Washington State University

Research, Scholarship, and Creativity Proposals Responsive to the Strategic Reallocation RFP

Description

The review of the WSU research, scholarship, and creativity (henceforth referred to collectively as *research*) enterprise (i.e., the 120-Day Research Study) identified 5 strategic areas for WSU research- the WSU "Grand Challenges"- and 19 recommendations to enhance WSU research performance (1). Two major items required to advance the WSU Grand Challenges identified in the Study are enhanced effort on multi-disciplinary activities, and improvements to WSU research infrastructure. Accordingly, the purpose of this RFP is to identify a set of focused research topics within the Grand Challenges for faculty recruitment and other strategic investments. This RFP will also identify high priority improvements in WSU research infrastructure that support the Grand Challenges and WSU research generally.

Eligibility for Participation in the Research and Student Success RFP Processes

- Proposals will be organized, prioritized, endorsed, and submitted by the College Deans in collaboration with each other and with administrative support areas. One proposal can be led jointly by the Dean of Students, Division of Student Affairs in collaboration with the Vice Provost for Undergraduate Education.
 - This is a limited submission process coordinated by the College Deans and the Dean of Students/Vice Provost for Undergraduate Education.
 - The College Deans and the Dean of Students/Vice Provost for Undergraduate Education will engage with faculty in the identification and refinement of RFP themes and in the creation of RFP proposals.
- Deans will involve Chairs/Directors, VPs of administrative support units, as well as the faculty of departments/schools, as appropriate, in envisioning a limited and prioritized number of focused research/student success initiatives that will be submitted within the context of college collaboratives.
- Deans will commission a number of select groups of faculty and staff to work in collaborations with colleges, as well as administrative support units as appropriate, to draft proposals.
- Each proposal submission is expected to be multi-disciplinary and must involve two or more degreegranting colleges. Involvement of the Honors College, Graduate School, Global Campus, Libraries, and administrative support units is encouraged, as appropriate.
- Pullman, Spokane, and Everett PBL is the primary source of the funding provided under this RFP. The Vancouver and Tri-Cities campuses are performing their own budget reallocation exercises based on their PBL. Involvement of Vancouver and Tri-Cities campuses in this RFP program is encouraged where appropriate and normally will include cost sharing or in-kind commitments from those campuses if a proposal team considers doing so to be in the best interest of an initiative.

Degree-granting colleges will be eligible to lead a fixed number of proposals, with that number driven by the size of the research and academic enterprise. The total number of proposals, including both research and student success proposals, for which each college can be the lead is designated as follows, including one additional proposal that can be led by the Office of Undergraduate Education/Division of Student Affairs:

College or Unit	Total number of proposals as lead*
Carson College of Business	1
College of Ag, Human, and Nat. Res. Sci.	3
College of Arts and Sciences	3
College of Education	1
College of Nursing	1
College of Pharmacy	1
College of Veterinary Medicine	2
Elson S. Floyd College of Medicine	1
Murrow College of Communication	1
Office of Undergraduate Education and Division of Student Affairs	1
Voiland College of Engineering and Architecture	2

*Total number permitted across both RFP types (Student Success and Research)

- Colleges can be participants on proposals from other colleges and Student Affairs/OUE, and this will not count towards their limit.
- The Honors College, Graduate School, Libraries, and administrative support units are eligible to be participants on proposals.
- VPs of administrative support units, and the Deans of the Honors College, Graduate School, Global Campus, and Libraries and/or their designees, as appropriate, will provide leadership in collaboration/coordination with colleges on the creation and submission of proposals.
- Proposals that address a research and student success goal jointly will be eligible for funding from both pools of RFP funds, although any single project award will still range from \$250,000 to \$1,000,000.
- The Provost's Office will facilitate discussion and program assistance workshops throughout the application period.
- Graduate students may be involved in and funded by Student Success proposals to the extent they facilitate undergraduate student retention and progress towards graduation.

