  - Expanded educational opportunities and attainment
  - Sustainable rural enterprises and livelihoods
  - Economic, behavioral, social, and cultural influencers
- Disease detection, prevention, and response in underdeveloped areas to promote global health security
  - Disease surveillance, monitoring, and associated computational modeling
  - Innovative solutions to infectious disease
  - Health care access in rural and underserved areas
  - Economic, behavioral, social, and cultural influencers of health and economic security

FUNDAMENTAL RESEARCH IN SUPPORT OF NATIONAL SECURITY continued

Descriptive Sentences of Each Key Research Theme

1. **The study of matter at extreme conditions and its application to fundamental science and U.S. nuclear security.** The study of matter at extreme conditions of temperature and pressure is a rapidly evolving area of physical science important to astrophysics, materials science, national security, and other areas. Rapid progression in experimental capabilities, including the WSU Institute for Shock Physics, is enabling researchers to study matter under physical conditions previously inaccessible in the laboratory. Research in this area involves established collaborations with universities and national laboratories in the United States and abroad. Specific topics to investigate include fundamental properties of materials at extreme conditions, related theory and computational modeling, and development of advanced materials.
2. **Advancing nuclear nonproliferation and nuclear safeguard goals through basic research.** Nuclear technologies are an essential aspect of advanced societies as they afford significant benefits such as nuclear energy, but also less well recognized applications in nuclear medicine, food preservation, water resources, and other areas. Such peaceful applications of nuclear technologies are encouraged via international agreements that require safeguards and verification to discourage proliferation for military or terrorism purposes. WSU supports international efforts to prevent the spread of weapons of mass destruction through basic research in chemistry, physics, and engineering. Using unique university facilities and infrastructure, WSU faculty engage in multidisciplinary research on matter in radiation environments and on radioactive materials. Through these research activities, WSU-led research teams are discovering the fundamental principles that enable key nuclear verification technologies, support nuclear forensics capabilities, facilitate development of adaptive materials for high radiation environments, and implement sustainable recycle and disposal options for nuclear wastes. These research efforts are enhanced via enduring collaborative relationships with the DOE national laboratories.



FUNDAMENTAL RESEARCH IN SUPPORT OF NATIONAL SECURITY continued

3. **Increase quality of life in underdeveloped countries through a community based approach to development of agriculture and education.** This research utilizes intensive dialogue, hands-on training, and Extension delivery methods to empower and expand the capacity of people while working within traditional leadership structures associated with the communities supported. In this way, the cultures of communities are respected while development is enhanced. Agricultural and educational technologies that are tested, affordable, and adapted to the local climate and/or culture are identified, designed, and implemented. Impacts are multiplied through the design and implementation of extension programs, increasing collaboration at the village level, providing access to materials and equipment, supporting marketing initiatives, and addressing cross-cutting health and social issues. This is important to developing strong and stable communities and thus a more secure global environment.
4. **Disease detection, prevention, and response in underdeveloped areas to promote global health security.** Global health security relies on the ability to recognize and respond to disease. As witnessed most recently in the Ebola disease crisis in West Africa, disease outbreaks can cripple the governmental, social, and economic fabric of a country, with lasting impacts that reach nations around the globe. Research is needed to carefully investigate the sustainability of developed country paradigms for disease surveillance in resource-poor environments. Objective, data-driven methods for disease detection and response that are sustainable in low income settings will be developed using a multidisciplinary "One Health" approach that addresses challenges from national to local levels, including trans-boundary issues. Political, economic, social, behavioral, and cultural drivers that impact disease emergence, as well as the sustainability of disease surveillance and response systems, will be investigated and incorporated into new models that serve the global community.

Final Study Recommendations

CREATING A CULTURE WHERE EXCELLENCE THRIVES

The nature of excellent scholarly research and creative activity is one of continuous striving to answer the next question, to pursue the next insight. To achieve excellence in scholarly pursuits requires a culture of innovation and constant effort to know more and perform better, no matter how high our current level of achievement is. In that same respect, a culture of excellence demands a willingness to regularly examine how we do things and strive to do them better. The 120-Day subcommittees were asked to examine WSU's current research enterprise, and identify actionable recommendations that will increase efficiencies and encourage a culture where research excellence thrives.

The subcommittees interviewed constituents across the university. They gathered and discussed hundreds of ideas, which were influential in shaping the final recommendations in this study. The work included in this chapter is the result of hundreds of hours of effort from more than 128 people representing 12 different colleges, 5 different campuses, and many disciplines who served on the 120-Day subcommittees.

The subcommittee reports contain many detailed recommendations that merit further consideration. In this chapter, the recommendations are distilled to capture the most broadly relevant and urgent steps toward greater levels of excellence. The M&I members synthesized the recommendations and tactics proposed in the four subcommittee reports (see pages 106-141). They summarized their final recommendations under three overarching principles that align well with WSU's Strategic Plan for 2014-2019. WSU's research path, as it seeks to accelerate the development of its unique strengths, must be:

Strategic **Collaborative** **Visible**

Each of these principles is followed by several strategic recommendations, suggested actions toward their implementation, and a description of indicators to benchmark progress. A table listing all goals and a detailed list of metrics is provided at the conclusion of the section (Table 1).

BE STRATEGIC

1

Integrate WSU Grand Challenges into WSU research strategies

Working with the deans, vice chancellors of research from the urban campuses, and department chairs, the vice president for research should appoint a faculty leadership team for each Grand Challenge. The teams should create a series of workshops to further develop and identify opportunities for integration of faculty from across the WSU system into each challenge. During workshops, the teams should identify subgoals based on research strength areas and prioritize infrastructure, expertise, and administrative support required to move forward. The teams should also develop linkages between the Grand Challenges and strategies to accommodate core functions that may fall outside specific challenges.

The teams should identify sources of internal funding to galvanize teams and provide seed grants for extramural applications. With Office of Research staff support, they should identify potential extramural funding sources and consider potential collaborators whose expertise would complement WSU's capabilities in the Grand Challenge areas. Teams should also consider potential private partnerships in Grand Challenge strategies.

Successful implementation of this recommendation will be demonstrated by accomplished tasks, as described above, a growing number of researchers pursuing research in Grand Challenge areas, and by the receipt of extramural grants and growing scholarly activity in Grand Challenge related areas. For a more complete presentation of metrics for this goal.

2

Align faculty recruitment with WSU research aspirations

Working together, the provost and college deans should devise a process to make integration of the Grand Challenge areas into hiring plans a priority and create a process to facilitate these hires so that WSU is attracting excellent and diverse faculty who will advance research in Grand Challenge areas at WSU.

Recommendation 2—continued from previous page

We should communicate WSU's strategic goals as part of the interview process and emphasize these goals again as part of new faculty orientation. Articulation of expectations should align with WSU's mission. Opportunities for outreach, engagement, and economic development activities that increase the visibility and impact of WSU research should be communicated.

Successful implementation of this recommendation will increase WSU strengths in specific research areas, extramural support, and other measurable research, scholarly, and creative activity in Grand Challenge areas. WSU should also realize added involvement by faculty in efforts to increase WSU research visibility, impact, and collaboration.

3

Ensure college's strategic plans, including multiyear and cluster hiring plans, are aligned with WSU's strategic plan and research strategic plans

Departments, schools, colleges, and urban campuses should build hiring plans that align with the WSU strategic goal to achieve impact in Grand Challenge areas. College hiring plans should be long-range and multiyear. Plans should articulate how area hires will contribute to strategic priorities. Of course, unit strategic hiring should continue to accommodate support for core functions and disciplinary-specific research that may fall outside specific Grand Challenges, as an essential part of WSU's mission. The provost and deans should work together to address issues that may prevent the implementation of multiyear hiring (e.g., re-opening failed searches and hiring ahead of retirees).

The provost, college deans, vice chancellors for research from the urban campuses, and department chairs should devise a strategy for cluster hiring plans in Grand Challenge areas, both within and across disciplines. An effective strategy should include a process to evaluate the success of a cluster hiring effort. The process should also address a means to provide a multidisciplinary perspective to the hiring process (e.g., encourage hiring committees to include faculty across units where appropriate).

Successful implementations of strategic hiring plans should increase faculty working collaboratively on Grand Challenge themes across disciplines and produce measurable research impact.

4

Offer competitive faculty salary and start-up packages and consider space, computing, and administrative impacts of hires in planning and recruitment

In addition to strategies and systems already in place, the provost, college deans, vice chancellors for research from the urban campuses, and department chairs should devise a way to provide a competitive compensation system that allows WSU to attract and retain excellent researchers. Where possible, steps to increase our competitiveness in recruitment and retention should be data-driven, including the gathering of information about packages offered at peer universities and reasons that faculty reject WSU employment offers or leave for other institutions.

University leaders should develop a standardized hiring proposal format to include all relevant considerations that would facilitate consistent planning and execution of hiring across the university (e.g., hiring proposals could explicitly describe space, infrastructure, and other support needs for each proposed position).

WSU should see improvement relative to benchmarks in faculty salary and start-up packages as well as an increase in new-hire offer acceptance.

5

Target resources to the retention and hiring of promising mid-career and prestigious faculty in areas of importance to achieve impact in the Grand Challenges.

Deans should identify areas of opportunity for senior faculty hires that intersect and significantly strengthen WSU's impact in the Grand Challenges. Senior and mid-level hires provide balance to departments by offering experience to share with early career faculty and trainees, a larger professional network, and established research portfolios. To compensate for the potentially higher recruitment costs of more experienced faculty, the provost, deans, and department chairs need to develop innovative strategies for supporting competitive start-up support.

Attracting and retaining outstanding faculty will require the creation of additional prestigious positions like distinguished professorships and endowed chairs. Working in conjunction with the CEO of the WSU Foundation, deans should be encouraged to align fundraising priorities with their development staff to pursue endowments that support this goal.

These steps should result in increased scholarly and creative activity in Grand Challenge areas, a potential increase in the number of prestigious awards received by WSU faculty, and a growing endowment fund.

6

Pursue excellence in recruitment and retention of research trainees

Research is emphasized as an essential part of every student's learning. Student and postdoctoral researchers are also a critical part of WSU's research enterprise. The dean for the Graduate School, the vice president for research, college deans, vice chancellors for research from the urban campuses, and department chairs should create an ad hoc committee of faculty and administrators to formulate strategies that would improve WSU's ability to recruit top quality student researchers, increase research output, and enhance graduate student funding levels across the system (e.g., increase doctoral student stipend to the minimum national average and provide more fellowship and RA opportunities).

The vice president for research and dean for the Graduate School should work together to provide central support to incentivize the successful pursuit of training and other center grants that will support graduate students, including underrepresented minority students.

Successful implementation of this recommendation should lead to more research trainees, increased scholarly and creative activity by trainees, and increased support for Pullman and non-Pullman based graduate programs.

7

Increase efficiency and impact of research infrastructure investments with the aid of a standing University Research Infrastructure Committee (URIC)

The vice president for research and college deans should populate a standing URIC and work with them to create membership requirements and a roles and responsibilities document. The URIC would be a faculty advisory board to the provost and vice president for research to guide and evaluate investments into infrastructure for the pursuit of research at WSU.

With administrative support from the Office of Research, the URIC should draft management guidelines for university infrastructure that includes broad guidance for the development, staffing, operation, and renewal of infrastructure for research.

Using the 120-Day Study infrastructure subcommittee report as a starting point, the URIC should devise a way to obtain and maintain up-to-date information on infrastructure availability and needs across colleges, campuses, and centers (e.g., consider further refinement of the subcommittee's proposed "bin" structure).

Successful implementation of these recommendations would yield targeted expenditures for research infrastructure to support Grand Challenges. Committee reports would yield important research infrastructure assessment, currently unavailable, like usage capacity, equipment status, accessibility, and technical and administrative support requirements, as well as strategic planning for future investment. In addition, working with the Office of Research, the URIC should make infrastructure availability information accessible to the university community to encourage shared resources across colleges and disciplines.

8

Develop and implement a community-based approach to institutional research computing that is responsive to the needs of the scientific and data-intensive computing community

Across disciplines, research could be significantly advanced with the addition of high performance computing (HPC) capability. The vice president for research, deans, vice chancellors for research from the urban campuses, and associate deans for research should create a working group to study HPC infrastructure to prioritize actions, advocate for, and create a priority and strategy report that describes how new HPC instrumentation will be funded, housed, and managed. The working group should also create use-metrics once the HPC is installed to assess the value of the HPC to the research community. The HPC committee should also be charged with leading campus efforts to obtain additional investment for HPC capacity.

Successful actions by the HPC group should yield proposal submissions for and grant expenditures on HPC needs.

9

Address small and/or non-equipment infrastructure needs and make recommendations for targeted investments

Research infrastructure involves more than equipment. It involves intellectual and social resources, technical support personnel, complicated compliance issues, maintenance, instrumentation upgrades, and use-management issues. Researcher access to infrastructure can be hampered by lack of coordinated support for these items. The needs are not static and thus ongoing mechanisms are needed to ensure infrastructure support. The University Research Infrastructure Committee (URIC) should further define "research infrastructure" such that it incorporates personnel and "soft-support" needs. The committee should devise plans to respond to soft-support infrastructure needs that will benefit multiple colleges and units. Working with college deans and the vice president for research, the URIC should propose and implement innovative approaches to meet these needs.

Working with the vice president for research, the URIC should develop a definition and scope for the proposed Small Infrastructure Investment Program (SIIP) (see infrastructure subcommittee report). The SIIP program should support small and non-equipment items that serve multiple colleges and units.

The URIC should create metrics, as part of the program, to measure success of the SIIP program.

10

Enhance and coordinate training and support systems for sponsored projects

Recent economic conditions and subsequent employee reductions have significantly reduced the number of research administration support staff. In many areas, research staff are working at maximum capacity. The vice president for research, deans, vice chancellors for research from the urban campuses, and associate deans for research should assess needs in each of the following areas: 1.) Adequacy of pre- and post-award support in each college as well as personnel needs to insure high-level support through the Office of Research; 2.) Capacity for support to help faculty find funding, provide grant training to faculty, and proactively develop and provide support for the creation of large, multidisciplinary, and training grant proposals in priority areas.

The vice president for research, deans, and associate deans for research should inventory existing faculty grant writing training programs offered within units and centrally and consider efforts to eliminate gaps.

The group should also consider expansion of the New Faculty Seed Grant Program focused on Grand Challenge related work and consider creating an internal seed grant program to support mid- and senior-level faculty research effort redirection toward Grand Challenges.

Successful implementation will yield improved grant support and training for faculty and, as a result, an increase in proposals successfully funded in disciplines specific to Grand Challenges. Seed grant programs should use existing metrics to assess success, but should complement those metrics with indicators that demonstrate activity addressing Grand Challenges.

BE COLLABORATIVE

11

Create effective information systems for tracking faculty and trainee activities to enhance opportunities for collaboration and improve program coordination and communication between individuals and units

Throughout the course of this study, and across the subcommittees, the need for improved data collection and improved internal coordination of university activities was apparent. The existing system for collecting activities was designed as an annual review system and not as a flexible reporting tool.

To facilitate improved coordination, communication, and assessment capacity across the university, the provost, vice chancellors for research from the urban campuses, and each college's associate dean for research should establish a task force to develop or identify an alternate system that can be used as both an annual review system and a comprehensive source for information on faculty and program activities. The system selected should have the capacity to collect and report a broad range of information including outreach and economic development activities, industry engagement, graduate and undergraduate student research, interdisciplinary scholarship and creative activity, and traditional research and scholarly activities. An effective system would not only facilitate a more reliable and precise metrics resource, as described, but would also allow for improved coordination between units and could be used to leverage current outreach activities to build stronger research engagement with industry.

To remove systemic barriers to collaboration, the task force should work with units to enhance existing information systems so that they accurately distribute effort (credit should follow effort) on collaborative grants and publications. In consultation with faculty from areas in which grant funding and journal publication are the norm, the task force should identify metrics for scholarship and creative activity that are discipline appropriate, strongly tied to WSU goals for scholarly productivity, and encourage cross-disciplinary and inter-institutional collaboration. The selected/ developed system will be capable of tracking and reporting such metrics.

To increase opportunities for industry engagement, the task force should explore the feasibility and propose ways to develop an accurate database and system to track graduate student and postdoctoral employment after leaving WSU.

12

Create physical spaces that facilitate interdisciplinary discussion and faculty engagement.

Most of the major research universities across the United States have an established faculty club. A physical space provides many opportunities for collaboration. It provides a forum for workshops, research showcase events, debates, presentations, and other participatory events that lead to greater faculty engagement.

The provost should create an ad hoc committee to develop 21st century strategies that would promote faculty interchange across disciplines and across WSU campuses and would consider the implications and potential benefits of creating a WSU faculty club. A report on findings and recommendations would be produced by this committee.

13

Reduce barriers to collaborative research and creative activity caused by WSU's geographic location and leverage the advantages of WSU's multicampus presence across the state.

While space is an advantage to WSU Pullman's location in rural eastern Washington, it can be a major hurdle for building collaboration with other universities and with industry. The provost, vice president for research, vice chancellors for research from the urban campuses, and the associate deans for research should seek out opportunities to bring prominent researchers and industry leaders to WSU. Funding should be identified to increase visiting scholar activities at WSU, both to provide outside exposure to WSU strengths and to provide faculty and students opportunities to explore cutting edge ideas. Visiting scholars should not be confined to academia. Private sector relationships should be developed as well.

In addition to current travel grants through individual colleges and through a collaboration between the Office of International Programs and the Office of Research, the group should increase funding for travel. Travel grants should be considered for national and international travel and for multiple purposes including activities that increase the visibility and prestige of research at WSU.

Increased visibility and exposure should increase the number of collaborations between WSU and international entities. Proposed scholars and grant programs should develop specific metrics based on the goals of their program.

14

Increase opportunities to develop industrial research partnerships with a focus on Grand Challenge areas

Led by the vice president for economic development and the vice president for research and with the council of the provost, vice chancellors for research from the urban campuses, and the associate deans for research from each college, a task force should be created to evaluate major existing industrial relationships and examine efforts and opportunities across the university to engage industry in research partnerships. The task force should create a set of recommendations for a more coordinated approach to building corporate engagement at WSU.

The task force should consider faculty motivation and consider incentives and initiatives to encourage faculty engagement in activities that further long-term relationships between the university and industry.

Evaluation criteria for faculty seed grants should be expanded to encourage faculty to develop research partnerships with industry in addition to pursuing federal sponsorship.

This recommendation will yield a report that would be used to increase R&D activity as well as increase the number of industry–student research internships; engagement of industry leaders on advisory boards; student judging panels, etc.; and grants from private entities. The committee would propose metrics for documenting industrial relationships.

BE VISIBLE

15

Enhance and coordinate mentoring for prestigious fellowships and awards

Prestigious awards are one of the most visible avenues of promoting the quality of WSU research to academia. To increase the number of prestigious fellowship and award recipients at WSU, the provost should establish a standing Prestigious Awards Committee (PAC) to provide a centrally supported and coordinated approach to nurturing strong candidates, identifying potential nominees, and supporting nominations. The PAC should be tasked with proactively designing pathways for outstanding junior and mid-level faculty to be well positioned to receive prestigious awards.

Personnel assistance should be provided through the Office of the Provost and the Office of Research to promote and streamline the application processes for AAU prestigious award nominations.

University leadership should encourage, promote, and support faculty involvement in nationally visible committees, advisory boards, and policy making efforts. Current NAS members and WSU offices, like the Government Relations Office, could be consulted to identify opportunities.

16

Encourage faculty, at all stages of careers, to participate in activities that raise visibility or deepen partnerships with external partners in both the public and private sectors

In addition to existing internal awards, the provost, vice president for research, deans, and chancellors from the urban campuses should offer funded and unfunded university and college-level annual awards that align with activities valued in the strategic plan (e.g., recognizing mentoring, interdisciplinary work, and international research, outreach, and commercialization activities). Internal awards recognize exceptional faculty achievement and offer opportunities for visibility, as well as providing pathways to build upon in pursuit of external awards.

The Office of Research and college deans should leverage expertise in WSU offices (e.g., Corporate and Foundation Relations, Government Relations,

Recommendation 16—continued from previous page

University Communications, Extension, and Economic Development) to provide training opportunities to faculty regarding how to communicate their research to the public and how to build and grow relationships with private organizations.

Faculty should be encouraged to communicate WSU research progress and plans to sponsors, federal and state representatives and legislative staff, and other key stakeholders. The vice president for research should establish new programs in the Office of Research to support this goal.

Successful implementation of these recommendations would yield new awards and greater recognition of faculty activities, which have long-term benefit to WSU. With the ability to track faculty activities like mentoring, international programs, and nationally and internationally visible panel and committee/association participation, the university will be able to measure progress.

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17 Enhance coordination and support for international collaboration across the university

The vice president for research and the vice president for international programs should create a taskforce composed of faculty and administrators to develop an institution-wide strategic plan that would enhance existing programs and increase international research collaboration by WSU faculty. The strategic plan should include ways to raise the profile and promote the outcomes of faculty who are involved in international research, publications, and citations. The plan should also include long-term, strategic international partnership strategies that include Grand Challenges as part of a comprehensive internationalization approach for WSU.

Department chairs should encourage faculty to involve the Office of International Programs in their international interactions. Their involvement provides WSU with the ability to leverage resources, experience, and relationships across WSU colleges and departments to increase involvement, improve visibility, and expand opportunities for student and faculty researchers and for university programs.

In order to encourage faculty involvement with International Programs, the vice president for international programs and the vice president for research should advocate for central resources to facilitate and expand support for international research-driven work (e.g., international travel grant). In addition, alternative methods to support faculty involvement in international research collaboration should be considered (e.g., release time to pursue collaboration building activities and seed funding).

Increased support and focus on international research should increase the number of faculty participating in international activities.

18

Improve pathways for WSU research and creative activity to be communicated to the public

University Communications, working closely with the vice president for research, vice chancellors for research from the urban campuses, and the associate deans for research, should enhance existing WSU websites to create up-to-date and easily searchable webpages with research strength descriptions aimed at communicating impacts to lay audiences.

University Communications, working with college deans, should streamline university-wide communications channels for faculty to communicate their research stories to the public. Increasing faculty participation in promoting their research will require a concerted effort by University Communications and leadership to increase faculty awareness of both the value of communicating their research to the public and the types of stories that are newsworthy. College leadership, working with their communication representatives, should establish ongoing training programs to increase faculty awareness of communication channels created in each college that should be utilized to promote their research through their unit and to central WSU communication groups.

In addition to training programs offered, successful implementation should yield better news stories which reach external sources. University Communications should also propose metrics by which external communication can be measured.

19

Clearly define WSU's message to communicate Grand Challenges and research strengths with consistency

In coordination with University Communications and with the vice president for research, the Grand Challenge teams should develop marketing materials and websites for each Grand Challenge. External communication of the Grand Challenges should be written so they are inspiring and accessible to a general audience.

University leadership should work with University Communications to create strategy and tools for faculty, staff, and leadership to accurately and consistently describe WSU's strategic plan as it pertains to research. This should include Grand Challenges as well as research themes and strength areas. It should also highlight the impact of WSU research to the public, its involvement with industry, and its benefit to the state and nation.

University leadership, with University Communications, needs to develop a system for handling 'push-back' from media on controversial research studies so that WSU can respond quickly and effectively.

Successful implementation of this recommendation will be demonstrated by accomplished tasks as described above. University Communications should propose metrics by which to measure external communication.

TABLE 1 Recommendations and Actions	Metrics (GC-Grand Challenge; SP-Strategic Plan Metric; AAU Metric)
BE STRATEGIC	
General metrics to assess overall research activity at WSU	Total research and development expenditures (reported to NSF) and rank among public institutions (SP#1) Federal R&D expenditures (reported to NSF) and rank among public institutions (SP#2) # of publications, juried or adjudicated shows, performances, books, and other evidence of research, scholarship, and creativity by arts, humanities, and social sciences faculty (SP#5) Citations per faculty member (H index) (and by tenure/tenure track [T/TT]) (and by GCs) (SP#7)
1. Integrate WSU Grand Challenges (GC) into WSU research strategies.	
Appoint team for each GC to further develop the Challenge, including workshops to promote integration of faculty into each challenge. Identify internal funding to galvanize teams. Prioritize Challenge research investments, including the identification of internal and external funding sources. Develop strategy to accommodate core functions that may fall outside specific GCs. Integrate GCs into Center/Institute/Laboratory (CIL) structure. Develop a strategy to include GCs in applicable WSU Foundation activities.	Sponsored research expenditures in identified areas of research excellence by T/TT faculty (SP#12) Sponsored research expenditures by GC and by T/TT Sponsored research awards and expenditures in emerging areas of research excellence by T/TT (SP#13) # of refereed publications by T/TT (and by GCs) (SP#4) *Other Evidence (qualitative, etc.):* *GC workshops held* *GC marketing materials produced* *Strategy plan for each Grand Challenge produced* *Documented number of faculty or collaborative faculty teams conducting research addressing GCs*
2. Align faculty recruitment with WSU research aspirations.	
Develop a prioritization process for evaluating hiring plans related to GCs. Clearly communicate WSU strategic goals and outreach, engagement, and economic development activity expectations to newly hired faculty. Faculty Senate should review the Faculty Manual to address expectation of high scholarship related to interdisciplinary research, e.g. GCs.	Annual percentage of T/TT hires aligned with GCs # of refereed publications by T/TT (and by GCs) (SP#4) Sponsored research expenditures in identified areas of research excellence by T/TT faculty (SP#12) Sponsored research awards expenditures in emerging areas of research excellence by T/TT faculty (SP#13) # of start-ups (and by GC) (SP#31) # of patents, startups, licenses, etc. by T/TT (SP#33) # of royalties and other revenue from commercialization activities (and by GCs) (SP#36) Total annual expenditures in Extension (SP#35)
3. Ensure colleges' strategic plans, including multiyear and cluster hiring plans, are aligned with WSU's strategic plan and research strategic plan.	
Align units and colleges' strategic plans with strategic goal of achieving impact in GCs. Encourage long-range and multiyear GC-related hiring plans that are based on unit vision and contribution to strategic priorities. Develop long-term strategic hiring plans that facilitate cluster hires across disciplines in GC areas.	Percentage of hires that align with approved hiring plans (and by GCs) (SP SG1.d) # of cluster hires in GC areas (disciplinary and interdisciplinary) (SP SG1.d) AAU-type contributions of cluster hire faculty to GCs at one, three, and five years post-hire Sponsored research awards to projects that engage multiple units (SP#14)

TABLE 1 continued Recommendations and Actions	Metrics (GC-Grand Challenge; SP-Strategic Plan Metric; AAU Metric)
4. Offer competitive faculty salary, start-up packages, and consider space, computing, and administrative impacts of hires in planning and recruitment.	
Increase efforts to provide fair compensation salary and start-up packages. Hiring plans should explicitly consider the space and other infrastructure supports needs for each position. Create a standardized hiring proposal format to include all relevant considerations that would facilitate planning and execution of hiring.	WSU and peer T/TT counts Average employee satisfaction rating from Employee Engagement Survey (faculty) (SP#53) # of faculty from underrepresented groups (SP#48) *Other Evidence (qualitative, etc.)* *Exit interview survey results* *Annual benchmark performance measures on faculty salary, start-up packages, and benefits comparison with peer institutions and between faculty in comparative disciplines on a regular basis.* *Document faculty who turn down employment offers*
5. Target resources to the hiring of promising mid-career and prestigious faculty to achieve impact in the Grand Challenge areas.	
Deans identify areas where senior faculty hires would significantly strengthen WSU's impact in GCs. Develop innovative strategies to compensate for higher recruitment costs. Create more endowed chairs as a tool to recruit prestigious senior faculty to WSU. Deans and WSU Foundation leadership should be encouraged to pursue endowments to support this goal.	# of hires from outside of WSU in chair/director/dean level positions # faculty hires by rank and by GC # of prestigious awards and by T/TT (SP#6) # of refereed publications by T/TT (and by GCs) (SP#4) # of citations per faculty member (per T/TT) (and by GCs) (H index) (SP#7) # of endowed professors and endowed chairs (and by GCs)
6. Pursue excellence in recruitment and retention of research trainees.	
Create ad hoc committee to enhance WSU's ability to recruit excellent postdoctoral fellows and graduate students. Expand grant development assistance that promotes the pursuit of training and other center grants that will support a larger cohort of postdoctoral fellows and graduate students. Expand grant development assistance that supports graduate and postdoctoral training. Prepare trainees (postdoctoral fellows and graduate students) to write proposals for extramural research support and fellowships. Expand graduate student enrollment and engagement at the urban campuses, as noted in the WSU Strategic Plan. Reward postdoctoral fellows and graduate students for high scholarship and creative activities, as noted in the WSU Strategic Plan.	# of PhDs and by T/TT (AAU Metric) Percentage of RA/TA funds going to doctoral students WSU doctoral student stipend comparison to national average # of training grants at WSU # of postdocs (and per T/TT) (and by GCs) (AAU metric) Total graduate enrollment (minority, first-gen, low-income) (SP#38) # of publications co-authored by grad students, postdocs, and undergrads (SP#15) *Other Evidence (qualitative, etc.)* *Grant development program benchmarks*

TABLE 1 continued Recommendations and Actions	Metrics (GC-Grand Challenge; SP-Strategic Plan Metric; AAU Metric)
7. Create and charge a standing University Research Infrastructure Committee (URIC) to increase efficiency and impact of research infrastructure investments.	
Vice president for research and deans to appoint initial standing URIC members and membership requirements, roles, and responsibilities. URIC drafts management guidelines for research infrastructure, including broad guidance for the development, staffing, operation, and renewal of infrastructure. URIC devises a means to maintain up-to-date information of infrastructure availability and needs across WSU (e.g., consider bin structure, Appendix H).	Total capital expenditures on academic infrastructure (and by GCs) (SP#9) Square footage allocated to research and development per T/TT (and by GCs) (SP#10) # of labs, classrooms, and conference rooms equipped for virtual collaboration (SP#11) *Other Evidence (qualitative, etc.)* *Annual report of core facilities for usage capacity and status of equipment* *Created systems for instrumentation accessibility*
8. Develop and implement a community-based approach to institutional research computing that is responsive to the needs of the scientific and data-intensive computing community.	
Implement a transparent governance model for the management, access, allocation, operation, sustainability, and acquisition of the shared and centralized research cyber-infrastructure. Establish a research computing user group to ensure that the governance model is implemented in a manner that is consistent with the efficient, productive, and responsive utilization of the university's research cyber-infrastructure. Establish strategic regional and national partnerships that leverage and augment the university's capabilities in scientific and data-intensive computing.	Grant expenditures on HPC computing activities # of proposals submitted/awarded for HPC computing activities *Other Evidence (qualitative, etc.)* *HPC committee priority and strategy report* *HPC committee to create use-metrics when installed* *Annual report on efforts to obtain funding for high performance computing*
9. Address small and non-equipment infrastructure needs and recommend targeted investments.	
Develop definition and scope for proposed Small Infrastructure Investment Program (SIIP) (see Infrastructure Committee report and Appendix H). Further define "research infrastructure" to incorporate soft-support needs (like personnel, intellectual and social resources, and instrumentation upgrades).	*Other Evidence (qualitative, etc.)* *SIIP grant program to report grant making benchmarks*

TABLE 1 continued Recommendations and Actions	Metrics (GC-Grand Challenge; SP-Strategic Plan Metric; AAU Metric)
10. Enhance and coordinate training and support systems for sponsored projects.	
Assess needs in each of the following areas: Adequacy of pre-award, post-award, and researcher support in each campus, area, department, and/or CIL. Personnel needs in the Office of Research to provide research and proposal development services and high-level service for training grants and other priority proposals. Evaluate new faculty grant writing training programs offered within units and centrally and eliminate gaps. Expand GC-focused faculty seed grants for early career faculty and consider expanding to mid and senior level faculty to induce redirection toward GCs. Enhance research administrative infrastructure for research compliance (i.e., campus vet, human subjects, animal care, bio-safety, radiation safety, export controls, etc.). Develop a research administration training and internship program.	# of proposals undergoing internal, technical, or red team review # of large proposals (over $1.0 million) per year # of proposals actively managed # of proposals actively managed by the VPR Research Development Unit R&D expenditures per grant admin. support FTE (new) # of proposals per unit/per unit level grant admin. support FTE (new) Internal grant and training programs to develop metrics (could include: expenditures by T/TT asst. professors and proposal success rate by T/TT asst. professors) # of large proposals and training grant proposals submitted/funded # of cross-disciplinary and multi-institution grant interdisciplinary awards (and by T/TT) (SP#3) Sponsored research awards to projects that engage multiple units (SP#14) *Other Evidence (qualitative, etc.)* *Annual satisfaction survey of WSU research administration systems*
BE COLLABORATIVE	
11. Create effective information systems for tracking faculty and trainee activities to enhance opportunities for collaboration, and improve program coordination and reporting efficiency.	
Establish ad hoc committee to identify an alternate system for annual review that can efficiently serve as a source of research information and assessment metrics (e.g., outreach and economic development activities, graduate and undergraduate student research, interdisciplinary scholarship & creative activity, traditional research and scholarly activities). Enhance information systems so that they accurately distribute effort (credit should follow effort) on collaborative grants and publications. In consultation with faculty from areas in which grant funding and journal publication is not the norm, develop metrics for scholarship and creative activity that are both discipline-appropriate and connected to WSU goals for scholarly productivity. Develop an accurate database and system to capture grad student and postdoc employment after leaving WSU. Promote wider involvement in the WSU Research Exchange Institutional Repository.	Implementation of the system with identified metrics Training provided and use of the system across WSU faculty

TABLE 1 continued Recommendations and Actions	Metrics (GC-Grand Challenge; SP-Strategic Plan Metric; AAU Metric)
12. Create physical spaces that facilitate interdisciplinary discussion and faculty engagement.	
Create an ad hoc committee to develop 21st century strategies to promote faculty interchange across disciplines. Consider the implications of creating a faculty club.	# of cross-disciplinary and multi-institution grant interdisciplinary proposals and awards (and by T/TT) (SP#3) Sponsored research awards to projects that engage multiple units (SP#14) *Other Evidence (qualitative, etc.)* *Program to propose metrics (could include number of programs created, number of attendees, number of members)*
13. Reduce barriers to collaboration, research, and creative activity caused by WSU's geographic location and leverage advantages of WSU's multi-campus presence across the state.	
Increase internal funding for national and international travel grants. Travel grants should be considered for multiple purposes including activities that increase the visibility and prestige of research at WSU. Identify funding to increase visiting scholar activities at WSU. Visiting scholars should not be confined to academia. Private sector relationships should be developed as well. Invest in communication tools enabling virtual collaboration on a global scale, as noted in the WSU Strategic Plan.	# of faculty participating in international activities (SP#45) # of "Lecture Series" events and visiting scholars *Other Evidence (qualitative, etc.)* *Programs to propose metrics (could include amount issued in travel grants, number of proposals submitted and ROI based on RFP requirements, number of lecture seminars facilitated)*
14. Develop strategy to increase industrial research partnerships.	
Appoint a task force to evaluate existing relationships and examine efforts across units to engage industry. Task force to recommend ways to better coordinate industrial relationship-building across units. Task force should consider faculty motivation and consider incentives to encourage outreach and engagement activities with industry.	Total research and development expenditures from industry (reported to NSF) (SP#32) # of invention disclosures, patent applications, patents issued, startups, licenses and options, active licenses, etc. by T/TT (SP#33) # of royalties and other revenue from commercialization activities (SP#36) # grants from private entities # of internships or practicum experiences (SP#20) # of academic units or programs with advisory boards that include alumni and constituency representatives (SP#41) *Other Evidence (qualitative, etc.)* *Develop metrics for documenting industrial relations*

TABLE 1 continued Recommendations and Actions	Metrics (GC-Grand Challenge; SP-Strategic Plan Metric; AAU Metric)
BE VISIBLE	
15. Enhance and coordinate mentoring for prestigious fellowships and awards.	
Establish a group of advisors (National Academy members and prestigious award winners) to create roadmaps for junior faculty to pursue prestigious awards. Provide personnel assistance through the Office of the Provost and Office of Research to promote and streamline the application processes for AAU recognized prestigious awards. Encourage and promote faculty involvement in nationally visible committees and policy. Ensure that prestigious awards are valued and collected in annual review process.	# of prestigious awards by T/TT (SP#6) # of National Academy members by T/TT (SP#8) # of faculty serving on external committees, panels, and policy advising # of grants issued to graduate and undergraduate students *Other Evidence (qualitative, etc.)* *Prestigious award support program created and metrics proposed* *National awards received by graduate and undergraduates*
16. Encourage faculty, at all stages of careers, to participate in activities that raise visibility or deepen partnerships with external partners in both the public and private sectors.	
Consider offering annual awards that align with activities valued in the strategic plan (e.g., mentor awards, interdisciplinary, international research, outreach, and commercialization activities). Provide training to faculty regarding how to communicate their research to the public and how to build and grow relationships with private organizations. Provide opportunities for faculty to engage federal and state legislative staff, sponsor contacts, and other key WSU stakeholders to enhance their research programs.	# of cross- and inter-disciplinary and multi-institution grants by T/TT (SP#3) # of faculty participating in international activities (SP#45) # of faculty participating in mentoring programs # of faculty serving on national policy panels and committees # of press releases # of faculty visits to Congress, federal agencies, and& other stakeholders sponsored by the Office of Research # of major scientific and other conferences hosted by the Office of Research *Other Evidence (qualitative, etc.)* *Social media impact (retweets, google analytics, etc.)* *Awards created and issued*

TABLE 1 continued Recommendations and Actions	Metrics (GC-Grand Challenge; SP-Strategic Plan Metric; AAU Metric)
17. Enhance coordination and support for international collaboration across the university.	
Charge a committee of faculty and administrators to develop strategic plan to enhance international collaboration. Encourage faculty to involve the Office of International Programs in their international interactions to better leverage resources, experience, and relationships across colleges and departments. Encourage faculty involvement with International Programs by providing centralized resources/funds to facilitate and expand support for international, research-driven work (e.g., international travel grant). Consider alternative methods to support faculty involvement in international research collaboration (e.g., time release to pursue, seed funding, etc.). Create an international strategy to raise the profile and outcomes of faculty who are involved in international research/publications and citations.	# of international publications and citations # of faculty participating in international activities. (SP#45) # of non-U.S. institutions that have active, documentable collaborations with WSU faculty. World ranking Documentable impacts of such collaborations <u>*Other Evidence (qualitative, etc.)*</u> *Number of successful programs initiated with extramural funding by University and college international program offices*
18. Improve pathways for WSU research and creative activity to be communicated to the public.	
Create searchable, up-to-date websites that streamline university-wide communications channels for faculty to communicate their research to the public. Increase awareness by faculty of the value of communicating research to the public. Increase awareness by faculty of communication channels to promote their research through their unit and University Communications. Provide training in what makes a story newsworthy to the public. Impacts to lay audiences.	<u>*Other Evidence (qualitative, etc.)*</u> *Estimated annual economic impact of WSU activities (SP#30)* *Number of stories picked up by external sources* *Faculty survey on University Communications* *Training programs proposed to create appropriate metrics to measure success*
19. Clearly define WSU's message to communicate Grand Challenges and research strengths with consistency.	
Coordinate GC marketing materials and website with University Communications. Create strategy and tools for faculty, staff, and leadership to accurately and consistently describe WSU's strategic plan as it pertains to research, highlighting the impact of WSU research. Develop system for handling 'push-back' from media on controversial research studies.	<u>*Other Evidence (qualitative, etc.)*</u> *Showcase report, demographics of attendance* *Number of outlets used to communicate research impacts* *University Communications to propose metrics by which external communication can be measured*

Study Purpose & Organization

EVALUATING ASSETS AND BARRIERS

Study Goals and Scope

Washington State University's vision, as described in the 2014-19 Strategic Plan (Appendix A), is to make WSU "one of the nation's leading land-grant universities, preeminent in research and discovery, teaching and engagement."[2] Progress toward this goal will be measured against the research productivity of other comparable universities and against those who have already achieved membership in the Association of American Universities (AAU).

One of the two central foci of the Strategic Plan is to accelerate development of a preeminent research portfolio. Such a portfolio will be achieved as a result of increased faculty research effort and strategic investment in research infrastructure, research faculty, and top-quality graduate students. To that end, the strategic plan tasks the vice president for research with "identifying WSU's strategic areas of research excellence and emerging areas requiring additional investment to achieve national and international prominence."[3] This study is an important step toward that goal.

With strong support from WSU's president, Elson S. Floyd, and the university provost, Dan Bernardo, Vice President for Research Chris Keane initiated the 120-Day Study of WSU's research enterprise. The purpose of the study is to create a comprehensive map of WSU's existing research enterprise. The study team will evaluate the university's assets, identify barriers, consider strength areas, and explore emerging areas of research.

The study team will use the results of their analysis to provide four primary outcomes:

1. Develop research themes that reflect future opportunities matched to current and emerging WSU capabilities.
2. Identify priorities to guide research infrastructure and other investments.
3. Provide specific and actionable findings and recommendations to strengthen research,scholarship, and creativity (as measured by AAU metrics).
4. Provide metrics for monitoring progress in key areas to support WSU's research enterprise.

[2] *Elson S. Floyd, President. Washington State University Strategic Plan 2014-2019, page 1.*
[3] *Ibid., page 5.*

"This study will be a critical next step to advancing WSU's research enterprise and doctoral training enterprise."

WSU Provost Dan Bernardo

Study Organizational Structure

The 120-Day Study involved over 100 individuals from across the WSU campuses, colleges, schools, and departments, as well as administrative offices.

- In order to ease the time demands on all of the 120-Day Study volunteers, the Office of Research provided technical and administrative support for each committee. The following committees were created:
- The Research Infrastructure subcommittee, co-chaired by Sue Clark (chemistry) and Steve Simasko (integrative physiology and neuroscience), was tasked with assessing the state of key research infrastructure, providing a tiered prioritization of the current and future elements of infrastructure needed to support WSU research themes, and identifying funding sources (operations and construction) for current and future WSU research infrastructure needs.
- The Research Themes subcommittee, co-chaired by Don Bender (Composite Materials and Engineering Center) and Tom Spencer (animal sciences), was asked to identify current and emerging areas of high impact research, analyze the research opportunity/research impact

associated with these themes, and provide recommendations for WSU research priority areas.

- The Faculty/Student Engagement subcommittee, co-chaired by Rebecca Craft (psychology) and Jonathan Jones (School of Molecular Biosciences) was asked to focus on areas key to advancing research, scholarship, and creativity. This included items such as recruitment and retention policies, faculty mentoring, and enhancing faculty recognition as well as recruitment and development of the postdoc and student community in support of WSU research goals.
- The Outreach, Engagement, and Economic Development subcommittee, co-chaired by Sita Pappu (Office of Commercialization) and Juming Tang (biological systems engineering), was tasked with identifying outreach and emerging economic development activities that are matched to current and emerging research themes, WSU capabilities, and interests of key stakeholders.

The subcommittees spent the early days of the study examining their membership rosters to ensure that representatives from a broad group of disciplines and campuses were given the opportunity to serve on a subcommittee and contribute to this study. Detailed membership rosters can be found in Appendix B.

Early phase 1 activities also involved individual group meetings, both as a group and with the vice president for research, Christopher Keane, to develop a specific charter and a list of tasks that would be undertaken to accomplish that charter. These charters can be found in the subcommittee reports section of this study.

To ensure overall coordination and integration of the 120-Day Study efforts, the Management and Integration (M&I) Group was created. This group, made up primarily of the associate deans for research from each of WSU's colleges and campuses, provided executive-level support for the subcommittee activities, guiding content and facilitating the execution of data requests, surveys, and other information requests. The group's members were tasked with coordinating content, maintaining focus and creating consistency between the subcommittees. The group generated the overall study conclusions, findings, and recommendations. The M&I Group, with the technical writing and editorial support of Esther Pratt and Sarah Wisdom, provided through the Office of Research, drove the preparation of the draft study report.

An Executive Review Group, made up of senior researchers and administrators, was assembled to provide senior-level oversight of study goals, processes, and recommendations and guard the direction of the study to ensure alignment with WSU's 2014-19 Strategic Plan. The Executive Review Group was asked to attend three large-group meetings with subcommittee and M&I leadership to review the study's progress. They were also called together to review the draft report prior to submitting it to WSU's president, Elson S. Floyd.

120 Day Study Timeline

Preparation: Subgroup chairs and members are selected and each group's charge is drafted.

Kick-off Meeting September 16, 2014

Phase 1
- Subgroups finalize their membership, ensuring inclusivity and diversity.
- Subgroups gather data via surveys, templates and other methods.

2nd Full-Group Meeting October 20, 2014

Phase 2
- Subgroups complete data gathering and analysis.
- Subgroups begin developing recommendations and priority rankings.
- Research Themes Subgroup: The decision is made to bring in outside facilitators to assist this subgroup.

3rd Full-Group Meeting December 2, 2014

Phase 3
- Subgroups complete discussions of priorities.
- Subgroups finalize findings and recommendations.
- Research Themes Subgroup: First information from outside facilitators is presented.

Research Themes Subgroup & Facilitators December 16, 2014

Phase 4
- Subgroups finalize recommendations.
- Research Themes subgroup has a final meeting with the facilitators to narrow the Grand Challenges list to 3-5.

Deans Meeting January 16, 2015

Phase 4 cont.
- Grand Challenges finalized in meeting with Deans.
- Draft Report Released at the end of January 2015.

Continuing Impact: The impact of the study continues as the university hones in on the identified research strengths through strategic hiring, capital planning, and funding in all departments and colleges.

WSU Research Overview

EVALUATING ASSETS AND BARRIERS

A Brief History of Research at WSU

Washington State University was founded as a land-grant institution in 1890, under the Morrill Act, to meet a critical need for agricultural, mechanical arts, and home economic research and education in the state of Washington. Unique to land-grant institutions, faculty at WSU were expected to not only educate students, but also conduct research and share the results of their research with surrounding communities through outreach programs. Graduate education began in the early years and, in 1902, the first master's degree was conferred.

From its beginning, WSU research has and continues to hold a critical place in sustaining Washington State's annual $29 billion food industry. WSU's wheat research and breeding, animal science, wine science, and tree fruit research programs attract collaborations from scientists worldwide. In addition, WSU studies on sustainable farming have helped shape U.S. public policy by demonstrating practices to circumvent the environmental hazards of conventional agriculture. WSU sustainable agricultural practices and technologies are helping farmers around the world adopt methods that will mitigate global threats to food security.

WSU has grown from its initial five agricultural faculty members to almost 2,500 faculty associated with ten disciplinary colleges and multiple interdisciplinary centers. WSU has expanded from a single campus in Pullman to an internationally respected multi-campus university ranked among the top tier American research institutions (Appendix E: WSU Research History Timeline). WSU faculty-led research activities now afford advances that are evident in virtually every aspect of modern life. WSU researchers and collaborative partners are developing sustainable approaches to energy and water-use, improving human health, addressing global infectious disease challenges, countering threats to national security, improving the reliability and efficiency of electric power and energy systems, developing advanced materials, creating technologies that improve lives and enable the pursuit of knowledge, improving communication across societies and cultures, exploring successful economic and business models, enhancing creativity through art and music, and developing the future leadership capacity of WSU's undergraduate and graduate students.

Much of this growth is due to the excellent leadership of past WSU presidents who established goal-oriented strategic plans to focus WSU's efforts. The former president, Elson S. Floyd, finalized the revised 2008–2013 Strategic Plan shortly after his arrival in May 2007. In retrospect, the years 2008 to 2013 were some of the most challenging in WSU's history, with WSU facing crushing budgetary reverses as a result of the Great Recession.

WSU is Washington's original land-grant institution, founded to educate students, conduct research, and share the results of that research for the benefit of citizens.

Between 2008 and 2011, the state cut WSU's funding by more than half. As a result, the institution made hard choices, discontinuing entire academic programs and eliminating over 500 employees. The reductions were devastating for the university, threatening both excellence and access throughout the multi-campus system.

Despite these budget difficulties, WSU far exceeded its strategic plan goal to increase sponsored programs expenditures by 10 percent, growing it instead by 74 percent in the five-year period. Competitive federal research and development expenditures increased nearly 30 percent, from $76 million to $98 million. External grants grew in both number and scope. Several of the largest grants in WSU history were won: a $40 million grant from the U.S. Department of Agriculture's (USDA) National Institute for Food and Agriculture to establish the Northwest Advanced Renewables Alliance, more than $25 million in USDA specialty crop funding, and $9 million from the National Institutes of Health for nursing research. In FY12, the most recent NSF Higher Education R&D Survey ranked WSU 68th among all U.S. universities in research expenditures.

The years covered by the 2008–2013 strategic plan also yielded its largest private donations to date—$25 million from the Bill & Melinda Gates Foundation and $26 million from Microsoft co-founder Paul G. Allen—to support programs and fund the construction of the new research-focused Paul G. Allen School for Global Animal Health, housed in the Paul G. Allen Center for Global Animal Health. The new building includes Biosafety Level 2 and Level 3 research labs. Private dollars dramatically strengthened research programming. In 2008, Gene and Linda Voiland provided $17.5 million to fund distinguished professorships and support research on new bioenergy technologies in the Voiland School of Chemical Engineering and Bioengineering.

In response to the recession, Recovery Act (ARRA) investments bolstered U.S. R&D funding for academic research by about $18 billion. These funds were extended between the years of 2010 and 2012. Since that time, U.S. R&D investment has slowed (Figure 2 and 3). Matt Hourihan, director of the R&D Budget and Policy Program at the American Association for the Advancement of Science, estimates that under President Obama's proposed FY2016 budget, R&D will increase by 6.4 percent or $8.8 billion to $145.3 billion (see Figure 2 for estimates per federal funding agency).

2014–19 Strategic Plan

WSU's new Strategic Plan for 2014–2019 builds on the success of the previous plan and provides specific goals and strategies which were "developed to achieve significant progress towards WSU's aspiration to become one of the nation's leading land-grant universities,

preeminent in research and discovery, teaching and engagement" (Appendix A).

With the vision of creating "exceptional research, innovation, and creativity," three primary goals were identified:

- Goal 1: Increase productivity in research, innovation, and creativity to address Grand Challenges and future opportunities.
- Goal 2: Further develop WSU's unique strengths and opportunities for research, innovation, and creativity based on its locations and land-grant mandate to be responsive to the needs of Washington state.
- Goal 3: Advance WSU's reach both nationally and internationally in existing and emerging areas of achievement.

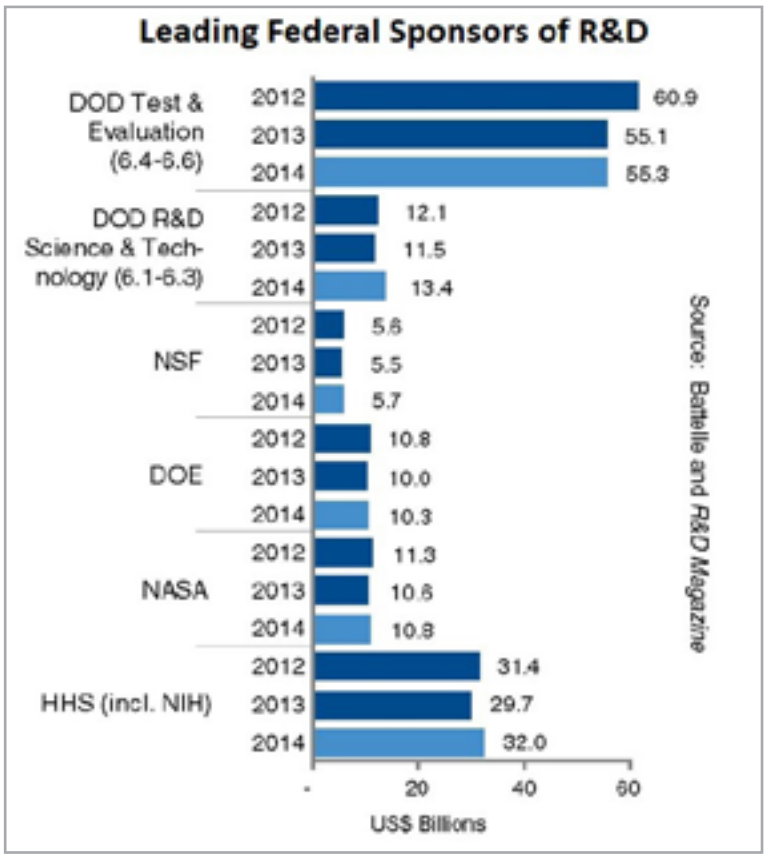

Figure 2: Leading federal sponsors of R&D

Toward the vision for outreach and engagement, the following three goals are identified:

- Goal 1: Increase access to and breadth of WSU's research, scholarship, creative, academic, and extension programs throughout Washington and the world.
- Goal 2: Expand and enhance WSU's engagement with institutions, communities, governments, and the private sector.
- Goal 3: Increase WSU faculty, staff, and students' contributions to economic vitality, educational outcomes, and quality of life at the local, state, and international levels.

Recognizing the dramatic changes in public funding that occurred over the duration of the previous plan, the 2014-19 strategic plan emphasizes the need to invest strategically in areas that will have the greatest impact for WSU's pursuit of a preeminent research portfolio. The plan specifically tasks the vice president for research to "identify areas of research excellence and emerging areas requiring additional investment to achieve national and international prominence." This 120-Day Study of WSU's research enterprise is the first step toward completing that task.

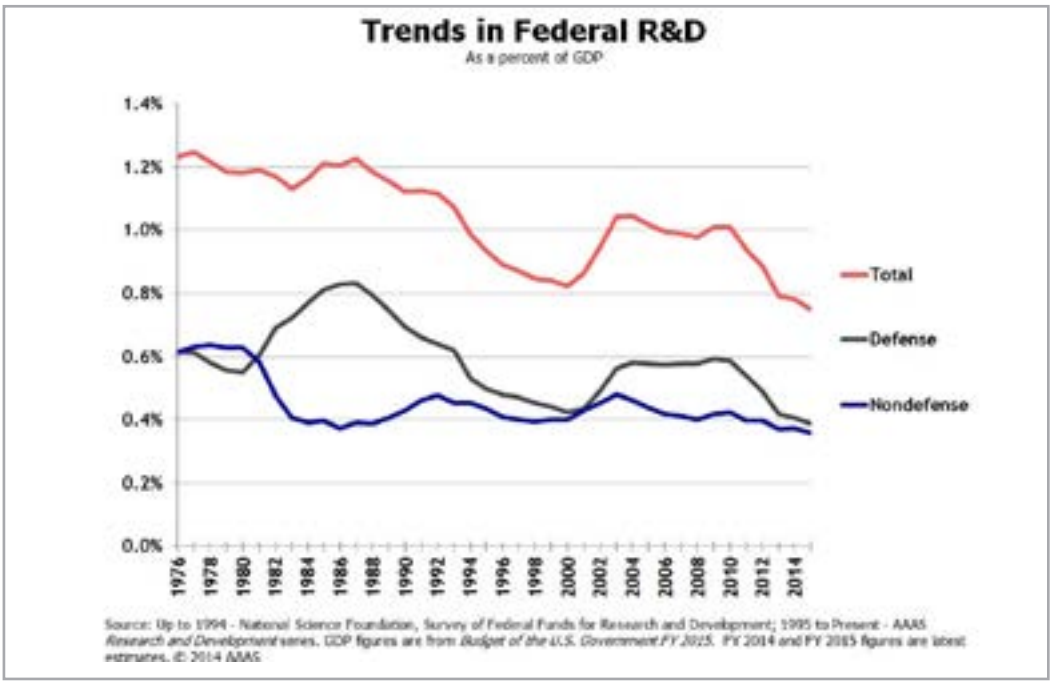

Figure 3: Trends in federal R&D 1976-2014

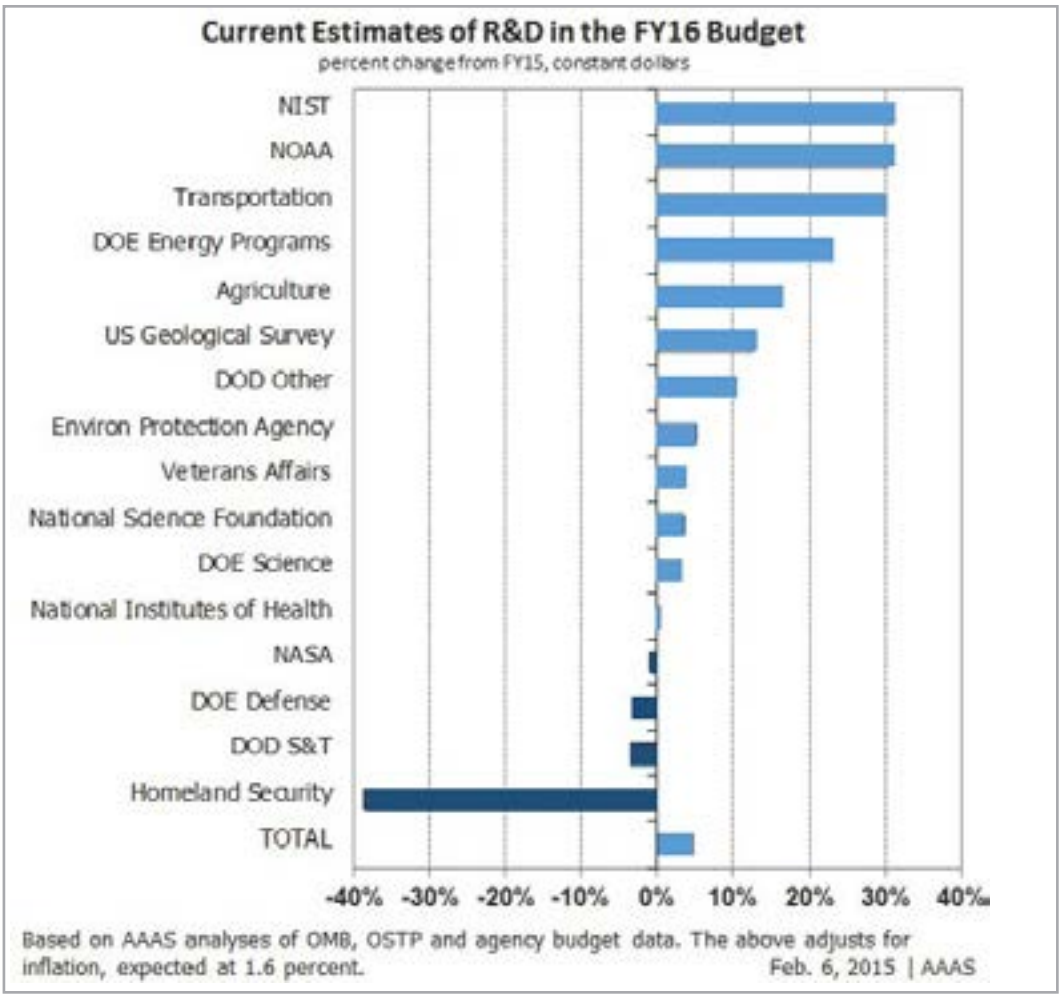

Figure 4: AAAS Current Estimates of R&D in the FY16 U.S. federal budget

WSU Research Activity

Rated by the Carnegie Foundation as a top-tier research organization with "very high" research activity, WSU demonstrates excellence in the agricultural sciences, biological sciences, clean energy technologies, and in medical and public health sciences. The knowledge and technologies generated by faculty scholars propels economic growth and solves critical problems facing our region and our world.