Timeline

December 15, 2015	Penultimate RFP documentation is vetted with College Deans and VPs,
	and preliminary contemplation of initiatives with faculty and staff under
	the direction of Deans and VPs can commence.
January 15, 2016	Final RFP documentation is released.
January 15, 2016	Provost Office program-support facilitation events will begin.
January 15 – February 15, 2016	All-System sharing of RFP ideas at meetings scheduled by the Co-
	Provosts and VPR.
February 15, 2016	Letter of Intent due that 1) identifies whether proposal responds to the
	RFP for Student Success, for Research or for Both; 2) identifies the
	primary RFP "area of focus" and specifies the major technical areas of
	research envisioned if a Research proposal, in order to help choose
	reviewers for the panel; 3) identifies the key contact's name, phone
	number and Email for the proposal.
April 1, 2016	Final submissions of proposals are due in the Provost's Office.
April 8, 2016	Proposals sent to reviewers by this date.
April 25 – 29, 2016	Proposal review panels meet in Pullman.
May 16, 2016	Executive Committee forwards recommended award package to Interim
	President Bernardo, Co-Provosts Mittelhammer and Austin, and VPR
	Keane for final decision.
June 15, 2016	Announcement of awards is made.
July 1, 2016	All applicants notified of final decisions. Funds will be transferred as
	proposed and as needed via the annual budget allocation process.
	Progress on plans will be monitored on a semiannual basis.

Areas of Focus

As discussed above, this RFP will solicit proposals for focused research in support of the WSU Grand Challenges and research infrastructure. Further details on these two areas are provided below.

- 1. Focused multi-disciplinary research activities in support of the Grand Challenges: Grand Challenges are ambitious but achievable goals that harness WSU and partner research, scholarly and creative capabilities to solve important national or global problems and that have the potential to capture the public's imagination. WSU Grand Challenges must be inspirational, multi-disciplinary, and inclusive. Proposals should identify:
 - A long timeframe (> 10 years) Grand Challenge question.
 - A focused research topic of up to five years in duration that addresses an element of this question.
 - Faculty support and other items needed to address this topic.
 - Faculty hired under this program should be able to address both the focused research topic of the proposal and the longer term (beyond the five-year horizon) research activities envisioned under the Grand Challenge program.

The WSU Grand Challenges are listed below. More detailed information on the Grand Challenges is available in Appendix 1 of this document and at the Office of Research <u>website</u>.

• Advancing Opportunity and Equity

Key themes for this grand challenge are i) Examining the causes and consequences of inequality of opportunity, ii) Promoting equity for individuals and communities, iii) Furthering economic, educational, and social policies that impact opportunity, societal cohesion, and engagement and (iv) Improving formal and informal education throughout the lifespan

- Sustaining Health: The Uncompromising Pursuit of Healthier People and Communities Key themes for this grand challenge are i) Understanding the continuum between optimal health and disease, ii) Health maintenance, disease prevention, and changing the course of disease, and iii) Promoting healthy communities
- Food-Energy-Water Nexus

Key themes for this grand challenge are i) Societal perspectives, policy and governance, ii) Food-Enhancing production systems and products, iii) Energy-Abundant, affordable, and low carbon energy, and iv) Water-Safety and sustainability

• Smart Systems

Key research themes for this grand challenge are i) Foundational technologies, ii) Components and Application of smart and sustainable systems, and iii) Adoption and implications of smart systems

• National Security

Key themes for this grand challenge are i) Matter at extreme conditions, ii) The science of nuclear nonproliferation, iii) Promoting Global Health Security by Strengthening Infectious Disease Surveillance, and iv) Promoting Global Food Security – Leading through Research and Development

2. Research infrastructure

- Physical research infrastructure (i.e., capital, operations, equipment) which includes infrastructure for research core/instrumentation labs
- Support personnel and management
 - Research advancement at campus, college, or central levels (e.g. team leaders, resource managers, proposal managers)
 - Management of multidisciplinary activities "Institute-like" activities (seed grants, workshops, etc.)
 - o Innovation and industrial engagement (commercialization, patents, licensing, etc.)

Award Details

- Approximately \$4 million is available for funding.
- Awards will range from \$250,000 to \$1,000,000.
- The cost of benefits will need to be accounted for in the budgets of proposals that involve hiring faculty/staff.
- Proposals can be made for PBL and/or one time or fixed-term funds.
- Proposals for which colleges provide some degree of matching funds will be accorded additional positive weight in the evaluation process.
- Funding for approved proposals may in some cases be managed centrally rather than by the Colleges.

All campuses can participate in proposals, with some matching funding expected by Tri-Cities and Vancouver Campuses for participation.