WSU's portfolio has expanded steadily and the scope and quality of research continues to grow (Figures 5 to 11 below). To fuel this expansion, WSU faculty have successfully pursued federal research sponsorship and have increased partnerships with private-sector corporations, private foundations, start-up firms, and industry associations (Figure 5). While federal and state agencies remain the primary sponsors of WSU research, the financial support of all of WSU's partners, including the generous support of friends and alumni, is critical to WSU's research mission.

Figure 5: Sponsored project expenditures by project type

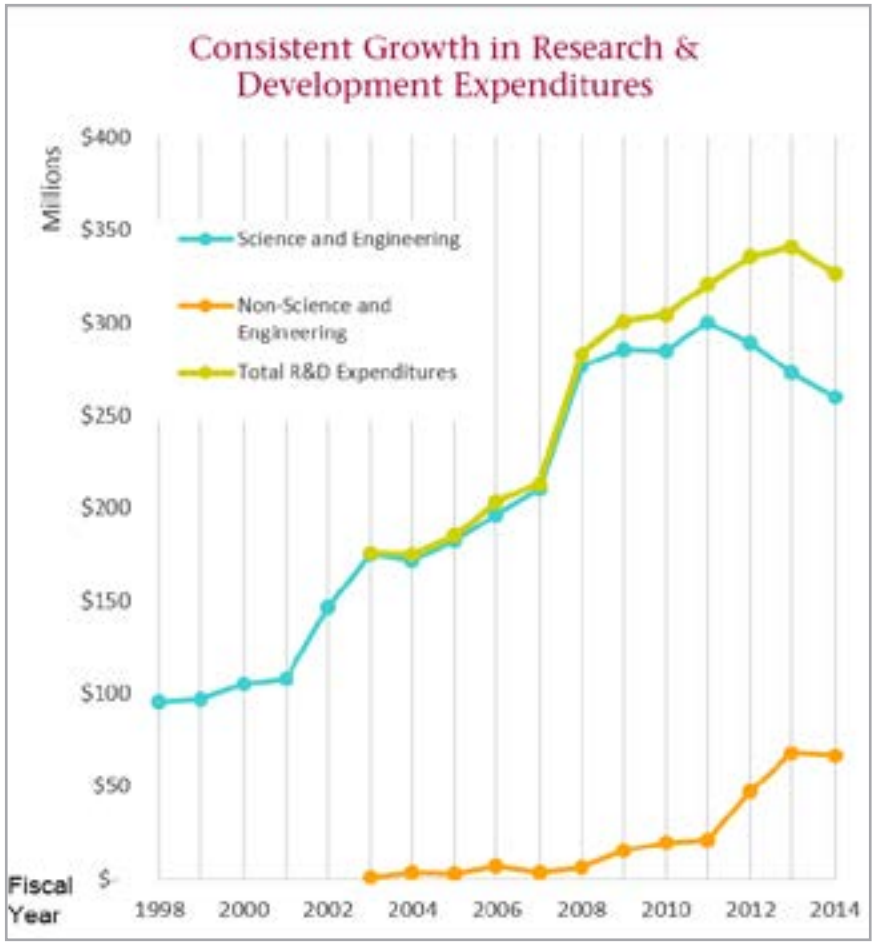

Figure 6: Total WSU research expenditures by FY and type

In the 2008-2013 strategic plan, WSU faculty set an aggressive goal of 10% growth in sponsored research expenditures per year. WSU faculty remarkably exceeded this goal, achieving almost 74% growth between 2008 and 2013 despite the difficult economic times. Several notable grants were awarded during this time:

$13 million from the USDA competitive specialty crop program, a $40 million USDA/NIFA grant for renewable energy under the Northwest Advanced Renewable Alliance, several NSF IGERT grants to support graduate student fellowships, a $5.6 million grant from NIH to study behavioral health for rural American Indian communities, a $9 million grant for WSU Nursing participation in a national children's study, an NSF ADVANCE grant to increase participation of Women in STEM careers, and several grants from DOE and other federal sponsors for research in the Institute for Shock Physics. WSU's top federal sponsor is still the United States Department of Agriculture, followed by HHS, NSF, DOE, Department of Education, and DOD (Figure 7).

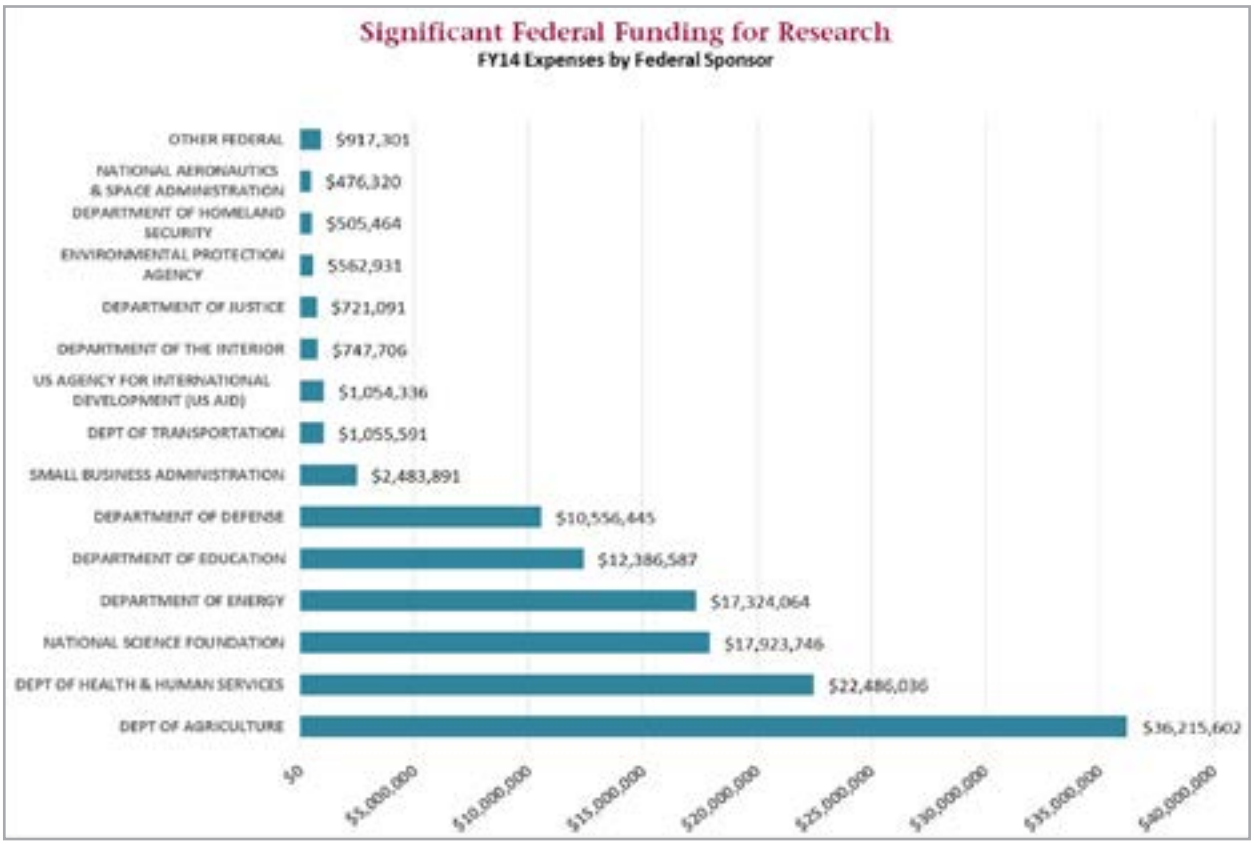

Figure 7: Federal sponsored project expenditures by agency, FY14

Support for research, creative, and scholarly activities has also increased from non-federal sponsors. The State of Washington supported over $26 million in projects in FY14 alone (Figure 8). Local governments, private foundations, institutes, and industry sponsored projects ranging from research and development to economic development programs, as well as programs to support the arts in the state of Washington, graduate programs for underrepresented students, rural health care outreach, and more. Private funding significantly enhanced WSU research and creative scholarship. WSU's Voiland School of Chemical Engineering and Bioengineering received a $17.5 million gift from Gene and Linda Voiland. This gift has funded distinguished professorships. The Washington State Tree Fruit Commission donated $32 million to the College of Agricultural, Human, and Natural Resource Sciences to establish endowed chairs and fund extension activities related to tree fruit production. In 2013, WSU received its largest private foundation gift to date—$26 million from Microsoft co-founder Paul Allen to fund construction of the new WSU Paul G. Allen School for Global Animal Health. This capstone gift followed a $25 million cornerstone gift from the Bill & Melinda Gates Foundation.

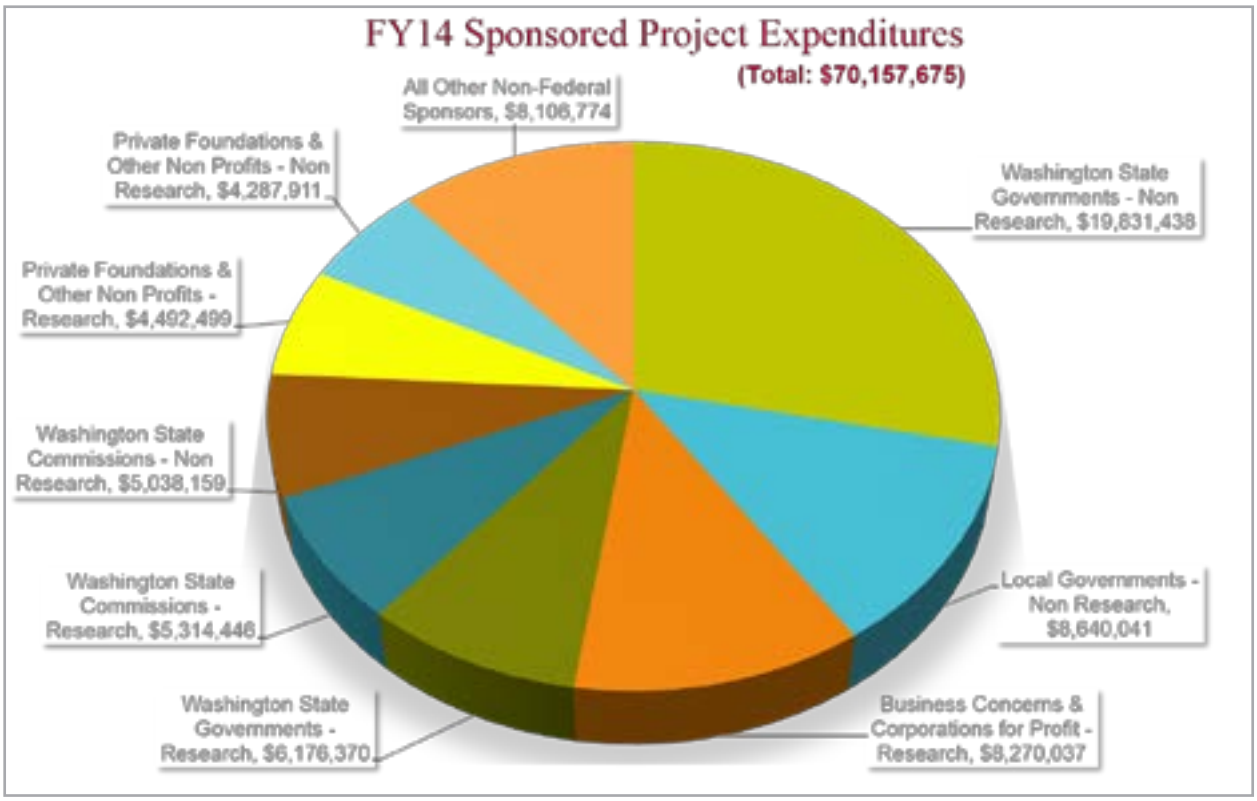

Figure 8: Sponsored project expenditures by non-federal sponsor, FY14

As a land-grant institution, WSU's activities clearly reflect its mission to advance knowledge, to extend knowledge through education, and to apply knowledge through local and global engagement to improve quality of life and enhance the economy of the state, nation, and world.

Many of our faculty are recognized internationally for cutting-edge discoveries and technologies. These discoveries provide benefits to the quality of human lives globally in agriculture, clean technologies, food processing, global animal and human health, engineering, and information technology. Under the leadership of Anson Fatland, associate vice president of economic development and external affairs, WSU reorganized its technology transfer office and created the Office of Commercialization (OC). The Office of Research (OR) and the OC are working together to support, nurture, guide, and sustain efforts within the university to translate research discoveries into innovation for the marketplace. The success of these efforts is reflected in Figure 9.

WSU faculty across the colleges, schools, and campuses participate in sponsored research and creative and scholarly activities. These activities, in each of the different disciplines, take unique forms and the various fields offer differing levels of funding opportunities and funding needs. The breadth of activity is an important aspect of WSU, reflecting its mission to strategically support a mix of disciplinary and interdisciplinary work, project-based and people-based activities, education and research projects, and creative and scientific exploration (see Appendix E: Sample FY14 Grants Received). These aspects are an essential part of the WSU ecosystem. The graph in Figure 10 reflects the breadth of activity in relation to the dollar value of each college's sponsored project funding.

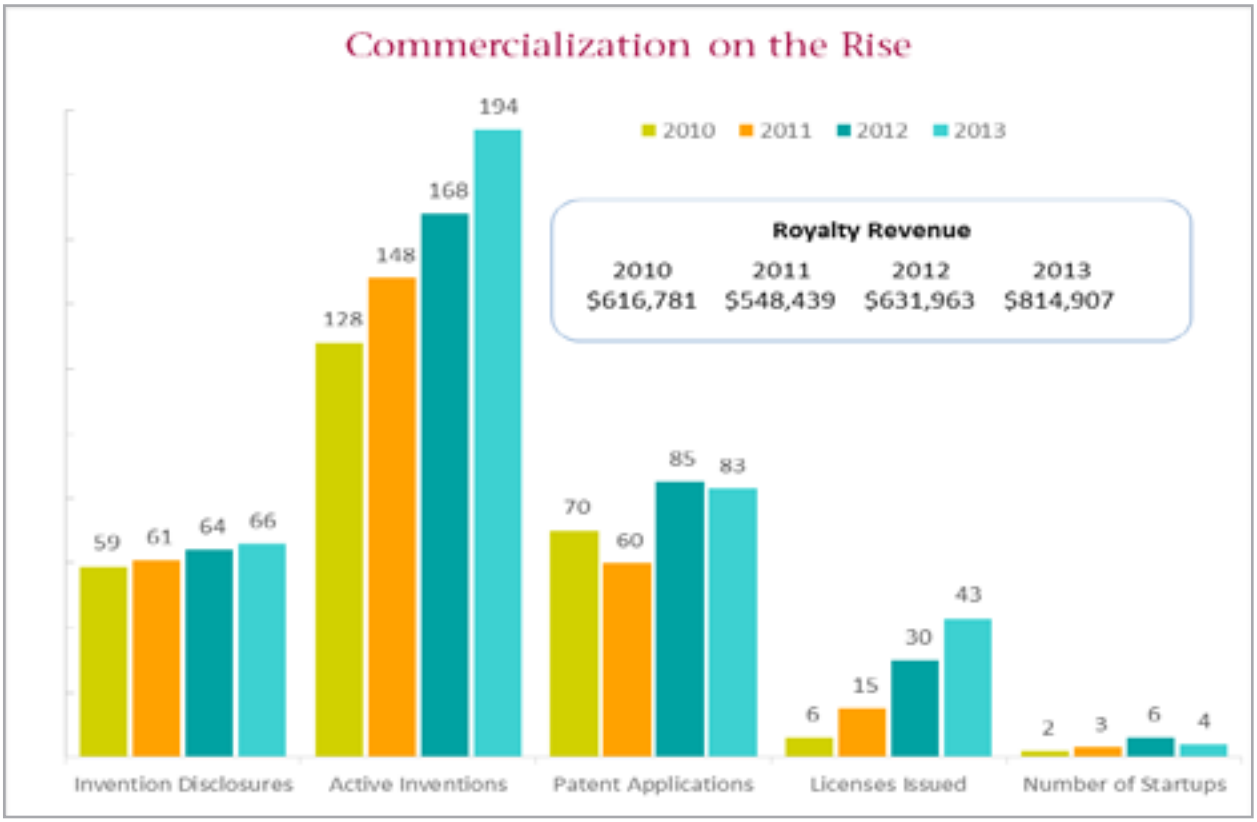

Figure 9: WSU Commercialization Activities, FY 2010-13

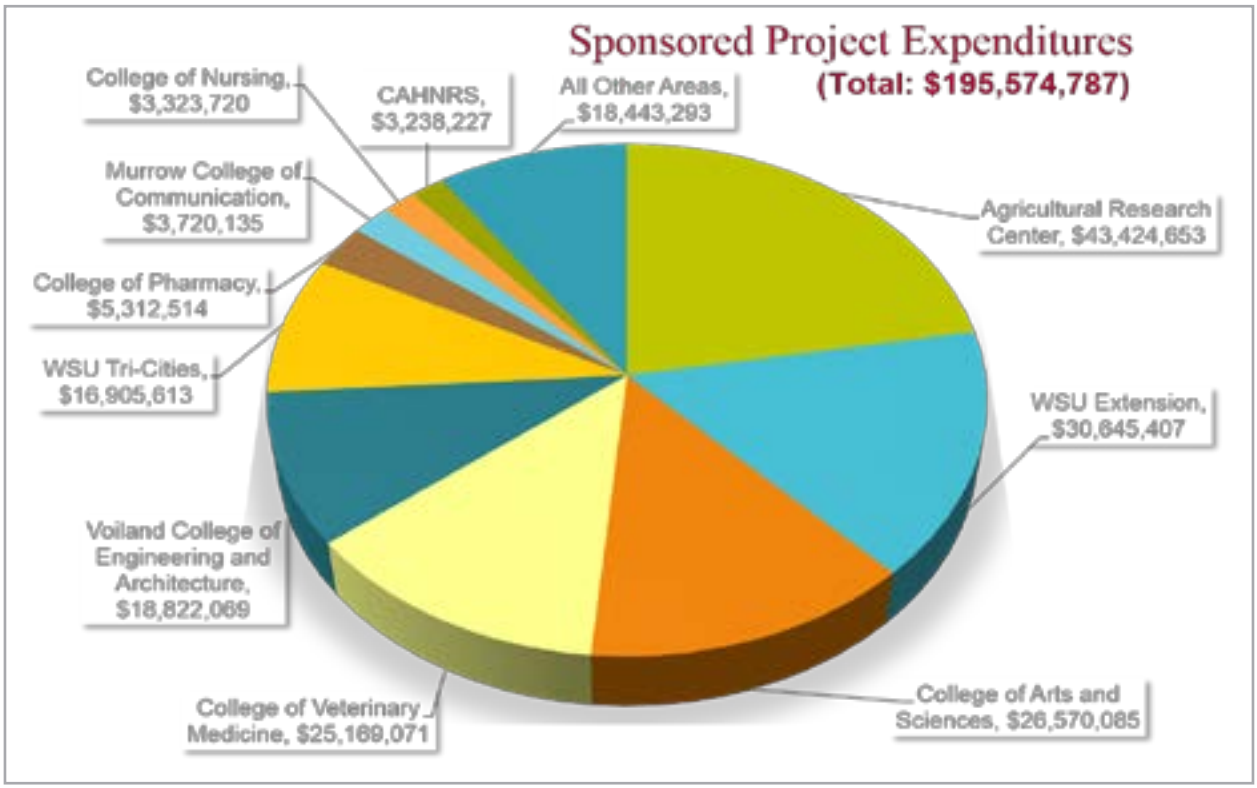

Figure 10: Sponsored project expenditures by college, FY14

WSU has significantly expanded its interdisciplinary research activities (Figure 11). Centers, like the Center for Environmental Research, Education, and Outreach (CEREO), which encompass multiple colleges and departments and provides multidisciplinary graduate-level training opportunities, have set a model for other programs. The Alcohol and Drug Abuse Research Program has focused researchers from across disciplines to study diverse topics as they relate to alcohol and drug abuse, resulting in a strong program which attracts national funding and collaborations with other universities. The Northwest Advanced Renewables Alliance (NARA) is another example of WSU's success with interdisciplinary projects. The NARA project involves 55 principal investigators leading a team of over 250 individuals at 16 institutions. The project incorporates multiple engineering disciplines (civil, chemical, materials, and biological systems), plus economics, forest science, climate science, education, sociology, chemistry, biochemistry, plant genetics, Extension, communication, and marketing to explore the conversion of biomass into jet fuel and other valuable products. There are many more examples. Researchers at WSU have discovered a unique environment that encourages researchers to engage, interact, and explore solutions to society's problems with the expertise of multiple disciplines.

Multidisciplinary centers at WSU play an important role in breaking down disciplinary silos. In these centers, researchers from a variety of departments collaborate, working toward goals bigger than any one focus area. The impact of these centers stretches beyond just the university community to the state and the nation. The four WSU Office of Research multidisciplinary centers are discussed on the following pages. There are many others across the university. For a complete list of centers at WSU, please see Appendix H.

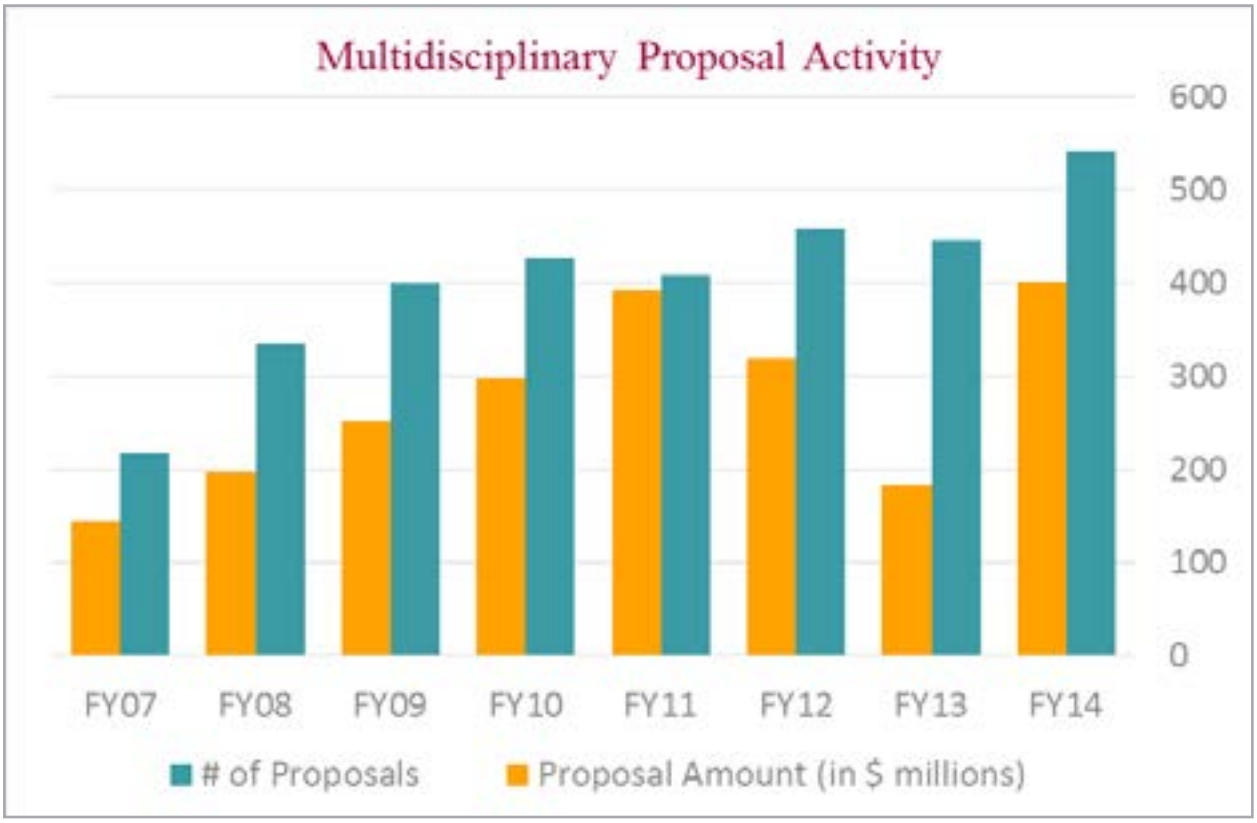

Figure 11: Proposals submitted by WSU that involved more than one college, FY07 to FY14

OFFICE OF RESEARCH MULTIDISCIPLINARY CENTERS

Center for Environmental Research, Education, and Outreach

The Center for Environmental Research, Education, and Outreach (CEREO) is a progressive network of more than 200 faculty, staff, students, and industry leaders working to resolve environmental issues through collaborative partnerships. Established in 2006, CEREO has been a faculty-driven initiative. Guided by a roster of distinguished scientists, CEREO seeks to apply innovative technologies and management tools to the ever-growing challenges of global climate change and environmental sustainability.

CEREO operates as a clearinghouse for a wide range of environmental projects such as watershed management, tracking the nitrogen cycle, and studying urban socio-ecological systems. Projects are initiated and conducted by a diverse community of people with expertise reaching from agriculture, biology, and communication to engineering and education. CEREO also brings a strong social science component into play, providing perspectives from experts in economics, political science, philosophy, anthropology, and more.

CEREO offers timely interdisciplinary expertise and problem-solving skills. For example, the center can help researchers better incorporate computer science skills into their environmental studies by merging data with informatics. CEREO hopes to prepare WSU students for real-world careers in the environmental arena by providing training and workshops unavailable elsewhere on campus.

CEREO students doing field research with Dr. Brian Lamb

Social and Economic Sciences Research Center

The WSU Social and Economic Sciences Research Center (SESRC) at Washington State University has been serving the research community with unique survey design and implementation capability for more than 40 years. Since 1985, the center has brought approximately $48 million of funding to WSU for conducting survey projects. Housed under the Office of the Vice President for Research, the SESRC conducts about 80 survey design and data collection projects per year for WSU faculty and administrative units, as well as for state, federal, and private-sector organizations. It maintains professional expertise and technical capabilities for conducting all phases of web, mail, and telephone data collection and analysis. SESRC is staffed by approximately 20 employees plus 100 student employees, all of whom are supported mostly by external sources of funds.