Deliverables and Outcomes to Consider in this RFP

Strategic Plan-Related Outcomes

- Enhanced federal funding leading to higher R&D expenditures
- Enhanced impact (publications and citations)
- Enhanced funding from innovation/commercialization activities

Additional Value Benchmarks

- Enhanced number and quality of submitted proposals
- Increased number of prestigious faculty awards
- Enhanced awards and expenditures in Grand Challenge areas
- Enhanced number of startups and patents
- Faculty visibility

Application Instructions

- Letters of Intent and proposals should be sent to Kristina Peterson-Wilson (kpeterson2@wsu.edu).
- Letter of Intent due February 15 should 1) identify whether proposal responds to the RFP for Student Success, for Research or for Both; 2) identify the primary RFP "area of focus" and specifies the major technical areas of research envisioned if a Research proposal, in order to help choose reviewers for the panel; 3) identify the key contact's name, phone number and email for the proposal. The Letter of Intent can be submitted in the form of an email.
- Proposal not to exceed 10 pages, recommended font size 11 for Times New Roman (or equivalent), 1" margins on all sides.
- Guidelines for the content of the narrative are in Appendix 2.
- Individual proposals may include both multi-disciplinary research and infrastructure components.
- Proposal components for multi-disciplinary research in support of the Grand Challenges:
 - Each proposal should focus on one Grand Challenge question that addresses a compelling problem or challenge, the resolution of which would have significant impact. The Grand Challenge question should have the long timeframe (10 years or longer) required for a compelling, inspirational problem of broad interest. *Impact may be on the public, on communities, on the economy, or on quality of life, impact is the focus of the Grand Challenges program. That impact may be achieved through basic research leading to scientific breakthroughs or significant advances in other fields, but it must ultimately be felt outside of the university or academia.* Proposals should clearly articulate a focused, shorter-term (up to 5-year) multi-disciplinary research plan that addresses an important element of the Grand Challenge question. The proposal must also identify the team that will address the proposed topic, and include projected milestones and outcomes for each year of the proposal. Faculty hired under this program should be able to address both the focused research topic and the longer term research activities envisioned under the Grand Challenge program.
 - Methodology and approach to address the grand challenge question and associated focused research topic.
 - Plans to generate additional outside financial support or to establish or demonstrate a strong capacity for public engagement and outreach to underserved communities locally, nationally, or internationally, ideally through ongoing partnerships.
 - Proposals that involve student participation should include plans for expanding participation across diverse groups.
 - Unit commitment (cost share).
- Proposal components for research infrastructure proposals:
 - Each proposal should clearly articulate a plan for the request that is compelling and clearly demonstrates the potential for advancing research at WSU.
 - o Description of the uniqueness of this capability.
 - Impact of the request on research at WSU and on WSU's visibility and reputation; impact of this request on expanding collaborations within WSU and/or with other institutions.
 - o Unit commitment (cost share).

- Budget and budget justification for all proposals: 2 pages max (this will not count towards the proposal page limit).
 - Include cost share by units.
 - The cost of benefits should be accounted for in the budgets of proposals that involve hiring faculty/staff.
 - For proposals that include both multi-disciplinary research and infrastructure components, all budget items must be identified as "multi-disciplinary research" or "infrastructure."
 - All budget items must also be labeled "capital" or "operating".
 - Budget duration can be up to 5 years (PBL continues beyond this timeframe). Specific budgets for each year should be included.
 - Budget should be submitted using the template provided.

Evaluation Process

The evaluation process will be overseen by an Executive Committee (EC). The EC will commission an external evaluation panel whose members will be assigned as appropriate to research proposals and student success proposals, with expertise appropriate to scientific, social scientific and humanities/artistic endeavors.

- The evaluation will be based on explicit sets of criteria relating to the two themed proposal categories, as delineated below.
- The criteria will be scale-weighted in importance, and evaluations will be conducted according to the criteria and their designated weights.
- The EC will evaluate and summarize the review input received from the panel.
- The EC will provide an advisory recommendation, including a priority order of funding of the proposals with rationale, to the President, Co-Provosts, and the Vice President for Research.
- The President, Co-Provosts, and Vice President for Research will jointly decide the awarding of funding to the proposals received, with the President being the ultimate decision making authority for funding.