Research to improve survey methods has been regularly conducted by former and current staff members, and the survey design methods developed by the SESRC are in use throughout the world. A book (now in its fourth edition), published by the SESRC deputy director and doctoral students (Don A. Dillman, Jolene D. Smyth, and Leah M. Christian, *Internet, Phone, Mail and Mixed-Mode Surveys: The Tailored Design Method*) is the most cited survey design book ever published, receiving about 24,000 citations according to Google Scholar, and is used by statistical agencies in virtually all industrialized countries. Nearly every federal agency in the United States uses some aspects of the methods developed here, and the international impact and use is nearly as great as in the United States. Recent published research conducted in the SESRC is providing guidelines for the increased use of mixed-mode survey designs that are now essential for achieving high quality results. The SESRC has been a major contributor to the scientific literature on how to solve measurement differences that would allow greater use of web+mail survey designs in order to reduce survey error.

WSU is the only university in the Pacific Northwest, and one of relatively few nationwide, who maintain a comprehensive survey design capability of this nature. This established capability is relevant to most of the Grand Challenge themes at WSU, including health, food, quality of life, and environmental and energy issues, and has been called upon regularly to provide survey design assistance in these areas.

SESRC student employees participate in data collection and analysis

Nuclear Radiation Center

Located in the Dodgen Research Facility, WSU's Nuclear Radiation Center provides unique opportunities to researchers, commercial clients, and government agencies—especially as the reactor housed here is the only research reactor in the State of Washington, and one of less than thirty in the nation. The facility, completed in 1961, runs and maintains:

- a 1 MW TRIGA nuclear research reactor,
- a mass spectrometer,
- a series of alpha-particle spectrometers,
- an X-ray diffractometer, and
- gamma irradiation facilities.

Two laboratories, the Neutron Activation Analysis Laboratory and the Radiochemistry Laboratory, are other high-functioning units in the facility. National and international research, isotope production, and community education initiatives all take place here, benefiting a variety of fields of study at WSU including nuclear engineering, physics, biology, archaeology, and medicine, to name a few. Current research supported by this facility includes isotope production, trace element analysis, and cancer research. The center also provides valuable training to WSU students interested in becoming U.S. Nuclear Regulatory Commission licensed reactor operators and senior reactor operators for the WSU reactor. This training opens the door for post-graduation hire at nuclear power reactors around the state and nation. Over 30 thesis projects have been completed at the department in the last 20 years. Through numerous projects for outside sources, which financially support the center, the NRC continues to be able to offer research support to university faculty at a very low price.

State of Washington Water Research Center

The State of Washington Water Research Center (SWWRC) is a collaborative effort by researchers from throughout Washington to oversee and conduct applied water-related research within the context of economic, social, and cultural well-being. The center was established in 1964 by the Water Resources Research Act and is one of 54 water research institutions or centers in the United States.

Led by Washington State University, the SWWRC serves as the integral connection between the academic community members who conduct research on water management issues and the organizations that regulate public water resources, including city, state, and federal government agencies and private industry. The center also strives to foster the education of the nation's future water professionals.

College Research Overviews

COLLEGE OF AGRICULTURAL, HUMAN, AND NATURAL RESOURCE SCIENCES

The College of Agricultural, Human, and Natural Resource Sciences (CAHNRS) provides global leadership in research and outreach focused on:

- contributing to a safe, abundant, and affordable food and fiber supply;
- promoting the well-being of individuals, families, and communities;
- enhancing the sustainability of agricultural and economic systems; and
- cultivating stewardship of natural resources and ecological systems.

CAHNRS embodies Washington State University's land-grant research and education missions. Research, education, and Extension are the means by which CAHNRS addresses many of our global challenges, and WSU is committed to addressing these issues using a variety of resources:

- The CAHNRS Office of Research's goal is to promote research specifically beneficial to the citizens of Washington. In addition to the many disciplines represented in the 12 academic units, faculty in the college engage in multidisciplinary research institutes, laboratories, and centers to accomplish the mission.
- The USDA Agricultural Research Service and WSU have a long and effective research partnership where USDA scientists are assimilated into departments, creating a seamless atmosphere of collaboration with WSU faculty members.
- There are four WSU Research and Extension Centers strategically located to serve the state's diverse needs. The Mount Vernon center utilizes

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Landscape architecture student discussing his research with poster judges

College of Agricultural, Human, and Natural Resource Sciences

AT A GLANCE

15	24	19	27	39
Academic Departments & Schools	Academic majors	Academic minors	Graduate-level programs	Extension offices across Washington

$77.3 Million in Research Expenditures (FY14)

Core Facilities

- Franceschi Microscopy and Imaging Center
- Laboratory for Biotechnology and Bioanalysis
- Molecular Biology and Genomics Core
- Plant Growth Facilities

Agricultural Research and Extension Centers

Mount Vernon, Skagit County

- Northwestern Washington Research and Extension Center

Prosser, Benton County

- Irrigated Agriculture Research and Extension Center

Pullman, Whitman County

- USDA Agricultural Research Service

Puyallup, Pierce County

- Research and Extension Center
- Avian Health and Food Safety Lab
- Plant and Insect Diagnostic Lab

Wenatchee, Chelan County

- Tree Fruit Research and Extension Center
- F.L. Overly Laboratory
- USDA Tree Fruit Research Laboratory

Research Institutes, Labs, and Centers

- Agricultural Weather Network
- Institute of Biological Chemistry
- IMPACT Center
- Clean Plant Center Northwest
- Center for Sustaining Agriculture and Natural Resources
- Center for Precision and Automated Agricultural Systems
- Field Disease Investigation Unit
- Composite Materials and Engineering Center
- Food and Environmental Quality Lab
- Advanced Plant Growth Facility
- State of Washington Water Research Center
- Western Wheat Quality Laboratory (USDA)
- Wine Science Center

39 Extension Offices across Washington state representing almost every county in the region.

the location's unique mild, marine climate and rich alluvial soils for small-crop and weed research, looking for specific benefits to the local small and mid-sized farms in this area of rural–urban interface. The 320 acres at the WSU Puyallup location houses efforts to improve waste water runoff and salmon health, and address urban agricultural issues. In Prosser, the Irrigated Agriculture Research and Extension Center (WSU-IAREC) supports research on irrigated crops with a focus on tree fruits, grapes, and hops. Research here focuses on developing innovative strategies in crop management. The Tree Fruit Research and Extension Center in Wenatchee houses the F. L. Overly Laboratory (horticulture, plant physiology, soil sciences, entomology, and plant pathology) and the USDA Tree Fruit Research Laboratory, among other laboratories and facilities on its 200 acres.


Roving cameras see the big picture for wheat breeding at WSU

The WSU Extension offices located in many of the state's counties have eight main areas of focus: agriculture, communities, energy, youth and families, natural resources, health and wellness, gardening, and economic development. These focus areas are often impacted by local resources and community needs.

The Plant Growth Facilities located on the WSU Pullman campus offer a variety of greenhouses and controlled environment growth chambers for researcher use. These facilities serve many departments—the Department of Plant Pathology, Institute of Biological Chemistry, and Department of Crop and Soil Sciences, to name a few. Currently, state-of-the-art greenhouse facilities are being constructed to provide more space for the extensive agriculture research going on at the university. To show their support for this important effort, the Washington Grain Commission recently gave a $5 million gift to the university.

Other research units include multiple research farms for organic and sustainable agriculture, facilities for dairy and beef research, and the Cook Farm, home to the USDA-designated Long Term Agroecosystem Research Site, the only site in the nation dedicated to diverse cropping systems.

IN THE NEWS

- Washington Grain Commission gives $5 million to WSU to expand plant growth facilities. *WSU News*
- WSU crop scientists show genes in barley defend against aging, drought, heat, and disease. *WSU News*
- WSU faculty effectively compete for and are awarded nearly 25% of funds awarded in the United States for the Specialty Crops Research Initiative. *USDA Agricultural Marketing Service*
- New discovery provides insight on how basil plant protects itself from pests and produces medicinal compounds. *WSU News*
- WSU breaks ground on state-of-the-art cereal greenhouse. Funded by the Washington Grain Commission, USDA-ARS, and WSU. *WSU News*
- WSU receives $2 million grant to build and maintain a national system for sharing digital plant genetic resources. *The Lewiston Tribune; Good Fruit Grower*
- WSU researchers provide the USDA Natural Resources Conservation Service with data needed to develop incentives for wheat farmers to change to more sustainable tillage systems. *Science Daily*
- WSU researchers are developing an intelligent bin management system supported by a robotic self-propelled fruit bin carrier in tree fruit orchards. *WSU News*

COLLEGE OF ARTS AND SCIENCES

Washington State University's College of Arts and Sciences (CAS) united the College of Liberal Arts with the College of Sciences in 2012, forming a college with a broad range of research foci. The college is made up of 4 schools, 12 departments, 5 programs, and 16 centers, institutes, or museums. The faculty that make up CAS are exceptional leaders and researchers: professional society fellows, international cultural experts, presidential appointees, cutting-edge scientists, Fulbright scholars, and award-winning authors.

Research in CAS is wide-ranging, resulting in numerous innovations and advancements that fuel the economic growth of Washington state. Faculty efforts advance the frontiers of knowledge in several key domains:

- Historical, cultural, and global perspectives on contemporary issues
- Materials science
- Ecology, earth science, and environmental change
- Scientific foundations of sustainable health, food, and energy systems
- Quantitative and qualitative analyses of behavior and social systems
- Causes and consequences of injustice and inequality
- Understanding diversity from genetic through cultural levels of analysis

Highlights of the research being done in this college include everything from conducting research over a wide range of geological, environmental, and natural resources and ecosystems to developing new drug therapies for alcoholism, seeking insights into reef recovery and aquarium species, and discovering how complex societies develop.

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Understanding the effects of sleep deprivation in the driving simulator

College of Arts and Sciences

AT A GLANCE

12	33	37	4,037	768
Academic Departments & Schools	Academic majors & 14 minors	Graduate-level programs	undergraduate students enrolled	Graduate students enrolled

$26.5 Million in Research Expenditures (FY14)

Core Facilities

- Center for Biomolecular X-Ray Crystallography
- Franceschi Microscopy and Imaging Center
- GeoAnalytical Laboratory
- Institute for Shock Physics
- Stable Isotope Core Laboratory
- Marion Ownbey Herbarium
- Conner Museum of Natural History
- Museum of Anthropology

Related Research Centers

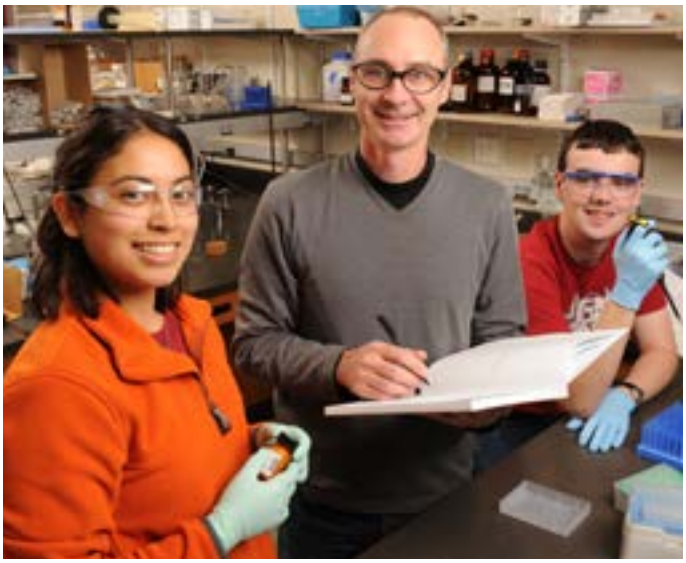
- Center for Environmental Research, Education, and Outreach (CEREO)
- Center for Reproductive Biology
- Plateau Center for American Indian Studies

Research Institutes, Labs, and Centers

- ISP/Applied Sciences Laboratory
- ISP/Dynamic Compression Sector
- Center for Materials Research
- Center for Social and Environmental Justice
- Division of Governmental Studies and Services
- Institute for the Study of Intercommunal Conflict
- Thomas S. Foley Institute for Public Policy and Public Service
- Initiative for Global Innovative Studies
- Simulated Hazardous Occupational Tasks Laboratory

Research units supporting this work include:

- The Center for Biomolecular X-Ray Crystallography and the Franceschi Microscopy and Imaging Center.
- The Institute for Shock Physics (ISP), a multidisciplinary research organization with an emphasis on materials research at extreme conditions.
- Museums and collections such as the Marion Ownbey Herbarium, providing access to nearly 400,000 specimens of plants and lichen, and the Conner Museum of Natural History, home to more than 65,000 bird and mammal specimens.



Dr. Cliff Berkman with chemistry students

The scholarship and creative achievements of CAS faculty in the arts and humanities have lead to national and international recognition, demonstrated by awards, prizes, invited lectures, performances, exhibits, fellowships, visiting faculty appointments, and grants. The activities of WSU faculty in critical culture, gender, and race studies, English, history, fine arts, and foreign languages and cultures deepen our understanding of the role of language, culture, and art in society and contributes to WSU's prestige and visibility.

IN THE NEWS

- Ion mobility and mass spectrometry are two tools WSU chemistry researchers are using to identify a "copycat" molecule that may mislead doctors who monitor dopamine levels in patients with Parkinson's disease. *Molecular Imaging, Genetic Engineering and Biotechnology News*
- The award-winning WSU Jazz Big Band and the new quartet Nighthawk have released albums on the peer-reviewed WSU Recordings label. *Saxophone Today*
- Analysis of the genome of the Arctic fly may lead to a wider understanding of how evolution helps insects cope with extreme environments. *BBC Nature News, International Business Times*
- Results of WSU study suggests that dogs may have migrated to the Americas much later than humans. This is the largest study, to date, of ancient dogs in the Americas. *Discovery News*
- Using a sophisticated "deadly force" simulator, WSU criminal justice researchers analyze how police, military, and the general public react in high-stress and threatening situations. *NPR, CNN*

CARSON COLLEGE OF BUSINESS

The Carson College of Business produces research that benefits academic and business communities in the state of Washington and the nation. The college is accredited by AACSB International across all degree levels and offers programs at six international locations. Doctoral students are prepared for successful teaching- and research-focused careers in higher education; 90% go on to teach or conduct research at prestigious colleges and universities across the globe. The Carson College consistently ranks among the top 100 national and international research universities in the category of research reported in leading business journals (UT Dallas Top 100 Business School Research Rankings).

Areas of research strength include:

- Behavioral Business Research—understanding causes, processes, and consequences of behaviors, actions, and decision making associated with various business stakeholders.
- Corporate Governance, Ethics, and Stakeholder Relations—pursuing insight into effectively managing stakeholder relations. Discoveries may address the challenge of sustaining and regaining public trust in business and government.
- Global Dimensions of Business—investigations in collaboration with partners in other nations on how institutional, financial, and cultural contexts affect cross-border trade and investment activities of multinational enterprises.

There are 10 specialized research and teaching facilities in the college. These include the Wine Business Management Classroom, the J. Willard and Alice S. Marriott Hospitality Teaching Center Dining Room, and the Center for Behavioral Business Research. The last of these is a world-class center for interdisciplinary behavioral research and education, bringing together industry leaders, academics, and students to study behavioral and consumer issues currently impacting modern organizations. Some of the topics studied at this center include the interface between retailers, brands, and consumers, the interaction between humans and technology, and the influence of perceived environmental impacts on consumers' decisions.

A highly regarded area of the college, the **School of Hospitality Business Management, ranks ninth in the world** for articles contributed to scholarly journals (*Journal of Hospitality & Tourism Research*). Three faculty members in the school have gained individual recognition for their publications, all of them ranking in the top 100 most prolific authors in both hospitality and tourism research and the top 50 most prolific authors in hospitality.

STEM research over the last five years has resulted in more than $1.5 million ($678,301 awarded to WSU) in funding from the National Science Foundation. Principle investigator K.D. Joshi, professor of information systems in the Department of Management, Information Systems, and Entrepreneurship, investigates the effect of gender, ethnicity, disability, and social class on career choices within the STEM field of information technology.

Carson College of Business

AT A GLANCE

5	9	3	2,844	577
Academic Departments on 3 campuses	Graduate-level programs	Campuses & WSU Global campus	undergraduate students enrolled	Graduate students enrolled

$260,000 in Research Expenditures (FY14)

$240,425 in Data Set Purchases

$390,000 in Summer Research Support

Centers and Institutes

- Entrepreneurial Studies
- Carson College Center for Student Success
- Innovation Assessment
- Economic Development Administration
- César Ritz Colleges – Switzerland
- Southwestern University of Finance and Economics – People's Republic of China
- Hoops Taxation Research and Policy Institute
- International Business Institute

Research and Experiential Teaching Facilities

- Center for Behavioral Business Research
- Financial Markets Trading Room
- Wine Business Management Classroom
- J. Willard and Alice S. Marriott Hospitality Teaching Center Dining Room
- Finance and Management Science Classroom; Technology Classroom

Graduate-level Programs

- Masters-level: MBA and Accounting
- PhD-level: Accounting, Finance, Hospitality and Tourism, Management, Information Systems, Operations and Management Science, and Marketing

Ranked 7 overall	Ranked 22	Ranked top 100
Best Online Graduate Business Programs & 3rd for veterans	Undergraduate International Business Program. Top 25 since 2005.	Undergraduate Business Programs & 56th among public national universities
US News & World Report	*US News & World Report*	*US News & World Report*

Carson College of Business Tech Symposium panelists discuss current and emerging issues facing information technology leaders.

IN THE NEWS

- WSU Carson College of Business researchers say drivers can be discouraged from texting and driving by public service announcements that evoke their fear of death in graphic terms. *King 5 News*
- Carson College of Business and University of Lausanne (Switzerland) researchers say even one small act, such as failing to recycle a water bottle, can decrease commitment to an overall goal of well-being, such as protecting the environment. *PR Newswire*
- WSU marketing study demonstrates that "future-oriented" women are the voting bloc most strongly motivated to invest money, time, and taxes toward reducing global warming. *Science Daily*
- WSU marketing researchers help firms understand when and why corporate social responsibility is effective and can protect against service failures. *WSU News, Forbes*

EDWARD R. MURROW COLLEGE OF COMMUNICATION

The Edward R. Murrow College of Communication at Washington State University is ranked as a top ten research program in 31 of 99 research areas by the Communication Institute for Online Scholarship (CIOS). It is a Tier 1 program for communication research concerning advertising, substance abuse prevention, and literacy (media literacy), and a top 10 research unit in a variety of areas including media and children, broadcasting, ethics, ecology, intercultural communication and international development, media and sexuality, political elections, politics and government, and regions of the world including Africa, Asia, and the Middle East.

The 2012 NSF Higher Education Research & Development (HERD) Report ranked the Murrow College of Communication within the top 3% (13/533) of communication programs for higher education research and development expenditures. The QS World University Rankings placed Murrow's faculty 14th in the nation for citations per paper.

Murrow faculty members study communication using a variety of methods, with a special emphasis on social science and quantitative research. Many research efforts span content areas in ways that are unique, even as they overlap and share similarities. College faculty study the ways humans communicate: as individuals, as part of groups and organizations, and as a society using digital technology and media. In addition, because digital communication and media influences are far reaching and not bound by geographic boundaries, Murrow faculty members' research examines issues that span the globe. Whether people are communicating about health, international and public affairs, or science and the environment, Murrow faculty are at the forefront, conducting leading research concerning each of these and related areas:

- Media and health promotion. Murrow faculty members examine the role of media and digital technology in contributing to healthier people and societies. Their research helps produce understanding and positive change in key health areas such as obesity reduction, alcohol abuse prevention, sexual assault reduction, sexual health promotion, and related topics.
- Science and environmental communication. Murrow faculty members examine issues related to a healthier planet shaped by current thinking in crisis, risk, and environmental communication. Research projects focus on effective collaboration and communication with multiple stakeholders, including local and at-risk populations on issues such as water and energy conservation, environmental sustainability, and stewardship.
- Media, society, and politics. Murrow faculty members examine issues concerning the role of media and communication technology in domestic politics and emerging democracies.
- The Murrow Center for Media and Health Promotion Research: The center examines how

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Edward R. Murrow College of Communication

AT A GLANCE

692	85	3	1,163	31
Academic majors	Academic minors	Academic sequences	undergraduate students enrolled	Graduate students enrolled

$3.7 million in Research Expenditures (FY14)

Research and Lab Facilities

- Technology-enhanced Focus Group Lab
- Media Viewing Lab
- Communication, Emotion, and Cognition Lab
- 26-station Digital Research Lab

Research Centers

- Murrow Center for Media and Health Promotion Research

Research Emphases

- Media and Health Promotion, Science and Environmental Communication, Media, Society and Politics

Related Interdisciplinary Research Centers

- Alcohol and Drug Abuse Research Program
- Center for Environmental Research, Education, and Outreach (CEREO)

Sequences

- Strategic Communication
- Journalism and Media Production
- Community and Society

Ranked in **Top 10** in 31 of 99 research areas by CIOS

Ranked top **3%** of communication programs for higher ed R&D expenditures (13 of 533)

NSF 2012 HERD report

Ranked **14th** among U.S. communication programs for number of citations per faculty

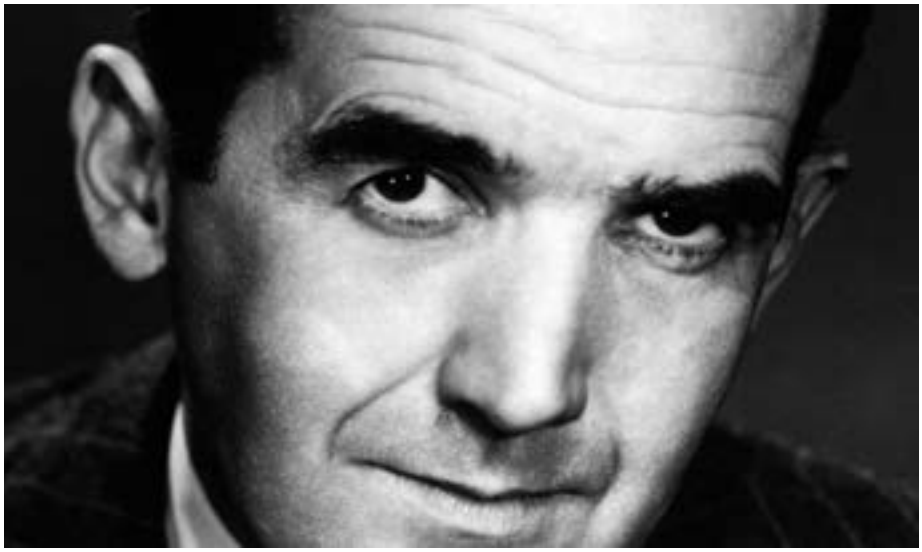
QS World University Rankings

people use media messages in their decisions about health, and how health promotion practitioners can maximize the effectiveness of health messages targeting young people and their families. The center's work is intended to help individuals and health professionals use media most effectively to facilitate informed and healthy decisions. Faculty members study the following areas:

- Media effects and strategies to prevent alcohol and drug abuse
- Use of media to reduce sexual assault and promote healthy sexual relationships
- Digital media, health, and well-being
- Parent-child communication about media and health
- Media literacy to promote healthy decision making

IN THE NEWS

- The Murrow College dean releases free digital primer: *Islam for Journalists*. *Investor's Business Daily, Huffington Post, CNN Web, Seattle Times*
- WSU study suggest young men who read men's magazines are more likely to engage in unwanted sexual behaviors. *Seattle Weekly, Seattle Times, The Times of India, Business Standard*
- Crime show viewers more likely to aid sexual assault victims. *Huffington Post*
- Collaborative WSU and UC-Davis study shows that even people who know certain foods are bad still find junk food more appealing than healthy food. *Medical Press*
- Through a pilot grant, WSU researchers are working to see how cell phones could encourage safer drinking behavior among college students. *University Herald, WSU News*
- Documentary app relives deadly Blackfeet Flood. *WSU News*
- WSU researcher on 'Why we are afraid of Ebola'. *WSU News*



"We will not walk in fear, one of another. We will not be driven by fear into an age of unreason, if we dig deep in our history and doctrine, and remember that we are not descended from fearful men—not from men who feared to write, to speak, to associate and to defend causes that were, for the moment, unpopular."

– Edward R. Murrow

COLLEGE OF EDUCATION

The WSU College of Education is comprised of two departments, with programs on all four WSU campuses. College faculty hold national and international leadership positions in their professional organizations and numerous editorial positions for major journals. Faculty research is disseminated in top tier journals, many books, and major national and international conferences. Major research thrusts with state and national significance include the following:

- STEM (science, technology, engineering, and mathematics) education
- Equity and diversity in education
- Leadership and innovation in teaching and learning
- Measurement and evaluation
- Physical and psychological health and well-being
- Management and sociocultural studies of sport

Other emerging themes include research in the neuropsychology of education and human–animal interaction. Research has been supported by the National Science Foundation, Institute for Educational Sciences (U.S. Department of Education), National Institutes of Health, Department of Agriculture, and numerous foundations.

Much of this research is conducted in collaboration with colleagues in STEM fields at WSU and other institutions, in partnership with schools and school districts throughout the state of Washington, and with local Native American tribes. Some of the research centers or laboratories that support this work include the following:

- Learning and Performance Research Center (LPRC). The LPRC is the nexus for the latest advances in cognition, measurement, and program evaluation. The award-winning faculty evaluate assessments for government agencies, school districts, corporations, and testing companies; conduct methodological studies; and collaborate with other WSU units on major grants.
- Center for Mestizo and Indigenous Research and Engagement. This center, the first of its kind in the nation, focuses on research and engagement with indigenous populations in the Pacific Northwest, with implications for Latino/Mestizo and Native/Indigenous communities both nationally and globally.
- Spokane STEM Health Science Education Research Center. The mission of this proposed center (currently under review by the faculty senate) is to coordinate and enhance excellence in health science STEM teaching and learning at WSU, the state, and beyond by conducting and disseminating health science STEM education research and related outreach programs.
- Gait and Posture Biomechanics Lab. Researchers investigate how concussions alter motor performance, and how balance control is affected by divided attention, environmental perturbations, and physical alterations to the body.

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College of Education

AT A GLANCE

2	5	15	1,763	474
Academic Departments	Majors & 25 subject area endorsements	Graduate-level programs	Undergraduate students enrolled	Graduate students enrolled

$701,000 in Research Expenditures (FY14)

Programs

- Educational Leadership
- Educational Psychology
- Counseling/Counseling Psychology
- Cultural Studies and Social Thought in Education
- Math/Science Education
- English Language Learners
- Language, Literacy, and Technology
- Elementary Education
- Secondary Education
- Special Education
- Curriculum and Instruction
- Athletic Training
- Health and Fitness Education
- Sport Science/Movement Studies
- Sport Management

Research Centers and Labs

- Learning and Performance Research Center
- Center for Mestizo and Indigenous Research and Engagement
- Spokane STEM Health Science Education Research Center
- Gait and Posture Biomechanics Lab
- Exercise Physiology and Performance Lab
- Concussion and Sports Medicine Lab
- Psychology of Physical Activity Lab
- Attentional Processes Lab

- Exercise Physiology and Performance Lab. Research involves the assessment of fitness levels and exercise capacities in intercollegiate athletes and the impact these have on athletic performance and training. Researchers also seek to understand physiological, psychological, environmental, and lifestyle-related factors that may facilitate or impede physical activity behavior during pregnancy.
- Concussion and Sport Medicine Research Lab. Researchers examine how neck biomechanics and the magnitude of impact in youth sports influence concussions, and the extent of knowledge of concussions by the medical community, athletes, and the general public.
- Psychology of Physical Activity Lab. Researchers investigate the mechanisms by which physical activity enhances well-being, the social/contextual factors that facilitate healthy lifestyle choices, the role of mindfulness during exercise in predicting physical activity motivation, and the impact of yoga on physical activity motivation and body image.
- Attentional Processes Lab. Researchers focus on attentional processes in ADHD, treatment of PTSD with hypnosis, and mediation of attention by hypno-counseling and self-hypnosis.

IN THE NEWS

- A WSU researcher uses computational modeling to streamline research on science curriculum in the classroom. *WSU News*
- Along with Purdue researchers, a WSU researcher works to find better methods to study teacher effectiveness. *WSU News*
- Through data gathered in an international survey, researchers in the Learning and Performance Research Center show interconnectivity between the teaching experience and learning. *WSU News*
- WSU researcher shows that, around the world, outgoing behavior leads to happier humans. *WSU News*
- WSU researchers find video games could dramatically streamline educational research. *Science Newsline.com, Scoop.It.com, Communications of the ACM, India TV News*
- WSU collaborates on grant to ease Spokane dropout rate. Working with a team from Gonzaga University, and funded by a large group of local nonprofits, a WSU researcher is studying which services will have the most impact on student success in Spokane schools. *WSU News*
- WSU faculty member Rick Sawyer is appointed fellow with the national Carnegie Project on the Education Doctorate. [citation]

VOILAND COLLEGE OF ENGINEERING AND ARCHITECTURE

The Voiland College of Engineering and Architecture is a major research engine at WSU, where solving critical issues in energy, environment, health, and security is priority. The college is the location of a critical mass of exceptional faculty, world-class facilities, and strong, existing research programs:

- Advanced materials
- Smart grid power networks
- Renewable energy
- Energy conversion
- Air and water quality
- Sustainable infrastructure
- Aerospace innovation
- Engineering for health

Advanced materials research has a long history at WSU and a large impact on the nation. More than 40% of the $1 billion wood-plastic industry in North America uses material formulations developed at WSU. Resources like the Composite Materials and Engineering Center, the Center for Materials Research, and the W.M. Keck Biomedical Materials Research Lab help WSU researchers directly impact the economy with their work in composite materials for airplane manufacturing, new battery technologies, sustainable building materials, and crystal growth.

In the Smart Power Networks research group, researchers work to improve the efficiency and reliability of electric power and energy systems. Research here is becoming increasingly recognized: this year WSU hosted the first-ever conference on synchrophasors, a key smart grid component, and also recently established the Energy Systems Innovation Center which was funded by DOE and industrial partners. This center conducts studies on electric energy and its social and economic impacts.

The generation and efficient use of power and energy is central to a variety of current engineering and societal problems, a challenge that the Energy Conversion and Catalysis research group at WSU takes seriously. The Gene and Linda Voiland School of Chemical Engineering and Bioengineering performs cutting-edge research in three focus areas: biomedical engineering, transformational energy technology, and engineering education. On the Tri-Cities campus, the Bioproducts, Sciences, and Engineering Laboratory houses part of the new Federal Aviation Administration Center of Excellence for Alternative Jet Fuels and the Environment, led by WSU and MIT. Located at Pacific Northwest National Laboratory, the WSU Institute for Integrated Catalysis facilitates collaborative research and development for a secure energy future.

Understanding the topics of air and water resources is critical for maintaining the health of our planet and the functionality of our finite water, air, and soil supply. The Laboratory for Atmospheric Research is recognized worldwide for its 50-plus year history and multidisciplinary

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Voiland College of Engineering and Architecture

AT A GLANCE

6	11	21	3,741	708
Academic Departments	Majors & 12 Minors	Graduate-level programs	Undergraduate students enrolled	Graduate students enrolled

$18.8 million in Research Expenditures (FY14)

Core Facilities

- Analytic Catalysis Center
- Physical Materials Imaging and Analysis Cluster (SEMs, XRD, XCT, NanoIndenter, etc.)
- Cleanroom for Microelectronics Manufacturing
- High Performance Computing Clusters

Research Institutes, Labs, and Centers

- Composite Materials and Engineering Center
- Energy Systems Innovation Center
- Laboratory for Atmospheric Research
- Sports Science Laboratory

Related Interdisciplinary Research Centers

- Center for Environmental Research, Education, and Outreach (CEREO)
- Center for Materials Research
- Water Research Center
- Materials Science and Engineering Interdisciplinary Doctoral Program

work. The Center for Environmental Research, Education, and Outreach consists of a network of more than 200 researchers, instructors, outreach specialists, industry leaders, and graduate students who lead projects like NSPIRE (nitrogen systems), BioEarth (regional, biosphere-relevant Earth system model), and WISDM (Watershed Integrated Systems Dynamics Modeling). The State of Washington Water Research Center is housed at WSU and serves to link 53 other water centers and institutes throughout the United States and territories ranging from academics to state and local governments and the private sector.

Susmita Bose and Amit Bandyopadhyay conduct ceramic bone implant research

The Sustainable Infrastructure and Design effort is made up of researchers who provide innovative approaches and pioneering changes to the design and construction of the built environments and the materials of which they are made. The Institute for Sustainable Design is responding to the challenge of creating a sustainable future with a focus on low impact development, sustainable transportation, and green buildings.

Aerospace Innovation includes active collaboration with industrial and academic researchers across the nation. The Joint Center for Aerospace Technology Innovation (JCATI) provides impetus for WSU researchers to team with industrial collaborators to use 3-D printing to make satellite parts, study shape memory alloys in hopes of maximizing engine operation, and develop new batteries that are safer and lighter than current lithium ion ones. WSU's reputation extends internationally, as demonstrated by WSU being one of just a few universities invited to attend the 2013 Paris Air Show.

Engineering for Health is a research area that seeks to increase fundamental understanding about biomaterials, molecular and cellular biological processes, and biomechanics. The laboratories in this area are the CASAS Smart Home Project which focuses on the creation of an intelligent home environment and the W.M. Keck Biomedical Materials Research Lab that focuses on research in musculoskeletal disease and functional restoration, bio-processing, and bio-computing.

IN THE NEWS

- Washington State University researchers are building the most comprehensive "smart city" laboratory in the United States to test smart grid technologies. *ECNmag.com*
- WSU researcher has developed a new catalyst that could lead to producing biofuels cheaply and more efficiently by solving one of the biggest challenges in biofuels production—removing oxygen. *ACS Catalysis, Science Daily*
- WSU researchers develop a unique method to use microbes to power wastewater cleanup in rural areas. *Processing Magazine, National Science Foundation News from the Field*
- A group of Washington State University students won first place in an international student competition to design a transportable, stand-alone, economical refueling station for hydrogen fuel cell powered cars, whose use may help reduce carbon dioxide emissions. *WSU News, Alaska Airlines Magazine*
- A biodegradable gel developed by a WSU researcher can absorb more than 250 times its weight in water and could help farmers store moisture. *Tri-City Herald, Lewiston Tribute, KXLY, Western Farm Progress*
- WSU researchers are developing a method to allow a computer to give advice and teach skills to another computer in a way that mimics how a real teacher and student might interact. *Reddit, NBC, NY Times, National Public Radio, Daily Mail (UK), Science 2.0*

COLLEGE OF MEDICAL SCIENCES

The newly-formed (May 2014) College of Medical Sciences, located in Spokane, Washington, is engaged in undergraduate and graduate education, medical education, and training of postdoctoral fellows. The college is currently moving ahead with plans to create a fully accredited medical school. The development of the WSU Medical School will have an immense impact on the college's research direction and growth.

As these plans move forward, the college will continue to emphasize faculty research by building on existing research strengths and developing new research programs. WSU's medical sciences faculty and research staff currently lead research projects involving behavioral health, neuroscience, molecular and cellular biology of disease process, and more.

The neuroscience of sleep, from the basic mechanisms of sleep studied at the cellular and molecular level to the effects of sleep loss on human performance, is a research strength in the college. Several faculty focus on sleep at the molecular level, exploring its essential function and its links to other systems in the body such as metabolism. Others seek to answer critical questions about how reduced and displaced sleep affects the cognitive performance and health of the average person. The college is closely aligned with the WSU Sleep and Performance Research Center, a nationally recognized center for studies in sleep and wakefulness. The center has an active cluster of sleep researchers from several WSU departments, in addition to medical sciences, with strong and diverse sources of extramural funding.

Cancer and aging research is a growing research strength in the college. The work of this group spans the study of telomere function and maintenance, cell signaling in cancer, and the molecular mechanisms of metastatic transformation of cancer cells. This research is increasing our understanding of how molecular changes in telomeres may make us more vulnerable to cancer and influence how we age, how the microenvironments where tumors grow influence cancer progression, and the role cell to cell communication plays in the formation of tumors. Other areas of cellular and molecular research include investigation of the basic mechanism of reproduction and the involvement of the nervous system in regulating immune responses.

The college's Department of Speech and Hearing Sciences emphasizes the physiological, neurological, behavioral, and psychological dimensions of normal and disordered communication across the lifespan. Researchers in the department lead studies in a wide variety of subjects including central auditory processing disorders, speech-language diagnostic and intervention practices used with culturally and linguistically diverse populations, and assessment and treatment of speech, language, and motor impairments in rare disorders and diseases. Many of these studies are conducted in the Speech and Language Laboratory, which conducts applied research to benefit people with speech, hearing, and language disorders. The department trains both undergraduate and graduate students, and is affiliated with the HOPE School of Spokane, a preschool for children with hearing loss, and WSU's Hearing and Speech Clinic—all housed in the Health Sciences Building at the WSU campus in downtown Spokane.

College of Medical Sciences

AT A GLANCE

$2.2 million in Research Expenditures (FY14)

Departments
- Biomedical and Clinical Sciences
- Speech and Hearing Sciences

Core Facilities
- Imaging Core
- Genomics Core

Related Institutes, Labs, and Centers
- Sleep and Performance Research Center
- Cancer and Aging Research Group
- Speech and Language Laboratory
- University District Health Clinic (2016)

The newly created Spokane Teaching Health Center (STHC) is a consortium comprised of Empire Health Foundation, Providence Health Care, and WSU Spokane. The college directly supports the clinical teaching faculty involved with training medical students and medical residents in the clinic. The STHC will allow WSU faculty and students to work together in an outpatient clinical setting with medical doctors. The goal is to give health sciences students the opportunity to work in a multidisciplinary care setting, such as those they will encounter in the real world. The center is currently under construction and will be completed in 2016.

IN THE NEWS

- A WSU medical school is necessitated by the needs of the local community. *Spokesman-Review*
- WSU scientists have found a brain protein that aids influenza recovery through boosting the healing power of sleep. *KREM.com, Healthcanal.com*
- A field study by WSU researchers suggests the need for new safety rules for truck drivers to effectively reduce fatigue. *Huffington Post*
- WSU is part of a consortium planning a $15 million health clinic in Spokane's U-District. *Spokane Journal of Business*

COLLEGE OF NURSING

The College of Nursing at WSU has received continuous accreditation since 1971 and now educates approximately 1,000 students annually at its four physical locations (Spokane, Tri-Cities, Yakima, and Vancouver) and remotely through video technology to Walla Walla. Patient-focused research is aimed at transforming health care delivery and improving health care for all. Research areas of distinction include:

- Behavioral health
- Community and public health, including environmental health and sustainability in health care
- Educational innovations and outcomes
- Patient care quality and safety

In the area of behavioral health, our researchers integrate physiologic, psychosocial, and behavioral knowledge to promote health and reduce the burden of illness, including mental health conditions, substance use, and addictions. College of Nursing research combines multiple approaches from laboratory research to community engagement and occurs in many settings, including acute care, outpatient and community-based, and in urban and rural settings.

Activities within our Community and Public Health Program are strengthened by strong relationships with regional health care partners. Our research aims to prevent illness and injury across the lifespan, from pre-conception through healthy aging, to promote health across populations and improve quality of life. Current research includes a focus on community engagement and sustainable environmental and policy changes to create healthier families, communities, and populations.

Educational innovations and outcomes are research areas developed as our faculty and student researchers implemented and evaluated various teaching modalities to prepare competent and compassionate nurses who work effectively within teams. Our current research includes approaches that involve working with fellow health science colleagues to transform knowledge, values, attitudes, skills, and behaviors that lead to improved health outcomes and care quality.

Innovations and system strategies to optimize patient care safety and quality are being explored and tested by nursing researchers. This research encompasses many different philosophical and methodological approaches and includes laboratory research as well as community engagement, but all with a focus on improving care provided in acute and ambulatory care settings. Examples of the research includes fall prevention, care transitions, and care coordination.

The college was one of ten schools chosen by the National Council of State Boards of Nursing to participate in a national study evaluating the effectiveness of simulation in the BSN nursing program. The Program of Excellence in Clinical Performance and Simulation Lab was the ideal location for this research, with more than 6,300 square feet, multiple learning spaces, access to high- to low-fidelity manikins, and faculty experts in simulation.

College of Nursing

AT A GLANCE

4	320	4	727	210
Locations state-wide	Graduates annually	Graduate-level programs	Undergraduate students enrolled	Graduate students enrolled

$3.3 million in Research Expenditures (FY14)

Graduate-level Programs

- Master of Nursing
- Master in Health Policy and Administration
- Doctor of Nursing Practice (effective January 2015)
- PhD in Nursing

Core Facilities

- Clinical Performance and Simulation Lab
- Clinical Laboratories

Research Programs and Centers

- Program of Excellence in Clinical Performance Simulation (PECPS)
- Program of Excellence in Addictions Research

Related Community Partnerships

- Joint scholar/faculty positions with Providence Health and Services
- Washington State University Tri-Cities Nursing Partnership (multiple health care organization partners)
- Bridging Care Across the Inland Northwest
- Yakima Memorial Valley Hospital Cardiac Risk Factor Screening Project

Nursing Faculty Expertise

- Substance use and addictions
- Community-based participatory research
- Environmental health
- Care coordination
- Health policy
- Health disparities

IN THE NEWS

- HRSA grant will allow the WSU College of Nursing to offer financial support to underrepresented students to help them become family nurse practitioners. *WSU College of Nursing News and Media*
- WSU College of Nursing is spearheading the first known study of addictive behavior related to use of a hookah. *WSU College of Nursing News and Media*
- WSU alumna is working with educators at WSU Vancouver to alleviate medical misinformation and false assumptions to promote a better health care experience for the marginalized. *WSU College of Nursing News and Media*
- WSU simulation experts partner with Washington Association of Nurse Anesthetists to provide experiential opportunities to nurse anesthetists. *WSU College of Nursing News and Media*
- A nursing professor at Washington State University Spokane has developed materials to get individuals who have a job-related injury or illness back to work as soon as possible. *WSU College of Nursing News and Media*

COLLEGE OF PHARMACY

Research thrives at the WSU College of Pharmacy where programs emphasize:

- pharmacy practice advancement, outcomes, and delivery
- quantitative and experimental systems pharmacology
- pharmacogenetics and pharmacogenomics
- drug discovery, development, and delivery

The three college academic units—pharmaceutical sciences, pharmacotherapy, and experimental and systems pharmacology—are the hub for constant, innovative research activities.

Research in pharmaceutical sciences covers a broad range of disciplines that are critical to the discovery and development of new drugs and therapies. Research conducted by faculty in this department focuses on cancer, cell signaling, drug metabolism, rheumatoid arthritis and inflammation, tobacco biomarkers and cessation, immunology and immunotherapy, and aging.

Experimental and systems pharmacology bridges laboratory science with clinical practice using advanced systems pharmacology approaches including in vitro and clinical studies and predictive modeling. Areas of specialization within the department include pharmacokinetics and pharmacodynamics of centrally acting therapeutics, drug–diet interactions, therapeutics for rare genetic disorders, and identification of therapeutic targets for cardiac hypertrophy.

Pharmacotherapy is focused on promoting the role of the pharmacist as an essential member of the health care delivery team. Research in this department is guided toward developing and evaluating innovative patient-centered pharmacy practice models and their economic, clinical, and humanistic outcomes. The Department of Pharmacotherapy also houses the Drug Information Center, which provides information about drug efficacy, interactions, side effects, and metabolism to health care professionals in the state of Washington through a drug information request line and through the publication of monographs evaluating medication use and comparative effectiveness.

Laboratory research on the Spokane campus is supported by the availability of a number of shared instrumentation facilities, including a Mass Spectrometry Core Laboratory that analyzes and quantifies small molecules such as drugs and their metabolites; a Microscopy Imaging Core Laboratory that provides live cell imaging, optical sectioning of biological samples, 3-D and 4-D reconstruction of images, and spectral scanning; a Genomics Core Laboratory that performs high-throughput genomic sequencing, genotyping, and gene expression and epigenetic analyses; a Nuclear Magnetic Resonance Core Laboratory that provides structural determinations of small molecular compounds, including peptides, nucleosides, drug metabolites, and potential new therapeutic targets; and a Flow Cytometry Core Laboratory that provides support for cell sorting and live cell imaging to assess the distribution of specific molecules within cell populations. The College of Pharmacy also houses a Clinical Research Center that provides support for investigators conducting studies with human participants.

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College of Pharmacy

AT A GLANCE

3	2	2	415	10
Academic units	Doctoral programs	Joint-degree programs	Doctor of Pharmacy students	Postdocs

$5.3 M in Research Expenditures (FY14)

Doctoral Programs
- Doctor of Pharmacy
- PhD in Pharmaceutical Sciences

Joint Degree Programs
- PharmD/PhD
- PharmD/MBA

Core Facilities
- Mass Spectrometry Core
- Microscopy Imaging Core
- Flow Cytometry Core
- Nuclear Magnetic Resonance (NMR) Core
- Genomics Core

Research Center
- Drug Information Center

Pharmacy Faculty Expertise
- Pharmacokinetic/pharmacodynamics modeling
- Drug/diet interactions
- Therapeutics for rare disorders
- Cell signaling
- Pharmacogenetics
- Drug discovery, design, and delivery
- Gene therapy
- Inflammation

The college has been accredited since 1912

Ranked
35th
for FY13 out of all U.S. pharmacy schools for total NIH funding by the AACP

Spurred by growing demand, the College of Pharmacy is extending its Doctor of Pharmacy program to a satellite campus in Yakima, Washington, housed at the Pacific Northwest University of Health Sciences. Preparations are being made for the first class of student pharmacists in fall 2015.

IN THE NEWS

- Combined studies between WSU and UCSD have given researchers new insight into the biological roles of gamma-aminobutyric acid (GABA) and opened up new strategies for treating a selected neurological brain disease called succinic semialdehyde dehydrogenase (SSADH) deficiency. *College of Pharmacy News, MD News*
- Washington State University will soon start offering a pharmacy graduate degree program at the Yakima campus of the Pacific Northwest University of Health Sciences. *Yakima Herald*
- A new assistant professor in the experimental and systems pharmacology department at the WSU College of Pharmacy is studying if maintaining a healthy sleep schedule will help prevent the development of melanoma, the deadliest form of skin cancer. *College of Pharmacy News*
- HSSA awards $1.964 million to WSU College of Pharmacy. [citation]
- Pharmaceutical sciences department welcomes three research faculty. [citation]
- Pharmacy program honored by state for community outreach. *WSU News*
- Green tea may help those suffering from rheumatoid arthritis. *WSU News*
- Pharmacy research on a rare genetic disorder may help others seeking to achieve equilibrium. *WSU News*
- Research project looks at drug regimens after hospital stay. *WSU News*

COLLEGE OF VETERINARY MEDICINE

The College of Veterinary Medicine (CVM) is one of the nation's leading veterinary schools. It houses one of the best-equipped teaching hospitals in the world and CVM faculty are recognized around the globe for their outstanding research. One of the oldest veterinary colleges in the United States, CVM also ranks fifth among peer veterinary colleges for its level of extramural research support. Extremely productive, CVM faculty generate over $20 million from various extramural sources, doubling the amount of funding provided through state of Washington allocations.

The college excels in research to benefit both animal and human health. Areas of significant research strengths are:

- DNA organization and repair and chromosome biology
- Systems neuroscience
- Reproductive and developmental sciences
- Tissue bioengineering and remodeling
- Immunology and infectious diseases
- Global animal health
- Individualized medicine

Over ten facilities house laboratories, classrooms, and equipment to support this research, which can be generally divided into five departments:

- Veterinary Microbiology and Pathology. The research topics in this department are integrated and focus on the biology of host and pathogen, and the interactions between the two that results in disease pathology and immune protection and clearance.
- Veterinary Clinical Sciences. The faculty focus on clinical studies and often work with faculty in other departments in the college. The VCS core research program in pharmacogenomics includes a translational research component in individualized medicine.
- Integrative Physiology and Neuroscience. Research in IPN takes an integrated approach toward topical issues in neuroscience and physiology that include feeding/obesity, addiction, sleep, animal emotions, and muscle physiology. IPN is the home department for the graduate and undergraduate neuroscience programs at WSU and also contributes to basic medical science education in the veterinary curriculum.
- Paul G. Allen School for Global Animal Health. Research in the Allen School focuses on providing solutions to global health challenges by intervention at the animal–human interface. The research grows from strength in infectious diseases but extends beyond to include economics-based assessment of program needs and effectiveness, and the social and cultural basis of effective program implementation in other parts of the world.
- School of Molecular Biosciences (SMB). The school has major curricular responsibilities in WSU undergraduate education and offers majors in biochemistry, cell biology and genetics,

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College of Veterinary Medicine

AT A GLANCE

5	180	535	484	1899
Academic departments & schools	Graduate students enrolled	Undergraduate students enrolled	Doctor of Vet Med students enrolled	Year the College was founded

$25 million in Research Expenditures (FY14)

Academic Units

- Veterinary Clinical Sciences
- Integrative Physiology and Neuroscience
- Veterinary Microbiology and Pathology
- Molecular Biosciences
- Paul G. Allen School for Global Animal Health

Clinical Services for the Public

- Veterinary Teaching Hospital
- Washington Animal Disease Diagnostic Laboratory

Research Centers

- Center for Reproductive Biology
- Center for the Study of Animal Well-being

Key Partner Programs

- USDA Animal Disease Research Unit
- WIMU—Washington (WSU), Idaho (U of I), Montana (MSU), Utah (USU)—Cooperative Program for DVM Education
- Consortium of Western Region Colleges of Veterinary Medicine

Core Research Facilities

- Animal Research Unit
- Flow Cytometry and Cell Sorting
- Advanced Light Microscopy
- IVIS Live Imaging Lab

Commercialization

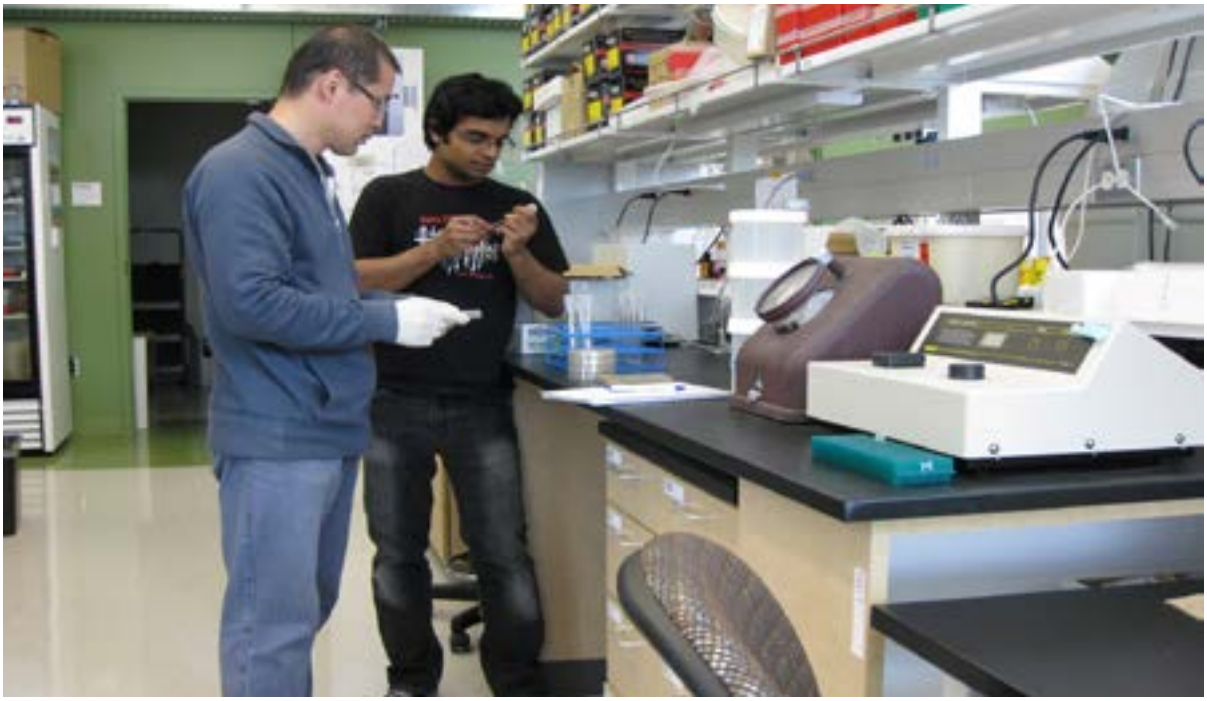
- CVM faculty hold or have pending 87 patents and have registered 2 trademarks
- Three start-up companies have spun off of IPN, SMB, and VMP research, one of which (VMRD) has become a global leader in animal health diagnostics

and microbiology. Research in SMB combines approaches from chemistry, physics, and biology to address the fundamental mechanisms of living things. Interdisciplinary by nature, SMB faculty collaborate across the colleges, applying their expertise in areas affecting both animal and human health: biochemistry and structural biology; cell biology and cellular signaling; chromatin, DNA repair, and cancer; microbial genetics, physiology, and infectious disease; molecular genetics, gene regulation, and chromosome biology; and molecular reproduction.

In addition, the college is home to the USDA Agricultural Research Service, Animal Disease Research Unit (ADRU). ADRU scientists are housed in the CVM, and have joint faculty appointments. ADRU also supports livestock research facilities that provide a unique resource for CVM faculty.

The entire Pacific Northwest is served by the Washington Animal Disease Diagnostic Lab (WADDL) at WSU which has a mission to provide accurate, state-of-the-art, timely, and cost-effective diagnostic service, consultation, disease surveillance, and outreach in order to safeguard animal health, the food supply, and public health. The Avian Health and Food Safety Laboratory in Puyallup is a critical branch of this laboratory, providing disease diagnostic services for all species of birds and food safety testing. The Veterinary Clinical Sciences Field Disease Investigation Unit works closely with WADDL and has conducted research investigations into diseases threatening the economy of herds in the Pacific Northwest as well as nationally. The Veterinary Teaching Hospital provides veterinary care to more than 14,000 privately-owned patients annually including dogs, cats, horses, cattle, camelids, and a wide range of exotic and wildlife species.

CVM students are encouraged to pursue research and are mentored in their studies by faculty both within the college as well as in other related colleges. The Research Scholars program encourages student researchers through weekly seminar courses in current research at the college as well as through courses on scientific literacy and philosophy and directed, faculty-led readings.



IN THE NEWS

- Professor Margaret E. Black receives the 2013-14 Samuel H. Smith Leadership Award. [citation]
- An article published by researchers in the Paul G. Allen School for Global Animal Health at WSU posits that the deadly rabies virus could be eliminated among humans by vaccinating dogs. *NBC News, Huffington Post, U.S. News & World Report, Science Daily*
- According to a study at WSU, horses have a positive effect on children. *American Psychological Association's Human Animal Interaction Bulletin, EQUUS, Fredericksburg.com*
- WSU researcher reveals a regenerative therapeutic pathway with the potential to reverse the course of neurodegenerative diseases such as Parkinson's and Alzheimer's. *WSU News, Science Coalition blog, "Science 2034"*
- WSU rabies vaccination program is working to eliminate rabies worldwide. [citation]
- Professor Joe Harding reveals a regenerative therapeutic pathway with the potential to reverse the course of neurodegenerative diseases. [citation]

HONORS COLLEGE

The WSU Honors College is a unique entity that offers liberal arts undergraduate education within the larger research environment of the university. An Honors College education prepares graduates for the 21st century interconnected world, whether that is joining a company, going to graduate or professional school, or starting their own business.

WSU Honors students are high-achieving scholars who enjoy new ideas and challenges. Honors College students are involved in cutting-edge research; are campus, community, and statewide leaders; are world travelers; and are academic role models.

They think critically, communicate well, and they want to make an impact in their world.

The Honors College promotes developing a strong global cultural competency and requires demonstrated proficiency in a second language. All Honors students are encouraged to spend some time abroad through university-exchange programs, international research abroad experiences, faculty-led summer activities, volunteer opportunities, or internships. They all have the opportunity to participate in undergraduate research programs. These programs allow students to work with world-class faculty members and can develop into thesis projects to showcase their academic work, interests, and talents.

IN THE NEWS

- The Honors College co-sponsors Jon McCourt, an Irish activist turned peacemaker, to present the Honors College 11th Bhatia Lecture, “Bloody Sunday and Beyond: Troubles in Northern Ireland.” *WSU News*
- A WSU Honors College undergraduate studying prostate cancer is one of 10 students nationwide to be selected by the American Association for Cancer Research for the annual Thomas J. Bardos Award. *WSU News*

Honors College

AT A GLANCE

More than **80%** of the **700** undergraduate students enrolled in the Honors College are involved in undergraduate research.