Evaluation Criteria

(4=Excellent/High Institution-Level Impact; 3=Very Good/Moderate Institution-Level Impact; 2=Good/Limited Likelihood of Institution-Level Impact; 1=Fair/Unlikely to Have Institution-Level Impact)

Criteria for Proposals Targeting Multi-Disciplinary Research	Points*	Weight
Quality of the proposal:		
A. Grand Challenge question specific, well-defined, achievable, inspirational and	1-4	0.05
of broad societal impact; plan clearly defined, compelling, and multi-		
disciplinary;		
B. overall impact of the proposed plan; clear milestones and outcomes; strength	1 4	0.2
and quality of the team	1-4	0.2
Ability to execute the proposed plan:	1-4	0.25
Research methodology and approach including suitability for WSU (alignment with		
current and emerging capabilities, scale of the proposal)		
Ability of project to generate additional outside financial support	1-4	0.25
OR		
Projects that are not likely eligible for large funding will be judged on their ability to		
establish or demonstrate a strong capacity for public engagement and outreach to		
underserved communities locally, nationally, or internationally, ideally through ongoing		
partnerships		
Student involvement that includes broadening of opportunities and expanding		0.1
participation across diverse groups		
Unit commitment (organizational, budgetary (cost share and other), accountability in	1-4	0.15
annual review, tenure/promotion decisions, evidence of faculty involvement in proposal		
development process, etc.).		

Criteria for Proposals Targeting Research Infrastructure	Points*	Weight
Quality of the proposal:	1-4	0.4
Is the request compelling? Are the outcomes clear? Does the proposed plan have the		
potential to advance research at WSU?		
Amount Requested: Is the request justified and reasonable in magnitude?	1-4	0.15
Uniqueness: Will the requested infrastructure/personnel bring a unique capability to	1-4	0.15
WSU?		
Range of impact:	1-4	0.15
What impact will this request have on research at WSU's and on WSU's visibility and		
reputation? Will this request enable significant collaborations within WSU and/or with		
other institutions?		
Unit commitment (organizational, budgetary (cost share or in-kind effort), accountability	1-4	0.15
in annual review, tenure/promotion decisions, evidence of faculty involvement in		
proposal development process, etc.).		

*Ratings to be used as a starting point for discussion among review committee members. Proposals will not be eligible for funding if a rating of "1" is received on any criteria.

Note: Proposals that include both multi-disciplinary research and infrastructure will be reviewed based on both the multi-disciplinary research and infrastructure scoring criteria described above and the scores will be proportionally weighted based on budget for each component.

Questions

Questions can be sent to: <u>RFP_Questions@wsu.edu</u>. Please designate in the subject line: Research RFP, Student Success RFP, or both (Research and Student Success RFP).

Or you can call: Kristina Peterson-Wilson at (509) 335-8915.

WSU Grand Challenges

Advancing Opportunity and Equity

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

Key Research Themes

To address this Grand Challenge WSU has identified four key themes and accompanying areas of focus for its efforts, though the scale and complexity of issues regarding opportunity and equity should encourage faculty to work both within and across these categories.

Theme 1: Examining the causes and consequences of inequality of opportunity

Understanding the causes and consequences of inequality for individuals and communities requires using both humanistic and scientific inquiry to produce thoughtful and culturally sensitive approaches that, wherever possible, engage the experiences and concerns of the communities they study. Faculty in multiple disciplines seek to investigate the complex roots of issues like poverty and discrimination based on race, gender, ethnicity, disability, and sexualities, as well as the continuing effect of those problems on individuals and societies. Efforts to understand the causes and consequences of inequality of opportunity also demand the development of robust analytic, modeling, and data collection strategies that consider the interrelation among inequality of opportunity in education, the labor market, the criminal justice system, and political realms. Survey research constitutes a critical tool in these efforts.

Theme 2: Promoting equity for individuals and communities

As we grow in our understanding of the history and current inequality and lack of opportunity in our society, we also look to the future, and in particular to how a more inclusive and just society can bring about greater engagement and achievement for all its members. We can begin to address these challenges by increasing our efforts to expand the diversity of the nation's scholarly and professional workforce and eliminate barriers to work opportunity; to develop and evaluate innovative programming that reaches across social, cultural, and political divides; to identify and remedy barriers to economic and intergenerational mobility; and to improve the access to and delivery of high-quality, cutting-edge health care.

Theme 3: Furthering economic, educational, and social policies that impact opportunity, societal cohesion, and engagement.

To realize fully a just and equitable future, we must also build upon our knowledge of the causes and consequences of inequality to help develop, implement, and sustain educational, economic, social, and political structures that effectively support all members of society. Doing so requires us to pay particular attention to the wide range of policy issues that influence opportunity, societal cohesion, and engagement, as well as the ways in which historical and global perspectives shape views on contemporary issues.

Theme 4: Improving formal and informal education throughout the lifespan

Research into the promotion of equity and the development of effective policy must also be accompanied by sustained attention to processes of education, which are a primary lever for increasing opportunity and addressing inequities in society. By considering the many different experiences and learning opportunities across the human lifespan—from early childhood through K-12 schooling, higher education, career, and retirement—we pursue a comprehensive approach to enabling people at all levels of society to achieve their highest potential.

FOOD-ENERGY-WATER Nexus

Key Research Themes

The following research themes are aimed at developing safe and abundant FEW resources. These themes are inextricably interlinked. Food from 'field to fork' depends heavily on water and energy. Energy production needs water, but climate impacts of energy choices affect water and food. Societal perspectives, economics, policy and social justice issues permeate throughout the FEW nexus.

Theme 1: Societal perspectives, policy and governance

Beyond scientific and technical innovation, sustainability depends on policy innovation and public involvement. Understanding public, industry and policy perspectives is essential for advances in research to translate into FEW sustainability. FEW solutions must encompass understanding of economic, social, cultural and policy barriers in order to reconcile diverse interests and value systems across different sectors. Value gaps cannot be bridged without cross-sectoral conversation, transparency, and accountability. FEW research must accordingly identify impact metrics and success indicators for contribution to good governance and public well-being. Because perspectives and impacts vary differentially amongst diverse populations, best research practices include assessment of varying vulnerabilities, and aim for local, flexible solutions that can be scaled up rather than topdown 'one-size-fits-all' solutions.

Theme 2: Food: Enhancement of production systems and products

A central challenge in food system enhancement is increased production of affordable, nutritious, safe food, given needs of growing populations, global desire for dietary improvement and Westernization, and competition from materials and bioenergy over limited land. The changing climate is increasing agricultural stresses from production to processing, preservation, and transportation. Supplies of fresh water and fertilizer inputs are diminishing.

Systems approaches to food developed by agricultural and atmospheric scientists, hydrologists, pathologists, ecologists, economists, policy analysts, and sociologists can maintain soil health, maximize water efficiency, minimize environmental impacts, and meet food needs for all.

Sustainable food systems can evolve more readily when growers, policy makers, distributors, retailers and consumers are educated on environmentally and socially responsible practices for producing healthy, safe and affordable food. Education and outreach through WSU's strong Extension network are therefore essential to the FEW challenge.

Theme 3: Energy: Meeting needs while protecting the environment

Securing energy resources is one of the most important problems of our time. Fossil fuels are important in the US energy portfolio, but they pollute, drive global climate change, and they are finite. Transition to renewables is urgently needed. Reliable production, storage, and transmission of energy are critical to maintaining the national economy, and define an energy-secure and sustainable America. A systems approach to overall energy needs is crucial to decrease foreign dependence and meet US needs for safe, affordable, sustainable energy. Conservation and smart grid distributed production are key to meeting future demands.

Theme 4: Water: Safety and sustainability

The water challenge is to ensure safe, abundant supply for multiple, competing needs while minimizing degradation of quality and ecosystem health. Needs grow more urgent as climate variability and the frequency and intensity of drought and heat events increase. Progress requires both specialized and interdisciplinary approaches to understanding biological, physical, chemical, socioeconomic, and technical dimensions of the regional and global water cycle.

Water security solutions are not restricted to provision but include increased efficiency. Food, energy, and social systems that promote greater water efficiency are key areas for innovations that consider impacts and synergies within the full water cycle. Advances will be made through systems-level thinking that identifies and incorporates interdependencies and feedbacks among ecosystem components as well as the socioeconomic dynamics of water users in order to increase efficiencies in existing systems, technologies and management tools. Innovations are needed in technology, management, and governance to move solutions to the public sector.