50% of graduating Honors College seniors spend time studying or doing research abroad

Global Experience Examples

- HIV research in South Africa
- Ocelot research in Costa Rica
- Neuroscience research in the United Kingdom
- Quantum physics research in Germany
- Humanitarian volunteer experience in Guatemala
- U.S. Department of State 100K Strong in the Americas program in Mexico
- Foreign-language immersion in Japan

Undergraduate Research Examples

- Cancer diagnostics
- Catalysis
- Genomics
- Epigenetics
- Advanced materials
- Autonomous vehicles

Outstanding Student Accomplishments

- Three Boren Awards for International Study
- Three Fulbright U.S.-U.K. Summer Institute Awards in 2014
- Eight Goldwater Scholarships in 5 years
- Three National Science Foundation Graduate Research Fellowships
- One Truman Fellow
- Seven Crimson Awardees in 2014 (top WSU Honor)

Subcommittee Reports

RESEARCH THEMES SUBCOMMITTEE

Guiding Principles

Grand Challenge approach to research at WSU: Based on guidance from the provost and other Executive Review Group members present at the 120-Day Study kickoff meeting, a decision was made to frame WSU research strengths in the context of grand societal challenges. Some benefits of a grand challenge approach are: 1) informed decision-making on strategic allocation of resources; 2) tackling problems with greater scope and impact by capitalizing on fundamental and applied research strengths across disciplines; 3) enhancing communication and marketing plans to strengthen WSU's brand; and 4) motivating and inspiring to the public to support WSU research programs.

Definition of Grand Challenge: Grand Challenge themes should draw on existing and emerging WSU research strengths (Figure 12). They are ambitious, but achievable, goals that harness WSU strengths to solve important national or global problems and that have the potential to capture the public's imagination.

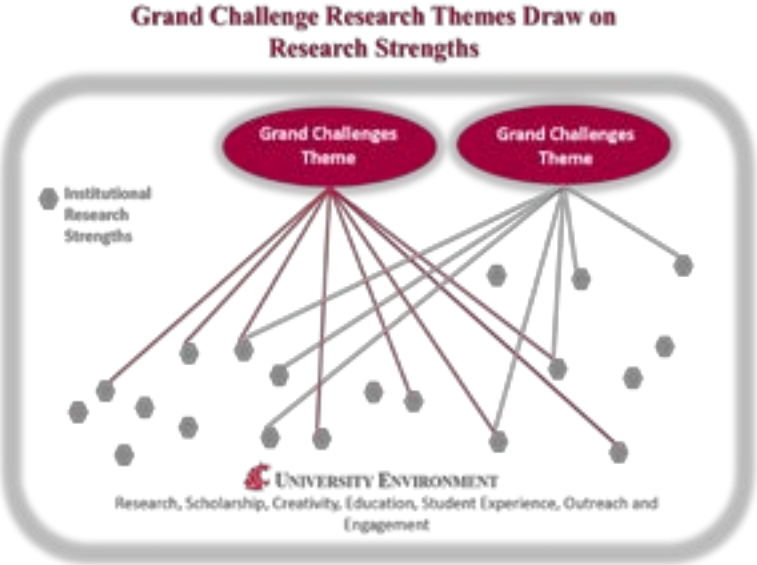


Figure 12: Grand Challenges draw together university strengths

Characteristics of a Grand Challenge: WSU Grand Challenges must be inspirational, multidisciplinary, and inclusive. A Grand Challenge must be articulated as a goal to solve a societal challenge, not as a topic or subject of inquiry. As such, it should be aspirational, but also achievable. Challenge themes should be accessible to non-academics and be phrased in such a way that they capture the public's imagination. The ideal themes will require intellectual and creative contributions from multiple disciplines. They need to motivate major public and private interests. They are important for developing a well-informed citizenry capable of critical analysis and solving a variety of social and environmental problems. They involve

many different stakeholders, are multidimensional, transdisciplinary, systemic, and require new ways of thinking, which go beyond traditional frameworks and disciplines. See Characteristics of a Grand Challenge Chart, Appendix C.

Commitment to discipline-specific and fundamental research: Identifying Grand Challenges for WSU should not limit creative investigation in non-Grand Challenge areas or the pursuit of 'curiosity-driven' research. Instead, resources allocated to infrastructure in Grand Challenge areas should augment the tools available to scientists across disciplines. WSU should continue to uphold its commitment to recruit strong fundamental scientists in discipline-specific areas, recognizing that one of the greatest values of a research university to society is the expansion of human knowledge, as an end to itself; it is with this knowledge that future societal challenges will be solved.

WSU Strategic Plan: The subcommittee's goals are aligned with the recently released WSU Strategic Plan which aims to create an environment for "exceptional research, innovation and creativity" at WSU, particularly emphasizing "Goal 1: Increase productivity in research, innovation and creativity to address the grand challenges and opportunities of the future."

Subcommittee Charter

The Research Themes Subcommittee's charter was to:

1) Develop a preliminary list of current and potential high-impact major research themes for discussion/comparison by the Management and Integration (M&I) Group and the Executive Review Group, and to provide information to evaluate WSU's research strengths associated with these themes. For each theme on the preliminary list, the group intended to:
    - Rate the degree to which WSU is well placed to pursue the theme (faculty strengths, infrastructure capability, potential sponsors' interest, and importance for maintaining an intellectually diverse and creative environment);
    - Rank the priority of each theme; and
    - Identify barriers to research excellence and develop specific recommendations to improve the research environment to advance the WSU research enterprise.
2) Provide metrics and other information needed to enable ongoing assessment of the WSU research plan.
3) Provide findings and actionable recommendations.

Subcommittee Activities

The Research Themes Subcommittee sought to understand WSU's research strengths and develop Grand Challenge research themes that would incorporate the combined and complementary research strengths of the university in addressing these issues. Once themes were identified, the subcommittee sought to identify the research strengths within each theme, identify barriers to advancement of each theme and develop recommendations to improve the research environment, and inform a strategic approach to investment toward the Grand Challenge themes. Theme-associated research strengths were to be prioritized based on the degree to which WSU is well placed to pursue them, including faculty strengths, current infrastructure, current and future sponsor interest, intellectual diversity, and a creative environment.

To accomplish this charge, the subcommittee took the following approach:

1) Expanded subcommittee membership to achieve balanced representation across colleges and campuses, with input from the M&I Group and the Executive Review Group.
2) Requested input from colleges and campuses across the WSU system regarding research strengths. For a summary of strengths see Table 2 below and Appendix G for more detailed college strength reports.
3) Requested grand challenge research theme suggestions from the WSU faculty and established a website portal, which remained open for input throughout the process (Appendix G).
4) Met regularly from September 2014 through January 2015 to discuss and evaluate input.
5) Obtained input and advice from a group of WSU Regents professors during one subcommittee meeting.
6) Participated in and responded to feedback from M&I members, 120-Day full group and Town Hall meetings, and the Executive Review Group.
7) Engaged and interacted with Academic Leadership Associates (ALA) facilitators to select, refine, and further develop research themes.

The subcommittee members evaluated a broad range of input from faculty surveys (over 115 faculty responses) and suggestions gathered during interviews with Regents professors and discussions among subcommittee members. Using this feedback, the subcommittee created a comprehensive list of potential research themes (see Appendix G). Over a series of four meetings during the span of two months, the subcommittee considered each of the suggestions, and teams of subcommittee members developed candidate challenges (see Appendix C). ALA evaluated the data on research strengths provided by the WSU academic community via our web database.

At the final subcommittee meeting and 120-Day retreat, the potential research themes were discussed and vetted by the M&I Group with input and facilitation by ALA. The list of proposed themes is provided in Conclusion #1 below.

Although the subcommittee's original charge included rating the degree to which WSU is well-placed to pursue a given theme, it was determined that these activities should occur after the themes list was further vetted and focused. Vetting and refining will continue after the subcommittee's activities are complete. Please see the Final Study Conclusions of this report for more information.

Conclusions and Recommendation

Conclusion #1: WSU Research Strengths Based on feedback from research strength surveys received from the colleges, the subcommittee assembled a summary list (see table 2). Definitions of 'strength area' appear to be widely varied. It is also unclear what criteria were used to identify a particular area of research strength.

Recommendation

1.1 **WSU research strengths should be further vetted and used to evaluate and strategize for final Research Challenge Themes.** Identification of emerging areas should also be identified and considered.

Conclusion #2: Preliminary Grand Challenge Research Themes The preliminary list of Grand Challenge themes, in Table 3, was developed based on faculty suggestions, subcommittee discussions, grant awards, and feedback from associate deans for research. Detailed descriptions of each preliminary theme and a sample of researchers whose work may align with each theme are in Appendix G.

Recommendation

2.1 **Preliminary Grand Challenge research themes should be further vetted and refined.** With the help of ALA, the executive leadership should review and select three to four research themes

Based on subcommittee input, the ALA suggested the following as potential Grand Challenges:

- Creating an educated society that maximizes individual and community potential
- Fueling the Future: Sustainable energy, water, and resources
- Healthy Living: Human, animal, and environmental health
- Independence and wellness for all
- Leveraging Diversity: Commonality and difference in a time of social and ecological change
- Promoting prosperity and cultural vitality throughout our communities
- Smart Environments: Advanced materials, technologies, and infrastructure

Conclusion #3: Identified Barriers In the course of gathering research strengths and research theme suggestions, the subcommittee identified salient barriers and limitations to the implementation of the themes. Since many are related to activities analyzed by the other 120-Day subcommittees, we have not included specific recommendations in this section; we opted instead to highlight some of the findings, as they are important to the ultimate advancement of research in WSU theme areas. Details specific to the Grand Challenge themes can be found in Appendix G. Following are the identified barriers:

Infrastructure. There is a pressing need for infrastructure investment in identified Grand Challenge areas. Faculty also reported the need for quality core facilities and adequate research space.

Service Centers for Computing/Modeling/Big Data. Service Centers are needed in order for WSU to advance in Grand Challenge research theme areas as well as in high-impact discipline-specific areas. Core facilities for state-of-the-art bioinformatics and computation biology ("data analytics") is essential for individuals to conduct "-omics." Service staff are needed to assist with acquisition, bioinformatics, and computational aspects for faculty who are not trained in these areas. Many established researchers would like to move into these realms; more staff dedicated to assist faculty in reaching this goal is essential for WSU to stay current in many areas of plant and human health research.

General Research Support. Faculty expressed a need for greater support from the university in the following areas: pre- and post-award administrative support; reduced teaching and advising duties; more consistent efforts across the colleges to mentor faculty; more effective and more transparent systems to track credit and facilities and administrative (F&A) distribution across administrative units; increased efforts to improve awareness, communication, and coordination across campuses and across disciplines; and increased proactive efforts to participate in formulation of federal grant proposal solicitations.

TABLE 2
SUMMARY OF WSU RESEARCH STRENGTH SURVEYS

CARSON COLLEGE OF BUSINESS

1. Behavioral business research
2. Corporate governance, ethics, and stakeholder relations
3. Global dimensions of business

COLLEGE OF AGRICULTURAL, HUMAN, AND NATURAL RESOURCE SCIENCES

Agriculture

1. Foods for health (basic plant sciences: genomics, metabolomics, and genetics; crop production systems and plant breeding; food processing systems; biologically intensive, sustainable, and organic agriculture)
2. Animal reproductive biology
3. Biofuels and bioproducts

Human Sciences

1. Individual and family development and prevention science
2. Apparel design for specific populations, textile characteristics and applications
3. Economics: agricultural, behavioral, consumer, health, international, marketing, supply chain, and transportation
4. Interior and landscape design

Natural Resources

1. Water resource management for ecosystem services and health
2. Planning for resilience in the face of changing water cycles due to climate change
3. The Columbia Basin and Puget Sound: Laboratories for agricultural and urban sociohydrology and economics
4. Environmental and resource economics

COLLEGE OF ARTS AND SCIENCES

Arts and Humanities

1. Understanding gender, race, and culture through artistic expression and critical inquiry
2. Society, media, and digital technology
3. Historical and global perspectives on contemporary issues

Natural Sciences

1. Materials science
2. Ecology, earth science, and environmental change
3. Scientific foundations of sustainable health, food, and energy systems

Social Sciences

1. Behavioral, cultural, and policy dimensions of health and well-being
2. Quantitative and qualitative analyses of behavior and social systems
3. Causes and consequences of injustice and inequality

Cross-disciplinary strengths addressing societal challenges

1. The social and cultural context of science and technology
2. Integrated data sciences and modeling of human and natural systems
3. Understanding diversity from genetic through cultural levels of analysis

COLLEGE OF EDUCATION

1. STEM education
2. Measurement and evaluation
3. Cultural and linguistic diversity
4. Leadership and innovation in teaching and learning
5. Health and wellness
6. Cultural studies in education
7. Management and sociocultural studies of sport
8. Students with disabilities
9. Neuroscience/neuropsychology of education
10. Educational technology
11. Human–animal interaction

MURROW COLLEGE OF COMMUNICATION

1. Health promotion, media literacy, applications of new technologies to health promotion and health literacy
2. Political communication, e-democracy, civic engagement, and public affairs
3. Science communication, and risk communication
4. Media psychology and communication processes and effects

COLLEGE OF MEDICAL SCIENCES

Sleep

1. Biochemical and genetic regulation of sleep
2. Sleep and neural development
3. Sleep and metabolism
4. Sleep and human performance

Cancer and Aging

1. Mechanism of telomere maintenance
2. Signaling pathways in tumorogenesis
3. Epigenetics and microRNAs

COLLEGE OF VETERINARY MEDICINE

1. DNA organization, repair, and chromosome biology
2. Global animal health
3. Individualized medicine
4. Immunology and infectious disease
5. Reproductive and developmental sciences
6. Systems neuroscience
7. Tissue bioengineering and remodeling

TABLE 2 *continued*	
COLLEGE OF NURSING	COLLEGE OF PHARMACY
1. Behavioral health and addictions 2. Community and public health 3. Educational innovations and outcomes 4. Patient care safety and quality	1. Genomics/genetics 2. Drug discovery 3. Quantitative systems pharmacology 4. Multidisciplinary health outcomes research/ epidemiology
VOILAND COLLEGE OF ENGINEERING AND ARCHITECTURE	WSU VANCOUVER
1. Bioenergy and catalysis 2. Advanced materials 3. Power engineering 4. Air/water 5. Machine learning—smart environments	1. Neuroscience—in particular, in the areas of hearing and addiction 2. Environmental science—in particular, in the area of watershed science 3. Math and science education

TABLE 3 PRELIMINARY RESEARCH THEMES Subcommittee-created themes for consideration

Detailed reports on each proposed theme can be found in Appendix G

Subcommittee-created themes for consideration

SUSTAINING HEALTH

One of the most pressing and inspirational challenges we face today is understanding what constitutes optimal health and how it can be sustained, for only when we understand "normal" can we prevent and treat disease. Indeed, advances made over the past century related to health and well-being have resulted in an unprecedented increase in longevity, accompanied by a shift from infectious disease-driven mortality to that due to chronic degenerative conditions such as obesity, cancer, cardiovascular disease, and type 2 diabetes. This shift, along with revolutionary advances in research technologies, has transformed investigation and exploration in health science toward a focus on interdisciplinary collaboration coupled with science-driven outreach and translation with a goal of extending both the quantity and quality of life for not only Americans but also the global population.

INFORMATION-DRIVEN RESEARCH (aka BIG DATA)

Peta-scale information processing refers to the transmission, generation, manipulation, and analysis of huge data sets to extract information and build a body of knowledge that can solve important problems and sets the foundation for future innovation. Information may come in the form of interrelated associations of data elements, where patterns are buried in the interconnections between the data, making information processing a complex task that requires the development of new algorithms, new hardware architectures, and even the use of altogether new physical processes that go beyond electronics. Developing peta-scale information processing technologies with a focus on existing critical needs at the forefront of information-dense research will stimulate the development of novel solutions for future problems.

BUILDING HUMAN CAPACITY THROUGH EDUCATION RESEARCH

Building human capacity is one of the grand challenges society faces, and education has been a consistent force for change throughout history. Education builds human capacity through its impact on cognitive, affective, and behavioral development by increasing access and opportunity for all individuals in society, and by addressing critical workforce needs (e.g., STEM education). Educational research addresses each of these components and is especially important in policy formation, transforming thought, developing tools for learning, and informing classroom instruction.

EXOTIC AND EMERGENT MATERIALS

This theme focuses specifically on matter with unusual composition and structure that can be applied to a variety of existing challenges such as energy generation and storage; can be used to develop new technologies such as ultrasmart morphing materials and self-healing materials; can enable new computing and information processing paradigms such as quantum computing and holographic information processing; and has the potential to lead to transformative technologies.

WATER

Water is integral to every biological process on earth and is critical in myriad ways for human welfare. Water is a necessary foundation for food and energy production, and water access and quality is a fundamental determinant of human health. Water provides valuable ecosystem services and recreation benefits, but also plays a central role in hazards such as flooding, landslides, wildfire, and sea level rise. The hydrologic cycle plays an important role in both responding to and driving global change. Far-reaching implications include those for air quality, climate, and the health of the biosphere. An environment in flux calls for new science with a new vision for scientific pursuit. WSU has a strong foundation for providing high marginal benefit and cost-effectiveness through a sharper focus on and additional investment in water research. A concerted and integrative effort would enable researchers across the university to identify collaborative overlap, and would provide the potential to greatly strengthen WSU's existing capacities and reputation in this crucial research area.

TABLE 3 *continued*
ENERGY IN A SOCIETAL CONTEXT
The sustainable, secure provision of energy is critical to the functioning of modern society. Not only is energy the backbone of much of what we take for granted (water, traffic, communication, food), but the way in which it is provided and used has implications for global challenges including climate change and social stability. The energy challenge must be met by a multifaceted approach. Hydropower along with fossil and nuclear power will continue to be part of the energy solution for the foreseeable future and improving these technologies for safer, cleaner, more efficient power production is essential. Development and production of sustainable, bio-based fuels, alternative renewable energy sources such as those derived from wind and solar power, and hydrogen-based fuel cells along with new storage technologies are all important elements of the solution. Design of buildings and infrastructure for more efficient energy use and optimized industrial processes for energy efficiency will help to reduce the energy demand that has skyrocketed and will continue to increase over the coming decades. Smart grid technologies with the capability of bi-directional communication are opening vast new possibilities for improving both efficiency and sustainability of energy systems. Knowledge about how to successfully bring these new technologies and infrastructures into use is in its infancy and the issues are complex. Successful adoption will involve better understanding of interactions among consumers, service providers, utilities, and governments. Fully realizing opportunities will require improved understanding through continuing research integrating technological, behavioral, and environmental aspects of energy systems.
SMART INFRASTRUCTURE
America is facing great challenges from a severely deteriorated infrastructure. The American Society of Civil Engineers (ASCE) report card graded the American infrastructure around “D”, which was mentioned numerous times in the U.S. presidential debates and State of the Union addresses. What makes the situation worse is the dwindling funds for infrastructure. As a result, Americans have to deal with potholes in cracked roadways, collapsed bridges, broken pipelines, flooded areas, crawling vehicles/trains, and so on, which directly or indirectly lead to fatalities. Durability and resilience are keys to a healthy infrastructure to support economic growth in Washington and beyond. Infrastructure directly impacts people’s living conditions and requires concerted efforts to reverse the current trend and jump-start the next generation of infrastructure. This requires integrated and innovative approaches in fields of materials, design, construction, management, economics, and sociology, as well as modern technology.

RESEARCH INFRASTRUCTURE SUBCOMMITTEE

Guiding Principles

Defining Infrastructure: Research infrastructure can be defined as the instrumentation, facilities, resources, and related services used by the scientific community to conduct top-level research in their respective fields.[4] Different fields, to varying degrees, require all of the main components of research infrastructure, which include:

1. Physical (e.g., buildings, lab space, power, cooling)
2. Equipment (e.g., instrumentation, computing)
3. Administrative (e.g., compliance, pre- and post-award support)
4. Intellectual (e.g., libraries, data, internet, training)
5. Social (e.g., networks for collaboration, mentoring, etc., between faculty, departments, and universities).

Generally, research infrastructure resources could be divided into two categories:

1. Single-sited (program-specific)
2. Distributed (university-wide)

Definition of Core Research Facilities: Core facilities are shared research facilities that provide access to instruments, technology, services, and skilled technicians that are not available in individual laboratories. Experts that support activities within core facilities are essential as they provide needed technical expertise and also foster collaboration between investigators, including interdisciplinary research.

Definition of Multi-User Facilities: The term multi-user facilities will be used to discuss instrumentation voluntarily shared by faculty members with other researchers. These researcher's individual labs often shoulder the costs and time commitment of managing and sharing the instrument.

Value of Multi-User and Core Facilities: In most disciplines, the performance of excellent research requires increasingly complex, expensive, and technical equipment. The equipment often requires operation by a dedicated, skilled scientific staff, as well as service contracts and operating costs that are well beyond the budgets of a single laboratory. In this environment, it is all the more necessary to be effective, proactive, collaborative, and strategic in our management and investment of these resources. Core facilities can also provide scientific expertise that may be lacking in a given research laboratory and can foster collaborations between investigators in different disciplines.

[4] "Investing in Research Infrastructure in the Behavioral and Social Sciences." NAP, NRC ISBN: 978-0-309-06248-0.

Core facilities and multi-user research equipment will increase our researchers' abilities to conduct cutting-edge research, increase competitiveness for faculty and student recruitment and retention, and increase competitiveness for external research funding.

Subcommittee Activities

Conceptualizing the issues of research infrastructure at WSU

Defining research infrastructure for the purpose of this study: While the definitions of infrastructure provided above appear clear, applying these definitions to existing infrastructure is considerably more complicated, particularly when an item or unit transitions from being programmatic to university-wide.

One approach to identifying available equipment was based on cost, but this was complicated by whether cost would be calculated based on each specific equipment item or on the total cost of a cluster of equipment that serves a single purpose (and what the definition of a "purpose" is, such that a cluster would rise to the level of university infrastructure). Furthermore, should the item/cluster be included solely based on cost, even if it required significant central support for purchase or maintenance but is primarily programmatic? On the other hand, as is often the case in the social sciences and humanities, there may be elements of infrastructure that are important for the research productivity of a large diverse group of faculty, but are relatively inexpensive. Because individual units may be reluctant to underwrite the entire support for infrastructure that supports faculty from multiple units, it might be more appropriate to consider these elements as part of the general university research infrastructure despite the low cost. For these reasons, the subcommittee determined that cost could not be the only factor considered.


Steve Simasko, co-chair Research Infrastructure Subcommittee

Another approach considered was to identify equipment through WSU service centers. The subcommittee found it was not possible to simply use a list of service centers on campus, as some of these clearly are part of the university research infrastructure (e.g., the Franceschi Microscopy Imaging Center, FMIC), and others may be as simple as a shared copier. Furthermore, using already existing WSU designations, such as centers, institutes, laboratories, cores, and facilities (CILs), was also found to be problematic because these designations are inconsistently assigned across campus. While some CILs, like the FMIC, are clearly university-wide research infrastructure, others are only capable of performing one or two types of analysis used by a local group of investigators. In addition, terms like 'institute' and 'center' can describe an intellectual focus rather than an item of infrastructure (e.g., Center for the Study of Animal Well-being, CSAW) or have intellectual and infrastructure elements (e.g., Center for Reproductive Biology, CRB).

Developing a structure to categorize or 'bin' infrastructure elements for evaluation: Thus, rather than make premature and arbitrary decisions of what should be considered university research infrastructure, and in order to make the task of inventorying university infrastructure achievable, the subcommittee decided on a multi-process approach to collect information on infrastructure and then create groupings of similar types of infrastructure ('bins'). The binning approach provided the following advantages:

1. Enabled a more efficient evaluation process, since like-types of infrastructure could be analyzed in the context of what other similar elements are present on campus.
2. Reduced the problem of the sheer volume of individual items that could be considered part of university research and made the problem more tractable.
3. Avoided the necessity of making preliminary judgments regarding an item/cluster's suitability as part of infrastructure. Rather, an item/cluster could be binned and a decision could be made as to whether the item should be part of the evaluative process after a more thorough survey of research infrastructure was completed.
4. Placed the focus on the infrastructure and the services provided rather than on the college or unit housing it.

While a preliminary set of bins was developed, these are only meant to be a guide. As information is further collected, it is expected that preliminary bins will be reconfigured to better accommodate types of infrastructure.

Collection of information

Specific items of infrastructure: There were four preliminary processes by which information was collected and cross-checked.

1. Items/clusters currently listed on the Office of Research website.
2. Associate deans of research (or equivalents) for each college and unit were asked to provide a list of items generally considered part of university research infrastructure. The Research Infrastructure Subcommittee recommended that the focus be on items that had a value greater than $200,000 but less than $2 million.
3. Individual faculty members contacted subcommittee chairs to identify items that should be considered part of the research infrastructure.
4. Redundant reporting across the three lines of information sources was removed, gaps were identified, and subcommittee members pursued information to fill those gaps.

Two important conclusions were drawn from this outcome. First, it is likely that the lists, as currently compiled, are still incomplete. Second, WSU has done a poor job defining research infrastructure and keeping accurate, up-to-date records of what infrastructure is present. This conclusion directly leads to the recommendation that the University form an oversight mechanism that more adequately monitors research infrastructure.

After this preliminary data collection and items were assigned to bins, the subcommittee assigned individual subcommittee members to oversee individual bins for further investigation (see Appendix H). While not all the bins have been fully investigated, individual bin leaders called meetings of relevant faculty and center directors to collect more information about items within the bins. This process is still ongoing for some of the bins. A spreadsheet showing the bin structure and specific items with their bin association is in Appendix H.

General discussions: In addition to collecting information about specific items of infrastructure, the process also engendered numerous conversations in a variety of venues that addressed the general concept of research infrastructure. Such venues included discussions within the infrastructure subcommittee meetings, feedback from presentations after general 120-Day Study updates, discussions led by individual bin leaders, and via thoughtful emails and conversations with concerned individuals. It is from these discussions that the following conclusions and recommendations were identified.

Conclusions and Recommendations

Although the charge given to the Research Infrastructure Subcommittee asked for tiered prioritization of future investments, with actionable recommendations that identified funding opportunities, it became clear in the process of investigation that the charter needed to be adapted. This decision was based on the following:

- More time is needed to best evaluate what elements of infrastructure are the most deserving of investment. More time is also needed to align infrastructure investment to strategic goals of the university. Without finalizing the Grand Challenges and strategic planning, it was impossible to develop a tiered priority list of infrastructure investments in Challenge areas.
- University strategic goals will evolve over time, so a mechanism is needed to ensure that infrastructure investments are kept current with university strategic priorities.
- Tactical opportunities for infrastructure development can arise with relatively short time horizons. A standing infrastructure committee will allow for timely, well-informed, and strategic decision making.
- 'Infrastructure' goes beyond equipment; it also involves people. Help is needed with complicated compliance and regulatory issues. Administrative support is needed for pre- and post-grant activities. Technical support personnel are needed for sophisticated equipment and also for ensuring that clinical research is done according to field standards and to legal regulatory requirements. An ongoing mechanism is necessary to ensure personnel infrastructure resources are met adequately over time.

Thus, rather than specific, one-time tiered recommendations for investment, the subcommittee recommends that WSU establish an infrastructure oversight structure, led by a University Research Infrastructure Committee (URIC). The URIC would be able to respond to barriers identified during the 120-Day Study and propose more strategic and inclusive research infrastructure investments. Specific recommendations are provided below for this oversight structure.

Conclusion #1: An ongoing review and oversight of research infrastructure needs at WSU is needed. The University needs to more adequately define research infrastructure and monitor what is available. As a result of the decentralized approach taken to research infrastructure, WSU's current infrastructure decisions are often ad hoc and lack overall strategic focus, causing issues such as:

- Little system-wide thought given to major capital opportunities (like new buildings), missing the opportunity to identify the highest-need infrastructure elements to target in those new buildings.
- Missed opportunities to coordinate purchases that best advance the technology available for our researchers.
- Proliferation of individual centers that tend to remain isolated from each other.

- Little system-wide, multiyear strategy applied to developing research instrumentation infrastructure, resulting in missed opportunities to submit our strongest needs to projects like the M.J. Murdock Trust and the National Science Foundation's Major Research Instrumentation (MRI) grants (both limit submissions to one proposal per university).
- Short institutional memory and a tendency to have investment decisions made by somewhat random opportunity rather than through a thoughtful, highest-impact process.

Recommendations:

1.1 **Primary Recommendation: Establish a University Research Infrastructure Committee (URIC) for ongoing oversight.** The URIC should be ongoing, renewing, and have broad input from across the University. For the purposes of this document, the oversight structure will be referred to as the University Research Infrastructure Committee (URIC). The URIC would be a faculty advisory board to the provost and vice president for research to help guide and evaluate investments into new infrastructure and maintenance of existing infrastructure. Staff support for the URIC would be provided by the Office of Research. The ongoing, renewing, and broad input to the URIC would:

- Help maintain alignment of infrastructure investment with WSU strategic goals, which can be updated as goals evolve.
- Ensure that a long-term strategic focus on investment is maintained, avoiding loss of institutional memory.
- Apply consistent means of evaluation of proposed investments to ensure that the highest impact projects obtain the highest priority.
- Work with the "Bin Committees" (described in Recommendation 2.2 below) to stay current with needs across campus. This will better position the URIC to rapidly and effectively respond to tactical opportunities that arise.
- Maintain a strong communication exchange, both for broad input and to better ensure that all interests at the university are heard, and to better educate the general university community on the overall direction of strategic infrastructure investment.

While there may be considerable effort needed to establish the URIC, once established it should be less difficult to maintain. An oversight group, like the URIC, would reduce inconsistent and duplicative efforts already being made across units and provide coordinated leadership to increase efficiency.

Specific recommendations for the general structure and charges to the URIC are provided in Appendix H.

Conclusion #2: Need for more coordination between college and campus support for research infrastructure that serves multiple programs. Access to information about infrastructure capabilities is fragmented and often outdated. This is especially frustrating when recruiting new faculty members who inquire about the availability of some central service or instrumentation and it is difficult to find if such services are available on campus.

Recommendations:

2.1 **Refine and maintain an infrastructure organization system in which infrastructure is grouped into like types and functions (i.e., 'binning' structure).** This bin-style cat-

egorization should be maintained as a fundamental and fluid framework for reviewing infrastructure. The current structure of the focused infrastructure groups should be used as a starting point (see Appendix H), but the bins should be fluid to allow focus groups to merge, be abolished, or be created as needed.

2.2 **Create bin committees to represent and advocate for the infrastructure needs in each infrastructure bin.** These focused infrastructure groups would be made up of faculty users as well as center directors and should represent the units and colleges served by each bin's infrastructure. Membership of bin committees should be multiyear, fixed-term appointments to ensure institutional memory while encouraging broad faculty involvement. See Appendix H for specific recommendations for the general structure and responsibilities of the bin committees.

2.3 **Create and maintain a webpage on the Office of Research website.** This page should list available instrumentation and contact information to encourage shared resources across colleges and disciplines. This webpage should be updated by the Office of Research staff working closely with the bin committee chairs.

Conclusion #3: There is a need for investment in smaller infrastructure items that serve multiple colleges and units. These items could be unique new items, an addition to an existing item/cluster, or a needed upgrade or repair on an existing item. There is often no mechanism to obtain funding for relatively small purchases (<$200,000) that will be multi-user resources. Moreover, some items/clusters are limited by the lack of maintenance of existing equipment (also a relatively small expense). The latter case usually results from the inadequacies of funds

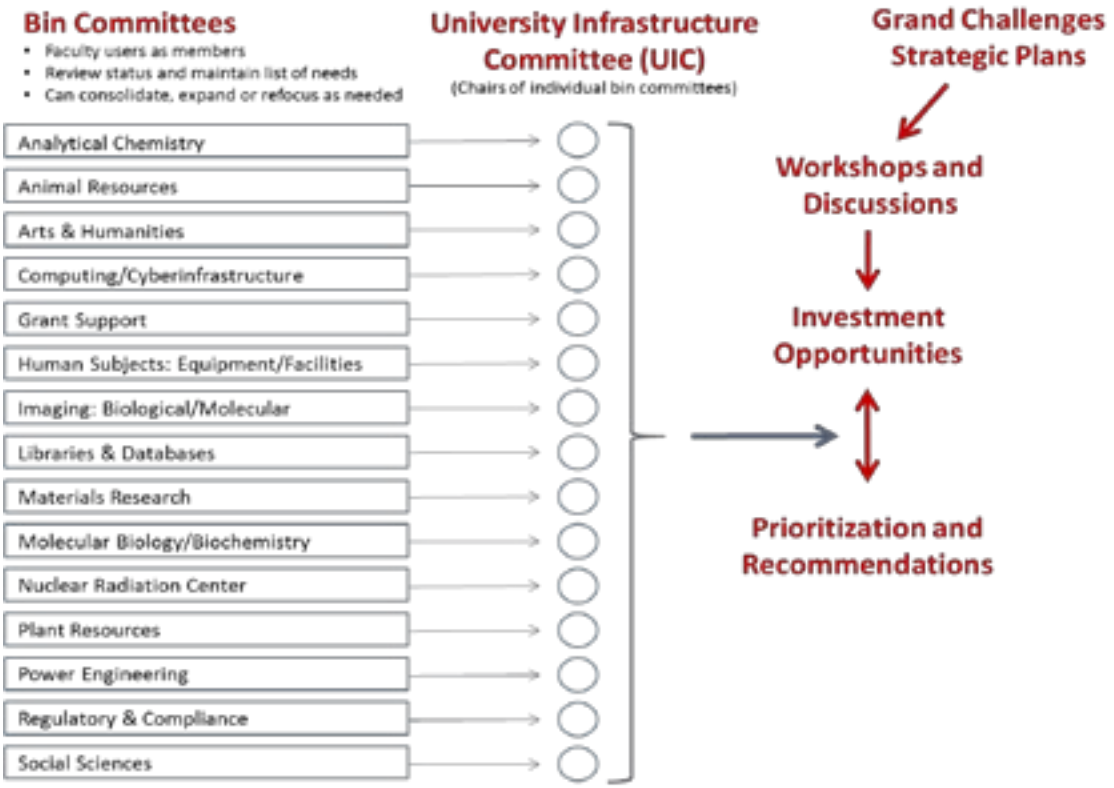


Figure 13: Recommended University Infrastructure Organization

in the service account to cover the maintenance, while the college/unit heads are reluctant to cover these costs because users are from other colleges or units.

Recommendations:

3.1 Establish a Small Infrastructure Investment Program (SIIP) to support smaller infrastructure needs. Projects would be solicited through quarterly calls for proposals. The SIIP program would be administered by the URIC and coordinated by the Office of Research (Figure 13). Specific details of the proposed Small Infrastructure Investment Program (SIIP) are provided in Appendix H.

Conclusion #4: WSU researchers need more help with research administrative tasks and with technical research instrumentation tasks. Severe university-wide budget cuts over the past five years reduced the number of research administrative support personnel at WSU. At the same time research expenditures have continued to rise each year. Faculty reported the need for more help with existing compliance and regulatory issues and particularly mentioned the need to develop WSU capacity for research administrative support in human subject research (clinical, biomedical, and social sciences—large areas that are currently underserved). Units also reported inconsistent degrees of help available through units both for proposal development and grant acceptance and reporting activities. Limitations in these areas affect the success rate and types of grants that faculty can apply for.

Recommendations:

4.1 The University Research Infrastructure Committee (URIC) and the bin committees should work together to further:

a. develop a comprehensive definition of university infrastructure that incorporates personnel and 'soft-support' issues.

b. evaluate feedback from faculty researchers around pre-award and post-award activities and explore solutions that would provide more responsive support services to WSU researchers in all colleges and on all campuses.

c. evaluate multi-user technical personnel needs to remove administrative burden from the principal investigators (PIs) if they choose to share their instrumentation.

FACULTY AND STUDENT RECRUITMENT, ENGAGEMENT, AND PRODUCTIVITY

Guiding Principles

"The Three Pillars." According to the National Research Council report *Furthering America's Research Enterprise* (2014), the three pillars of a world-class research institution are:

- a talented and interconnected workforce;
- adequate and dependable resources; and
- first-rate basic research in all major areas of science.

These three pillars should be our mantra as we strive to expand and develop the research enterprise of WSU. Indeed, the ultimate impact and success of WSU's research efforts largely depends on coordinated investment and management to support and promote each of the pillars.

1

A talented and interconnected workforce involves recruitment and retention of excellent faculty as well as talented and creative undergraduates, graduate, and postdoctoral-level trainees. This requires good communication and coordinated efforts between colleges to share resources and experience, provide mentorship, and move forward with a common vision of what success means for our institution.

2

Adequate and dependable resources are essential to a functioning research enterprise. Resources include facilities and instrumentation, but also adequate and dependable funds, administrative support and technical staff, training, mentorship, and organizational systems that support research. Stability and availability of appropriate infrastructure that sustains all disciplines at WSU are essential for faculty and trainee retention, engagement, productivity, and development.

3

World-class basic research is the creative engine that facilitates knowledge generation. It characterizes excellence and high-intellectual merit within the university and is shared through peer-reviewed publications. It is augmented by intentional efforts to break down silos. Novel scientific discovery and artistic creation rely on insights from many areas. The exchange of ideas interrelates systems making connections that lead to new ideas that advance both disciplinary and interdisciplinary scholarship. Finally, cultivating world-class fundamental research attracts outstanding scholars and students from around the world.

Subcommittee Activities

The goals of the Faculty and Student Recruitment, Engagement, and Productivity (FSREP) subcommittee were to develop strategies for enhancing professional development of WSU faculty and trainees in key areas to advance WSU research, scholarly, and creative activities. These areas include recruitment and retention issues, mentoring and training, and recognition. The subcommittee recognized the value of a number of AAU metrics as an appropriate guide for assessment of university excellence. Specifically, the Subcommittee set out to develop recommendations aimed at increasing faculty and trainee recognition and productivity as measured by AAU Phase 1 and Phase 2 indicators (Appendix C), while also considering broader indicators and issues unique to WSU.

The subcommittee's goals are aligned with the recently released WSU Strategic Plan to create an environment for "exceptional research, innovation and creativity," particularly emphasizing "Goal 1: Increase productivity in research, innovation and creativity to address the grand challenges and opportunities of the future" and "Goal 2: Advance WSU's reach both nationally and internationally in existing and emerging areas of achievement."

In order to understand WSU's current strategies for recruitment, retention, and professional development of faculty and trainees, the chairs and members of the subcommittee took the following measures:

1. Ensured subcommittee membership represented a broad range of disciplines and campuses.
2. Included new and long-standing chairs and unit directors as members of the subcommittee in order to provide perspective on current practices in faculty and trainee recruitment and development issues.
3. Created an internal survey issued to the associate deans of research.
4. Interviewed Provost Bernardo to learn more about his proposals for faculty recruitment and the granting of promotion and tenure.

Shelley McGuire, member of the Faculty and Student Recruitment, Engagement, and Productivity Subcommittee

5. The co-chairs interviewed Shelley Pressley, director of the Office of Undergraduate Research, to learn more about efforts to encourage undergraduate student participation in research across all of our campuses.

The subcommittee evaluated internal survey responses and reviewed information accrued during interviews and discussions. During the course of their deliberations, the subcommittee members developed a broad list of recommendations for ways to improve recruitment, productivity, and retention of faculty (a focus of their efforts in October 2014) and trainees (a focus in November 2014). Each recommendation was reviewed and prioritized. A final list of key recommendations was discussed and refined by the subcommittee and co-chairs during November and December 2014. The recommendations were grouped into three categories: faculty recruitment; faculty engagement, productivity, and retention; and enhancing trainee recruitment, productivity, and engagement. Conclusions below represent groupings of the key recommendations proposed by the subcommittee.

Conclusions and Recommendations

Faculty Recruitment

Conclusion #1: Need for competitive salary and start-up packages for new WSU faculty hires as well as adequate planning of space and staff to support faculty expansion. In most disciplines, WSU faculty salaries lag behind peer institutions (see spring 2014 OSU Faculty Salary Peer Comparison and AAUP Salary Comparison Charts in Appendix I). While no data were available regarding start-up comparisons, the subcommittee found, through interviews and discussions, that adequate start-up packages are very important for new faculty to initiate their research programs. The subcommittee also found cases of newly hired faculty whose research was delayed due to lack of planning for research space and equipment requirements.

Recommendations:

1.1 **Unit chairs/directors should consult the OSU Faculty Salary Survey** or the AAUP Annual Report on the Economic Status of the Profession or other national salary data to determine to what extent proposed hiring salaries are at or near the national average within discipline and within rank. These data should be referenced in the hiring proposal. Even if we are not able to address all of the current salary compression/inversion problems, future hiring at competitive salaries is crucial for recruiting the best faculty.

1.2 **Ensure that startup packages include sufficient funding** to sustain a faculty member's research program and engagement with the discipline for more than two years. While in the sciences, a startup package typically meets the needs for equipment/supplies/personnel for the first two years and to some extent beyond, in the arts and the humanities faculty startup funds are primarily needed for travel to conferences, to support performances and exhibitions, and to conduct archival research. Although the startup costs for faculty recruits in the arts and the humanities are comparatively lower than those in the science, technology, engineering, and math (STEM) disciplines, arts and humanities faculty have significantly fewer opportunities to secure extramural grants and contracts. Thus, it is important to provide funds to arts and humanities recruits over a longer period of time than what is typical for STEM startups. The vice president for research and the dean for the College of Arts and Sciences are encouraged to consult with arts and humanities unit chairs and directors to discuss how travel/exhibit/performance support for faculty in these units can be sustained over extended periods of time (i.e., for more than two years).

1.3 **Hiring proposals should articulate space needs and support staff** (office and technical) requirements to support faculty expansion. For example, "need X new support staff (of what type?) and X amount of space (of what type?) for X faculty hired." Increased administrative and space burden associated with new hires must be integrated into all hiring plans.

1.4 **Articulate university, college, and unit space policies.** Some colleges do not have policies in place, particularly with regard to research space that can and should be reallocated according to needs and productivity.

Conclusion #2: Need to build area strengths by supporting multiyear and cluster hiring plans within and across units. Failure to enable and authorize hiring plans further than one year out limits strategic planning and encourages a focus on immediate replacement rather than the longer-term development of innovative research concentrations. It also limits the capacity of units to develop effective interdisciplinary hiring and research efforts. This became apparent from the discussions of subcommittee members, many of whom were chairs and/or directors with extensive experience in hiring at all faculty levels.

Recommendations:

2.1 **Guarantee that units can re-open failed searches** the following year to encourage unit chairs/directors to hire only the best-qualified candidates rather than settling for "second best."

2.2 **Allow chairs/directors to hire "ahead of retirements"** by at least one year, when a strong case is made to maintain an area of strength within a department/unit. This will facilitate more seamless research/teaching transitions so that those planning to retire do not feel compelled to delay retirement in an effort to retain their faculty line.

2.3 **Search committees should include faculty from relevant disciplines outside of the primary hiring unit/college, in cases of interdisciplinary and cluster hires**, to increase the likelihood of a high-quality hire who will collaborate effectively across units/colleges and to help decrease the "siloed" culture at WSU.

2.4 **Interdisciplinary hires should receive offer letters plus role statements and mentoring that provide clear guidance** and expectations regarding their interdisciplinary contributions in research, teaching, and/or service.

Conclusion #3: Need to target a broad range of research experience levels as well as expand diversity to increase the visibility and vitality of research at WSU. Calculated hiring of faculty, at all levels, ensures the depth of experience needed in departments. Faculty with the rank of associate and full professor tend to take on broader responsibilities in departments, including more service and administration. They also bring experience and connections with which they can effectively mentor graduate students and early career faculty.

Recommendations:

3.1 **When strength in a given area of expertise needs to be established quickly, target the hiring of associate and full professors.** Across the nation, associate professors are experiencing diminished earning power (compared to ranks above and below them). This marks them as an ideal target group to recruit to WSU. Moreover, recruiting high-caliber mid-level faculty will increase WSU's research portfolio and experience level.

The potentially higher costs associated with hiring these more senior leaders will likely be offset by increasing WSU research grant income, improving publication impact and bestowing of prestigious faculty awards (AAU metrics).

3.2 Seek more endowed professorships in all areas of research, scholarship, and creative activity. Endowed professorships are critical to recruiting and retaining productive and scholarly senior-level faculty. Endowed positions provide researchers with the academic freedom to push the boundaries of their fields and serve as an important recruitment tool for talented scholars. WSU must actively encourage the creation of endowed professorships by individuals as well as corporations.

3.3 Increase the likelihood of more diverse hires by establishing mandatory search committee training. Searches provide WSU an opportunity to demonstrate its commitment to diversity and equal opportunity by creating a search environment that respects the rights of all persons and values the variety of characteristics that make individuals unique. Adding mandatory training that addresses best practices for equal opportunity hiring will decrease any potential unconscious bias in faculty hiring. See the University of Virginia Office of Equal Opportunity Programs search committee training program (virginia.edu/eop/searchcommittee.html) and WSU ADVANCE program Faculty Recruitment Resources (advance.wsu.edu/facultyrecruitmentresources).

Faculty Engagement, Productivity, and Retention

Academic reputation and the caliber of the research an institution generates hinge on a university's ability to retain nationally competitive faculty. Because of the recent recession, federal research funding stagnation, and state-wide cuts to university budgets, it is predicted that we will lose funded faculty to competitor institutions. Moreover, junior faculty who are unable to obtain external funding will fail to secure tenure. In order to retain funded faculty, we must ensure that we provide them with the appropriate support, access to state-of-the-art infrastructure, top quality trainees, skilled administrative staff, and competitive salary compensation (see Appendix I for comparison data). We must also provide junior faculty with mentoring and training to ensure that they submit competitive applications for funding and develop leadership skills. To maximize engagement, faculty need to feel part of the larger community and confident that they will be provided with the necessary tools for their success. This will require that the leadership of units and colleges foster a nurturing environment with individualized, achievable sets of goals outlined at yearly reviews.

Conclusion #4: Need to develop plans to maintain and regularly update research/creative activity and instructional facilities, including information technology (IT) at college and campus levels. Lack of investment in basic infrastructure drives discontent, devalues specific programs, and pushes productive faculty to seek positions at institutions where it is provided. This includes not only state-of-the-art instrumentation, but sufficient technical support staff with operational expertise. See infrastructure subcommittee report for responsive recommendations.

Conclusion #5: Growing WSU's research portfolio requires increased staff support for pre- and post-award research activities, including extramural grant and fellowship application development, submission, and research assurances. Decreasing federal research dollars has resulted in heavy competition for limited funds; most investigators have to submit multiple times to multiple agencies in their attempt to secure research funding. This has increased the burden on unit and institution administrative staff involved with grant submission management.

The subcommittee also found that faculty are experiencing increasing delays in receipt of IRB approvals, and many faculty who conduct human research face significant bureaucratic roadblocks in the daily conduct of their work (e.g., paying research participants). Such delays and roadblocks must be eliminated to accommodate growing grant activity from both faculty and trainees.

Recommendations:

5.1 **Increase Office of Grant and Research Development (OGRD) staffing and ensure appropriate training and reasonable workload** to facilitate proposal submission and improve grants management.

5.2 **Increase sponsored research support staff at the college level.** Different colleges have different levels of administrative staffing with some staff having little or no experience in proposal submission and grant management. In some units, there is a constant flux of staff since those with any experience are recruited away. Moreover, units have tried different approaches to accomplish more with less due to state cutbacks, with varying success. There is also hesitation on the part of Human Resources to reward staff who show superior initiative. Moreover, salary levels for senior administrative staff are quite low. This inhibits WSU's ability to recruit individuals with expertise from outside the immediate Pullman area. Finally, limitations exist in some colleges' ability to get help with pre-award activities (finding funding, proposal writing training, peer reviews of proposals prior to submission, assistance on proposal writing for researchers whose first language is not English) and on post-award activities (grant management, reporting and compliance).

5.3 **Increase staffing in Research Assurances** (IRB, IACUC, IBC, COI, RSO) and training of new staff. Also, reinstitute a process separation between medical/biological research from attitudinal/behavioral research, since the later requires comparably small and standard procedures that can be processed more quickly.

5.4 **Streamline financial procedures so that research participants can be compensated in a timely manner**. At present, it is extremely cumbersome to provide remuneration to human research participants (particularly when remuneration is greater than $10 or must occur at multiple intervals during a study). In some cases, faculty have been required to pay participants out-of-pocket and then wait for reimbursement, even when grant or start-up funds are available. These roadblocks must be eliminated to enable faculty researchers to optimize productivity, to ensure that participants continue to volunteer for studies conducted by WSU researchers, and to ensure that WSU's research reputation is not tarnished in the eyes of the public. For an example of a system that appears to work efficiently, see the University of Washington (f2.washington.edu/fm/ps/how-to-pay/research-subjects/department-responsibilities).

Conclusion #6: Data collection at WSU is sub-optimal and needs improvement. Many of the metrics required by the subcommittee to analyze faculty and student engagement and productivity were unavailable or the data was inaccurate.

Recommendations:

6.1 **Implement user-friendly, effective, institution-wide information systems for tracking faculty and trainee activity to enhance opportunities for collaboration and improve program coordination and reporting efficiency.** The subcommittee was provided with data indicating that more than 90% of the faculty report activities via WORQs. Yet chair and director subcommittee members commented that their own faculty

disliked WORQs and, in some instances, failed to complete WORQs, suggesting that there were inconsistencies in reporting data acquisition. The consensus was that WORQs was not user-friendly and should be replaced. The subcommittee recommends:

a. Determining what information collection systems other universities are using successfully. Examples might include: (1) Academic Analytics (used by some AAU schools, but expensive); (2) Elements (recently adopted by VA Tech) (symplectic.co.uk/products/elements).

b. Form a subcommittee that includes faculty from a diversity of departments, from STEM to arts and humanities, to vet new software and to ensure that the new product will function effectively for all disciplines at WSU.

6.2 Improve OGRD and Sponsored Program Services (SPS) grant-tracking system so that PI/co-I contributions (e.g., eREX allocation of credit) can be accurately determined. Systems should be improved to eliminate inaccurate, typically over reporting, of research expenditures by units/colleges due to "double-counting" on collaborative projects (i.e., multiple units/faculty claiming the total expenditure on a grant instead of dividing it up by percentage of effort).

Conclusion #7: WSU should improve its standards of tenure and promotion and develop workload flexibility guidelines and additional remuneration programs, especially at the full professor level, to encourage and sustain scholarly and creative productivity across the entirety of a faculty member's career.

Recommendations:

7.1 Address unit concerns regarding loss of a faculty line by guaranteeing a replacement hire, should a faculty member fail to obtain tenure or be recruited elsewhere (assuming that a strong case can be made to retain expertise in that area).

7.2 Allow highly productive faculty to buy out of at least some teaching to pursue funded research/scholarship/creative activity (this is already done in many units, but not all).

7.3 Compensate productive faculty appropriately (e.g., through salary increases or F&A returns).

7.4 Consider early retirement packages for faculty who are no longer effective in teaching and research but resist retiring.

Conclusion #8: More financial support for faculty development is needed.

Recommendations:

8.1 Expand faculty seed grant opportunities, particularly for collaborative and interdisciplinary work. National Institutes of Health (NIH) and other research grant awarding bodies now emphasize that they wish to support research encompassing multiple disciplines. To be competitive we need to build research teams across units and colleges. Thus, we recommend the establishment of a VPR-sponsored program that encourages and funds interdisciplinary research effort.

8.2 Increase faculty travel support, particularly in areas with lesser access to grants and contracts (e.g., arts and humanities). Funded STEM researchers have access to travel monies from their grants, while arts and humanities faculty rarely have such funds. To ensure that all faculty have the opportunity to demonstrate their successes on the

national and international stage, WSU needs to provide travel funding dedicated to those who have limited access to such monies.

8.3 **Increase doctoral student stipends at least to the national average within each discipline** (and determine strategies to guarantee four to five years of funding, assuming satisfactory progress), so that faculty can compete for, train, and graduate on-time the best students possible: use national doctoral student salary survey data to adjust stipends where necessary, use NIH recommended salaries for postdoctoral trainees in STEM units, provide additional scholarships for graduate students in addition to those we provide for undergraduates in order to grow our training enterprise, and encourage endowment of our graduate training programs.

8.4 **Develop campus-level funding to increase visitation of prominent scholars to WSU** (e.g., the VPR Distinguished Lecture Series). Send out annual call for units to invite prestigious scientists, writers, musicians, and artists to WSU. Visits should be jointly supported by the vice president for research, colleges, and units. Individuals coordinating these visits should be dedicated to showcasing the leaders in their respective fields. During visits, WSU's star faculty and star trainees should be introduced to guest speakers to increase awareness of the high level and quality of scholarship that is being undertaken here at WSU.

8.5 **Seek more endowed professorships,** which can be used to retain faculty in some cases, as well as endowed doctoral fellowships, which enhance faculty recruitment and retention of the best doctoral-level trainees. In the STEM disciplines there are only limited numbers of externally funded grants that support trainee stipends. Faculty should be encouraged to seek grants for trainee funds by giving them credit on annual reviews for such efforts. Development offices across campus should also urge potential donors to support graduate and postdoctoral trainee stipends and/or their research programs.

Conclusion #9: Create an environment where faculty are supported and encouraged by leadership and each other.

Recommendations:

9.1 **Hire, train, and support unit and college leaders** who demonstrate balance: the ability to inspire, promote, and support faculty as well as expertise in research, scholarship, and creative activity.

a. Refine leadership training and mentoring programs at WSU. We need to learn from our competitors and provide mentoring and training to all levels of our faculty if they are to be competitive for grants and to receive invitations to present their research and scholarly products at meetings, exhibitions, and shows (for example, see pubapps.vcu.edu/gehli/vculeadership.html and provost.vt.edu/faculty_affairs/leadership_development/leadership_development.html).

b. WSU mentoring programs should include creation of subcommittees for all junior faculty. These subcommittees should be composed of current grant awardees and individuals with extensive grant proposal reviewing expertise, training insight, or management expertise.

c. Continue regular provost–unit director meetings to encourage "360" leadership and communication at WSU. Regular interactions of the leadership within each college as well as across colleges will allow us to coordinate hiring and expand successful

approaches in engagement and communication. These interactions are essential if we want the faculty to 'buy in' to institutional evolution.

d. Support recruitment of leadership (at chair/director, dean levels) from outside WSU to broaden perspective. In particular, seek demonstrated leadership in multi/interdisciplinary work. Hiring external top-flight leadership helps put WSU on the map and will assist us at all levels of recruitment. Internal appointees certainly know how the institution works and are appropriate in many instances. However, new blood brings diverse experience and opportunities to learn how others do things.

9.2 **Cultivate and promote promising faculty for prestigious external awards.** Develop a university committee composed of current National Academy of Sciences and other prestigious awardees, to solicit recommendations from units regarding how to promote faculty externally and to provide additional mentoring to these promising faculty. See Outreach, Engagement, and Economic Development Subcommittee report for specific recommendations.

9.3 **Recognize/reward and support faculty mentorship of trainees (including undergraduates).** It is important to reward faculty for their training activities, given that trainees' performance directly affects faculty success. More specifically:

a. Reinstate annual university mentor awards at graduate and undergraduate levels and encourage more colleges to offer these awards.

b. Request explicit information regarding the number of mentees (and awards/grants/fellowships that mentees win) on faculty annual reviews.

c. Provide seed funding for training grant application preparation and/or administrative help to complete such proposals. There are few training grants at WSU and faculty need both financial and administrative support to submit competitive proposals.

9.4 **Recognize/reward faculty engagement in interdisciplinary and collaborative work** across WSU units and campuses and with external collaborators. As mentioned before, many national funding agencies now emphasize multidisciplinary research. We recommend encouraging WSU faculty to become involved in such activities by undertaking the following:

a. Add explicit consideration in annual reviews of a faculty member's contribution to the entire WSU enterprise, including interdisciplinary/collaborative work in research, teaching, and service.

b. Stipulate workload effort for co-authored publications and other collaborative work (or brief descriptions of each co-author's role/contribution) on annual, third-year, and tenure and promotion reviews.

9.5 **Develop metrics in arts and humanities fields that can be used to assess impact of scholarly and creative work** when traditional measures used in STEM fields are not appropriate. We recommend establishing a taskforce composed of senior leadership in arts and humanities who will devise modified faculty review forms to ensure fairness and equity in the review process relative to the STEM disciplines.

Enhancing Trainee Recruitment, Productivity, and Engagement

Trainees at the undergraduate, graduate, and postdoctoral levels are essential to our research enterprise. Thus, we must attract the brightest and the best: they not only help to expand and develop our current scholarly efforts but, if they have a positive experience, they are the best advertisement for the recruitment of our future trainees.

Conclusion #10: Expanded cross-disciplinary training programs are needed to better prepare our trainees for life after WSU.

Recommendations:

10.1 Develop certificate and joint programs linking STEM and non-STEM disciplines to enhance or complement primary training emphasis, to enhance the public impact of WSU research, and to produce more marketable graduates. Examples could include STEM and technical writing, STEM and communications, STEM and digital technology, and STEM and business (marketing, finance).

10.2 Provide university funds to encourage development and maintenance of interdisciplinary programs (and to encourage training grant submissions in emerging interdisciplinary fields).

10.3 Streamline WSU curricular development and revision process so that new programs can be initiated more quickly and existing programs can adjust more nimbly in response to changing needs.

10.4 Build relationships between corporations and the University to provide more opportunities for the professional development of WSU trainees and to inspire innovation in research. These relationships can be used as a selling point in our efforts to recruit the best and brightest trainees since we will be in a better position to provide them with a conduit to their next job.

Conclusion #11: A centralized approach is needed to better coordinate graduate and postdoctoral programs across the university and to provide cross- and extra-disciplinary professional development. Some cross- and extra-disciplinary training opportunities are already available, but they are somewhat scattered and there is a general lack of faculty awareness of such efforts, which impedes students benefiting from these resources.

Recommendations:

11.1 Create a comprehensive, centralized WSU Career Development Center for graduate students and postdoctoral fellows. This center should provide specialized information and training regarding non-academic careers, leadership skills, oral/written communication skills, and award, grant proposal, and fellowship application preparation. The center will link graduate and postdoctoral students across campus and serve as a campus-wide resource on graduate and postdoctoral affairs. A center provides a high visibility, consolidated resource on campus, and is also immediately value-added in regard to training grants, as it indicates the importance WSU places on graduate and postdoctoral training and the financial commitment already made. For example, see postdoc.harvard.edu.

Conclusion #12: Need to increase the number of training grant proposal submissions. Research grant dollars do not always provide enough support for trainee stipends. Training grants supporting the research of graduate students and postdoctoral fellows are rare at WSU.

These grants not only provide valuable monies with which to support and expand our training programs—and thereby our research enterprise—but also are an external indicator of the quality of training that we offer. Faculty know this, and if we want to recruit mid-career faculty, we need to increase external support for their trainees.

Recommendations:

12.1 Develop a WSU matching fund to motivate submission of training grant proposals by units.

12.2 Provide staff assistance to faculty for preparing training grant applications. Each proposal requires extensive data acquisition, including such elements as the numbers of publications each of our trainees generate and what position each trainee takes after leaving WSU. The accumulation of these data is a significant burden on the faculty who agree to submit such proposals. Substantial data collection/tracking can be accomplished more effectively by skilled administrative staff.

12.3 Document training grant proposal submission/participation on faculty annual reviews.

Conclusion #13: Increase graduate student training by tenure-line faculty on regional campuses. Faculty need students to sustain and expand their research programs. This is the case on all WSU campuses. Regional campus faculty have less access to graduate students since they have no independent programs and depend on those in Pullman for students.

Recommendations:

13.1 Identify the best models for doctoral program delivery on the urban campuses and extend to other programs (e.g., some programs are using online course TA-ships to support students working with faculty at urban campuses).

13.2 Expand AMS capability within departments and colleges and encourage alternative forms of course delivery (e.g., hybrid courses) so that more graduate courses can be shared across campuses.

13.3 Consider using revenue generated from graduate courses taught at urban campuses to fund more graduate TA-ships to cover stipends of students who are located at urban campuses.

13.4 Encourage development of targeted graduate programs that are uniquely suited to a particular urban campus context and community.

Conclusion #14: Develop an accurate database of graduate and undergraduate student productivity in research, scholarship, and creative activity. Such a database is essential for training grant applications which require such information. These data are also useful as a recruitment tool when we interview potential future trainees.

Recommendations:

14.1 Insert specific questions on faculty annual reviews to gather data on: (1) number of graduate and undergraduate students mentored (whether paid, working for course credit, or volunteering); (2) research publications, scholarship, and creative works produced by trainees; and (3) awards or honors earned by trainees.

14.2 Gather accurate data on undergraduate participation. If it's less than 25%, develop strategies to increase it to 25% (AAU peers are around 20-25%), such as increasing

the number of scholarships and grants available to support undergraduate research, scholarship, and creative activity. We may also need to limit the number of intramural grants that a single undergraduate can obtain, to ensure that funds are distributed more broadly.

Conclusion #15: Increase recruitment of high-quality undergraduate, graduate, and postdoctoral underrepresented minorities (URM) as well as high-quality non-URMs. We must strive to diversify our trainees and make sure that we recruit the best of the best. This is consistent with the overall goals of WSU and our state. Subcommittee members reported examples of local (Idaho) National Merit Scholars who were not actively recruited by WSU.

Recommendations:

15.1 Target recruitment of the best students from high-quality regional colleges (e.g., Gonzaga, Lewis & Clark, Evergreen); recommend that the Graduate School contact each department/school to determine what feeder schools have the most potential in each discipline.

15.2 Attempt to recruit every regional National Merit Scholar.

15.3 Develop student-friendly technological recruitment strategies (e.g., weekly text messaging, Facebook) used by AAU schools to appeal to the current generation of high school and college students.

Conclusion #16: We need to use our limited research and training funds to support trainees who will pursue top notch research. The subcommittee learned that TA/RA funds are sometimes used to support students pursuing terminal master's degrees, even when the master's degree is not the terminal degree in the discipline.

Recommendations:

16.1 Reserve TA/RA support primarily for doctoral students (or master's degree students with doctoral potential, or master's students in disciplines in which the master's is the terminal degree).

Conclusion #17: Develop an accurate database of graduate student and postdoctoral employment post-WSU. In addition to the need for such data for training grant proposals, these data are also a valuable resource for researchers who are interested in training outcomes. While the subcommittee recognized that no comprehensive system yet exists, any system-wide approach at WSU would improve the quantity and quality of currently available data (made up of ad hoc collection attempts by a few faculty and departments). Studies offered by the National Science Foundation's Early Career Doctorates Survey and the National Association of Colleges and Employers First-Destination Survey Task Force should be considered. For a discussion of this issue on a national scale, see insidehighered.com/advice/2014/10/27/essay-importance-tracking-phd-career-paths.

Recommendations:

17.1 Initiate exit surveys for graduate students and postdocs in all colleges.

17.2 Initiate a graduate degree tracking system to obtain ongoing career outcomes data. Consider data mining and social media as options for low-cost, low-burden strategies.

OUTREACH, ENGAGEMENT, AND ECONOMIC DEVELOPMENT

Guiding Principles

Value of fundamental and applied research: As a land-grant institution, with a culture and founding mission to advance, extend, and apply knowledge, WSU is well-positioned to respond to society's needs for both basic and applied arts and sciences. Recognizing that basic research is the underlying platform on which all innovation is built, WSU's success will be inextricably linked to our ability to support broad, creative exploration while also encouraging practical applications of discoveries to improve the quality of life.

Role of land-grant universities in economic development: The United States federal and state governments have supported scientific research for the benefit of society since near the time of the first land-grant institutions. Research done in land-grant universities has led to innovations that have changed the way we live, enabling prosperity, security, and a high quality of life. While land-grant activities at WSU originally focused on agriculture and engineering, there are many opportunities for the university to respond to a changing society in a broader capacity. With growing global competition, U.S. industry is conducting a smaller share of their own basic research and increasingly turning to universities to partner in the translation of basic research to innovation and the creation of new technologies, research collaborations, and market efficiencies. In addition, both state and federal governments are encouraging universities to work with the private sector by, increasingly, requiring industry partnerships and matching funds on university grants. This is particularly true of economic development focused grants.

Importance of communicating research to the public: WSU, known for strong basic and applied research, is closer to the marketplace than it has ever been. Because of that, public perception of WSU is extremely important. Our ability to communicate the research done at WSU and its relevance affects our ability to partner with industry and government. It affects the freedom we have to do our work, the funding of research, and the policies that shape the playing field in which we operate. It is not enough for WSU researchers to do excellent research; we must communicate that work in a way that translates its potential and importance to the broader public. As a land-grant institution, this is a foundational core value of the WSU. WSU averaged one well-publicized research news story per week in 2014. WSU research news has appeared in virtually every major news outlet and has the potential to reach billions of people. However, room remains for improvement.

University-wide excellence is essential to effective outreach, engagement, and economic development activities. A culture that inspires the pursuit of excellence in a way that transcends policies and practice requires:

- Strong commitment and engagement from senior-level leadership to articulate a clear vision for WSU and to pursue that vision with strategic hiring and intentional steps to retain its excellent faculty.

- Coordinated approach from administration and staff to ensure strong support to facilitate research excellence. It requires dedication from the faculty to create a culture of collaboration, of support for each other, of mentorship, and of idea exchange.
- University-wide effort of faculty to look for and share the significance of the faculty's work, not only with students but also with the community, affecting policy, improving society, and feeding innovation into the economy.
- Institution-wide effort to pull a traditionally highly-decentralized organization together to accomplish common goals of both knowledge generation and knowledge dissemination, and to effectively communicate WSU research and impact both within academia and to the public in general.

Subcommittee Activities

This subcommittee sought to examine WSU's engagement and visibility within the state of Washington and the existing structures within the University to take a strategic approach to encouraging a culture of innovation, engaging our community and promoting our strengths to all our stakeholders.

To understand WSU's current strengths and identify potential barriers to maximizing our outreach, engagement, and economic development efforts, we took the following approach:

- Analyzed metrics currently used to assess outreach, engagement, and economic development activities (see AAU / APLU Membership Metrics – Appendix C) at WSU compared with peer institutions.
- Analyzed traits of peer institutions who are well engaged.
- Interviewed National Academies members (Anjan Bose, Guy Palmer, and Norm Scott of Cornell University).
- Interviewed faculty members who have been successful in obtaining large research grants.
- Created an internal survey issued to the associate deans of research.
- Discussed stories of successful stakeholder outreach and engagement.
- Interviewed personnel in WSU departments engaged in outreach, engagement, and economic development activities (WSU Extension, WSU Foundation, Corporate and Foundation Relations, University Communications, and Economic Development).

WSU research and development (R&D) expenditures and prestigious faculty award metrics, though in the lower range, fall within the metrics of aspirational AAU institutions (between Iowa State and Purdue). Other metrics, including doctoral students per tenure/tenure-track faculty, number of articles (Scopus) per tenure/tenure-track faculty, etc., need to be improved (see Table 3).

The subcommittee members evaluated internal survey responses in the context of information gained from interviews. The subcommittee members were divided into sub-teams and each sub-team focused on analysis of the information submitted by one to three colleges and/or units. Each sub-team was asked to analyze the strengths, identify possible gaps, and summarize their recommendations for the rest of the subcommittee (see Appendix J for college analysis reports). Summaries of college-specific strengths and barriers were then discussed with the larger subcommittee over the course of several meetings. The recommendations below were drawn from those discussions and represent the key points which the subcommittee felt could be strengthened across the colleges to facilitate improved outreach, engagement, and economic development at WSU.

Conclusions and Recommendations

Conclusion #1: Need to expand efforts to recruit excellent faculty who are well-aligned with WSU research goals, mission, and purpose, and to retain excellent faculty by creating an intellectually rich, collaborative, and supportive environment. The comparison of WSU AAU metrics with our AAU aspirational peers (Table 3) and discussions with our current National Academies members revealed areas of future strategic focus for WSU. These include increasing WSU's presence and participation in the National Academies and other nationally visible, policy-affecting roles, improving graduation rates at the doctoral level, and growing R&D expenditures. All of these findings led to the conclusion that recruiting and retaining excellent faculty is the best way to accomplish these goals.

The visibility and impact of WSU's research enterprise is built on the outstanding research, scholarly, and creative activity done by WSU faculty. Recruitment should be viewed as an ongoing effort that includes proactive retention of productive and established faculty. Efforts to recognize, invest in, mentor, award, and support current faculty in disciplinary and multidisciplinary research efforts need to be expanded. The subcommittee recognized that efforts have been made to strategically hire and retain strong and capable faculty who are well-aligned with WSU research goals across various units. Most of WSU's colleges and departments have multiyear hiring plans and there are several examples of successful multi-college cluster hires (e.g., alcohol and drug addiction research across campus). The results were encouraging and these efforts should continue with the recommendations that follow.

Latest Available Data: Peer Comparison of AAU and other Metrics

Total R&D Expenditures (2013)	$141,082,000	$266,596,000	$595,739,000	$743,487,000	$820,015,000	$1,192,513,000	$236,423,000
Total R&D Exp./T-TT Faculty (2013)	$369,186 : 1	$213,448 : 1	$161,492 : 1	$415,042 : 1	$479,541 : 1	$801,959 : 1	$194,427 : 1
Fed R&D Expenditures (2013)	$134,329,000	$121,993,000	$271,504,000	$468,798,000	$314,104,000	$928,193,000	$111,510,000
Fed R&D Exp/T-TT Fact. (2013)	$145,378 : 1	$97,673 : 1	$164,748 : 1	$274,311 : 1	$183,687 : 1	$624,205 : 1	$91,702 : 1
National Academy Members (2012)	9	7	26	55	23	109	7
Significant Faculty Awards (2012)	9	11	22	24	22	42	9
Doctorates Awarded (2012)	203	326	649	869	663	708	367
Doctorates/T-TT Faculty (2012)	0.22 : 1	0.30 : 1	0.39 : 1	0.51 : 1	0.39 : 1	0.48 : 1	0.30 : 1
Postdoc Appointees (2011)	184	152	297	548	316	1,186	219
Postdocs/T-TT Faculty (2011)	0.20 : 1	0.12 : 1	0.18 : 1	0.32 : 1	0.18 : 1	0.80 : 1	0.18 : 1
Undergraduate Student Count (Fall 2013)	23,070	27,659	30,446	32,695	44,072	29,756 (main campus only)	26,928
Undergrads/T-TT Faculty (Fall 2013)	25.0 : 1	22.1 : 1	18.5 : 1	19.1 : 1	25.8 : 1	20.0 : 1	22.1 : 1
Tenure & TT Faculty (2012)	924	1,249	1,648	1,709	1,710	1,487	1,216
SciVal (Scopus) Articles (2012-2014)	6,868	9,322	16,456	19,665	19,793	30,755	6,999
SciVal (Scopus) Articles/T-TT Faculty (2012-2014)	7.4 : 1	7.5 : 1	10.0 : 1	11.5 : 1	11.6 : 1	20.7 : 1	5.8 : 1

Table 3. Peer Comparisons of AAU and Other Metrics. Green fields represent AAU member metrics surpassed by WSU's equivalent metric. Yellow represent metrics equal to WSU's.

Recommendations:

1.1 **Hire strategically rather than simply replacing faculty who leave.** During interviews and discussions, the subcommittee found that a climate of fiscal instability, hiring freezes, high competition for excellent faculty recruits, and state cuts to education creates pressure within colleges to hire quickly to fill short-term gaps or fill jobs for fear of losing funding for a position. The subcommittee recommended that efforts should be made across the university to encourage hiring for long-term goals around research strength areas, and not just to fill short-term gaps.

1.2 **Proactively recruit.** Establishing Grand Challenges built around strength areas creates an opportunity for WSU to coordinate across colleges to take a proactive approach to faculty recruitment. Through professional networks, research publications, and scouting at conferences, WSU should actively seek out excellent junior and senior scholars to fill gaps and expand capability in addressing multidisciplinary themes. Faculty should be hired with clear communication of outreach, engagement, and economic development responsibilities as part of the core culture of a land-grant institution. The process of active recruitment expands WSU visibility around theme areas within academia and ensures that faculty are aligned with WSU's three-pronged mission of advancing, extending, and applying knowledge generated through research.

1.3 **Coordinated approach to increasing diversity.** As a land-grant institution, one of WSU's principal missions is to disseminate knowledge that is generated for the betterment of the society. Its location within the Pacific Northwest makes it imperative that WSU reach out to serve both traditional and non-traditional underrepresented minorities (URMs) in the region. There are already existing pockets of knowledge and expertise within WSU that should be coordinated and leveraged to accomplish this goal.

1.4 **Create a "Global Academy" to foster social, cultural, and intellectual interchange between faculty across the campuses.** WSU's Global Academy would be comprised of a physical space (i.e., a faculty club) that serves as a meeting place and a forum for workshops, research showcase events, debates, presentations, and participatory events that lead to greater engagement by faculty in WSU academic life across disciplines. The Global Academy would address efforts surrounding faculty engagement, interdisciplinary exchange, diversity issues, leadership development, and mentoring and facilitate the creation of a culture of excellence.

1.5 **Define "research" across the university and create shared goals that inspire collaboration, not competition.** The subcommittee found that research is defined very differently in every discipline and college and thus recommends that WSU benchmark research performance against similar colleges from other institutions, as opposed to comparing with other WSU colleges.

1.6 **Articulate the value of collaborative, interdisciplinary efforts and create a system to recognize and accurately provide credit for these activities.** Current trends in R&D expenditures across the nation show the value of interdisciplinary research. It is well known that components of outreach and engagement are critical to the R&D efforts in most of the research areas to ensure dissemination, adoption, and application of the knowledge created. Effective outreach and engagement is a necessary step to measure the success of the adoption of new knowledge and to prepare and plan for improvement and advancement of the research. The more we collaborate within and outside the institution, the more we raise the visibility and stature of WSU's research efforts. This, in turn, leads to increased R&D expenditures, visibility, and recognition of the value, quality, and excellence of research conducted at WSU and of its faculty. Incentivizing this area by recognizing and rewarding the efforts made by faculty is one way to promote and encourage faculty to lead and participate in multi- and interdisciplinary research efforts.

a. Create a streamlined system for increasing faculty awards. Prestigious awards are one of the most visible avenues of promoting the quality of WSU research to academia. Responding to information provided by WSU National Academy awardees, the subcommittee proposes a systematic 'star-faculty' track to increase the number of prestigious awardees at WSU. As part of the Global Academy, senior faculty and WSU National Academy members should be engaged in providing guidance to mid-level and STAR junior tenure-track faculty. Senior faculty, academy members, nominating committees, and department chairs should work together to develop roadmaps for outstanding young and mid-level faculty to pursue prestigious awards (as defined by AAU; see Appendix I).

b. Centralized staff support should be provided to assist with committee efforts to identify strong candidates, coordinate applications for internal and external mid-level awards, promote involvement in national policy setting advisory boards and participation on nationally visible panels, facilitate important introductions, and coordinate and submit nominations for prestigious awards.

c. Establish a university-wide database, linked to faculty annual reviews, to allow easy extraction of important statistics regularly measured (AAU awards, fellowships, and other AAU indicators).

Conclusion #2: Need for clearly articulated, shared goals and coordinated support for those goals. In a highly competitive research environment, universities are asked to accomplish more with less. This requires prioritized and coordinated efforts and strong leadership to articulate shared goals and vision. The Research Themes Subcommittee addressed this charge by developing Grand Challenges, but the Outreach, Engagement, and Economic Development Subcommittee felt that the leadership's ability to articulate a clear sense of identity, shared values, and direction in other areas is also necessary for effective outreach engagement and economic development activities. From an outreach perspective, everyone representing WSU should be able to share a consistent message of what makes us unique. As it relates to the internal community, creating integrity between stated goals and the support provided to effect those goals is essential for faculty and staff morale and will encourage engagement and camaraderie, create trust, establish a sense of pride in WSU's accomplishments, and rally the support of faculty and staff to pursue the advancement of institutional goals.

Key elements in effective organizations are shared vision, clear communication, well-defined roles and responsibilities, and sensible accountability. WSU, like most universities, is highly decentralized and, because of that, often suffers from disparate goals and overly complicated communication, coordination, and collaboration issues across units. An effective internal operation will enable effective collaboration with external partners and will increase WSU's outreach engagement and economic development impact. Besides their value to WSU as a means to engage society, outreach, engagement, and economic development activities are increasingly important to obtaining national and corporate funding. In addition, federal agencies require broader impacts and engagement and encourage collaborative projects with industry.

Below are recommendations for additional shared goals and support around outreach, engagement, and economic development efforts.

Recommendations:

2.1 Articulate the value of sponsored research and creative activities and add capacity to existing proposal writing support and training units such as Corporate and Foundation Relations, Office of Grants and Research Development, and at the college level to support grant acquisition. Major grants from federal and private sponsors are critical to WSU's ability to perform outreach, engagement, and economic development activities. There are varying degrees of support for faculty proposal writing efforts across colleges. Central support exists for large multidisciplinary proposals through the Office of Research. Other colleges provide central support for larger and strategic proposals and some support for individual proposal writing efforts. Through interviews and survey results, the subcommittee identified a need for a better support program for faculty in obtaining funding. This would include items like notification of grant opportunities, help with proposal budgets, time away from teaching to write, writing support/templates for certain sections of grant proposals, and assistance to navigate forms and the grant process.

2.2 Articulate the value of outreach, engagement, and economic development activities and structure faculty annual reviews to recognize and reward involvement. Efforts to reach out to the public, serve on committees, advise on policy, increase the visibility of WSU, commercialize technology, and other activities that benefit the economy need to be recognized and rewarded in annual reviews. The subcommittee found that not all administrators value public engagement equally, and many faculty feel they cannot seek out such opportunities due to time and resource constraints. In some disciplines, younger tenure-track faculty are discouraged from engaging in outreach, engagement, and economic development activities when there is no tenure-based benefit to these activities.

a. Develop a system-wide Economic Development Council managed by the Office of Economic Development to raise awareness of faculty, administration, staff, and external partners about opportunities in research-focused partnerships with external stakeholders. This council would be charged with increasing internal and external communications of these opportunities to build partnerships throughout the university, by convening representatives from academic units and external partners to help all stakeholders work toward a common goal without redundancy.

b. To facilitate a culture change, the subcommittee recommends that a taskforce be assembled by the provost to explore, with the colleges, whether system-wide change to metrics valuation is advantageous or if these issues can be addressed through recognition and awards alone.

c. Provide training and support, across units and administrative support offices, to increase understanding of the benefit of long-term, results-driven collaborations with industry, private, federal, domestic, and international partners. These have long term benefits such as increased self-supported graduate students and increased development funds as well as reputation building benefits as a "partner of choice," building on the land-grant mission of interconnectedness with regional businesses and communities.

d. Increase exchange programs with industry such as student internships, industry sponsored capstone projects, faculty participation in corporate professional development education opportunities, industry advisory panels, and as judges in student competitions. Some suggested ways to approach this goal would be to implement creative programs to allow faculty time to participate in such activities, and streamlining dissemination of the available opportunities with industry by creating a centralized portal that organizes these resources in an easily searchable manner, which in turn leads to efficient adoption of the resource.

e. Pursue funding and partnerships to develop faculty and student programs to increase involvement in commercialization and economic development activities. With the reorganization of the Office of Commercialization, many new programs have been initiated and should continue in an effort to involve students and faculty in commercialization and economic development activities and to increase student involvement in innovation.

2.3 Articulate and coordinate a WSU-wide strategy to increase international collaboration. International activities dramatically increase WSU research impact and contribute to the overall AAU metrics in the areas of R &D expenditures, graduation rates, and recognition and awards to faculty. The institution should provide a clear message of support for international research activities by:

a. Providing centralized resources to facilitate and support international work and international travel (e.g., International Research Travel Award) to encourage central coordination and sustainability of WSU's international partnerships. Including the Office of International Programs in these interactions allows the institution to leverage resources, experience, and relationships to increase WSU's overall international research portfolio.

b. Providing alternative means to support international research (e.g., time release to pursue/grow WSU's international collaboration and research enterprise).

c. Raising the profile of outcomes from international research, publications, and citations.

Conclusion #3: Need to increase global visibility of WSU research and accomplishments. Preliminary findings from a reputation analysis conducted in Washington state indicated that WSU's general reputation is good, but that the general public does not know much about WSU in terms of its areas of expertise and the diversity of research programs. Stakeholders appreciate WSU's land-grant mission, which was founded on the principles of access, collaboration, and engagement. This philosophy of partnership and community engagement upon which we were founded has come to define us as an institution. In the State of Washington and beyond, our identity and reputation as a strong, effective, results-oriented partner is widespread and growing. We are known in many circles as "Washington State's university," a moniker we are proud to wear. Preliminary surveys from the reputation analysis suggest that, in order to fully benefit from this positive public perception, there is a need to overcome geographic barriers caused by our remote location. We need to better educate our stakeholders on the wide array of research programs, available expertise, and knowledge that is being created. WSU's rural location limits opportunities for face-to-face engagement with major influencers in Washington's public and private sectors, and travel in and out of Pullman is time consuming and restrictive. This translates into a need to increase WSU research visibility in creative ways. Our commitment to community engagement is expanded in the WSU 2014–2019 Strategic Plan, which includes the following goals under the "Outreach and Engagement":

- Increase access to and breadth of WSU's academic and extension programs throughout Washington and the world.
- Expand and enhance WSU's engagement with institutions, communities, governments, and the private sector.
- Increase WSU faculty, staff, and student contributions to economic vitality, educational outcomes, and quality of life.

Some recent examples of successful stakeholder engagement are included in Appendix J.

Recommendations:

3.1 Focus on enabling industry engagement in metropolitan regions of Washington and in rural communities across the state. Through the Offices of Economic Development and Government Relations, WSU has built up the university's reputation and should continue to increase involvement with Washington trade associations and policy makers. These relationships are valuable to the institution because they align with the major industry sectors and unmet needs of Washington state. These relationships present researchers with opportunities to engage in areas of expertise, but travel funds are often an issue.

a. Increase travel and visibility sponsorship funds to enable broader faculty participation in research and outreach, engagement, and economic development related activities outside of Pullman. Face to face interaction is key to building relationships; bringing faculty and their research to industry events and community gatherings builds our reputation as an engaged and responsive university.

b. Leverage existing groups like Extension, Corporate and Foundation Relations, Economic Development, Government Relations, WSU Foundation, and other WSU staff based in Seattle to increase outreach and engagement with business, community, and government leaders, as well as involvement in statewide events and initiatives. As these groups have the ability to interact with industry and policy makers on a daily basis, these relationships are well developed to support university research initiatives.

3.2 Increase WSU research visibility.

a. Seek out opportunities to establish physical research displays both in high-traffic areas of the Pullman and Spokane campuses and in the Seattle area. Consider establishing banners and museum-like research displays in public spaces such as French Ad Building, the CUB, WSU offices in Seattle, WSU Connections store locations, Pacific Science Center, and other prominent spaces on the west side of the state. An example cited was WSU's Future of Flight display in the museum in Everett.

b. Improve internal communication and coordination of outreach, engagement, and economic development activities and opportunities between units and faculty to maximize efforts and travel funds.

c. Create streamlined, WSU-wide communication channels to coordinate publicity, news releases, and faculty research accomplishments. The subcommittee found that it is difficult for communications staff to identify story-worthy research for promotion. They also encounter difficulty effectively communicating the broad range of research that is represented in some colleges with too few staff. While WSU's communication staff try to cover the wide range of topics in their units, without a university-wide process to bring strategic research, impact stories, and notable awards to their attention, the result is a fairly ad-hoc communication process. Communication channels among faculty, public information officers, and the university-wide communications office should be improved to better coordinate publicity and showcase faculty research accomplishments. Faculty and information officers need to work together to increase the number of newsworthy stories from a broad range of research. A clear set of best practices could help make the process more transparent and inclusive and invite greater participation. A system of metrics beyond the largely anecdotal collections of articles could go a long way in identifying the University's most resonant and far-reaching research news topics.

d. Offer on-going seminars and workshops to train communicators on how to relay complex research to the public in an engaging way, demonstrating how science impacts people's lives.

e. Organize college and university-level research showcases more often and target stakeholders. WSU holds annual showcases such as the Wiley Research Symposium, and other showcases organized locally, but we would benefit from increased frequency of such events and by targeting the research to the right stakeholders at various locations across the nation. These events provide opportunities to invite and publicize WSU research to external stakeholders who play a vital role in funding and advancing the visibility and performance of university research both nationally and internationally.

3.3 Invest in resources (or advertise and train people on the use of existing resources) that provide searchable portals to WSU research expertise across the whole university system. Administration, faculty, and staff encounter difficulty identifying research expertise across colleges for collaboration opportunities.

a. An improved system to communicate research within WSU is needed both to facilitate partnerships and to identify areas of emerging research impact.

b. Create up-to-date website information on WSU research and faculty. Efforts are currently underway to update the WSU website and provide for timely and more accessible updating capability. These efforts should be fully supported and expedited. In addition, University Communications and information officers need to educate faculty on the value of keeping website information up-to-date. University Communications should also create standardized and simplified procedures to allow faculty to keep web page information current and regularly provide training and encouragement to do so.







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