SUSTAINING HEALTH

THE UNCOMPROMISING PURSUIT OF HEALTHIER PEOPLE AND COMMUNITIES

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

WSU is positioned to engage across traditional disciplinary boundaries to tackle the challenge of sustainably improving health and well-being across society. Through our state-wide reach, including medically-underserved communities, WSU can engage with health care providers and community members to improve preventive and restorative care delivery for both infectious and non-communicable diseases, and to ensure that therapies are accessible, affordable, and effective. More broadly, WSU's state-wide campuses and extension centers are home to an impressive contingent of scientists and clinicians actively engaged in basic and translational health research with domestic and international impact. WSU is positioned to improve mental and physical health by advancing knowledge of our natural, social, and built environments and the social systems that influence the food we eat, the air we breathe, the water we drink, and the creative arts we enjoy. Through collaborations and synergies across WSU programs such as the Allen School for Global Animal Health and health sciences programs in Spokane, along with related areas of WSU strengths--from cell and molecular biology to the psychosocial, neurological, and policy underpinnings of physical and mental well-being-- WSU can play a comprehensive, holistic, and unique role in addressing the challenge of promoting and sustaining health for all people, including those in underserved communities.

Key Research Themes

To address this Grand Challenge WSU has identified three key themes.

Theme 1: Understand the continuum between optimal health and disease

Basic research aimed at investigating, characterizing, and understanding human health and disease at the molecular, cellular, organismal, and behavioral levels is fundamental to health promotion, disease prevention, and treatment across the lifespan. WSU research programs span approaches from the molecular level through humans and animals in their environmental context. From the basic biochemistry of toxin exposure to the health implications of environmental degradation, from the biology of antimicrobial resistance to global emerging disease surveillance, from the neurochemistry of circadian rhythms to the safety risks associated with shiftwork, and from the alteration of synaptic function by psychostimulants to the behavioral treatment of opiate addiction, there is great potential for WSU researchers to collaborate and increase our impact on sustaining health by generating new knowledge at the foundations of health and disease.

Theme 2: Health maintenance, disease prevention, and changing the course of disease

Understanding what constitutes "health" and "disease" is a key step, but this fundamental knowledge must be translated into inventions and clinical practices if we are to help people maintain health, prevent illness, and slow or reverse disease progression. The university has a foundation of critical expertise in conducting clinical and other intervention trials to advance the discovery and development of novel therapies and vaccines. We are particularly well-positioned to build on our basic, translational, and clinical research capacities to address how population health is influenced by environmental quality. With advances in understanding genetic variation among individuals, these therapies can be tailored to achieve maximum benefit with minimal ill effects. In addition to strengthening our research focus on disease mechanisms, a goal will be to develop and maintain mutually beneficial relationships with providers and patient advocates to enable evidence-based treatment and prevention interventions that will have a profound impact on decreasing the mortality and morbidity associated with human disease.

Theme 3: Promoting healthy communities

The burden of chronic diseases related to lifestyle, epidemic levels of substance abuse, and threats to health and well-being from continuing health disparities represent problems of enormous social significance both locally and around the globe. To address these challenges in ways that result in healthier communities requires building on WSU's relevant expertise in fundamental biological mechanisms of health and disease *and* the economic, social, and cultural determinants of human behavior. By marshalling these areas of expertise, we can address both 'downstream' influences on health, such as poor diets and substance abuse, and 'upstream' determinants of health including economic and social disparities and policy factors that affect health care access. Moreover, effective communication and outreach are needed to deliver evidence-based health information to communities and diverse populations. Somewhat unique to the expertise and mission of WSU is the potential to improve the production, processing, and distribution of safe and nutritious foods needed to sustain human health around the world. Further,

we recognize that what is optimal in terms of dietary patterns and nutrient intake is likely to vary with the genetics and culture of individuals and their communities. Understanding the physiology underpinning these differences will not only allow the provision of "personalized" nutrition recommendations to individuals and populations but will also lead to the development of "smart crops" and "smart foods" designed for various genetic predispositions and disease risks.

Smart Systems Improving quality of life and driving economic growth

Washington State University is well-positioned to take on this challenge, building on our research strengths in smart systems, materials science, computational sciences, math and statistics, health sciences, design disciplines, social sciences, and education. A core existing strength at WSU is the application of smart technologies for single users. This Grand Challenge extends that strength into a variety of applications including city-scale integration and in key sectors of society such as manufacturing, farming, and health care. When applied to industrial complexes or entire cities and regions, in collaboration with the design disciplines and social sciences, smart environments 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.

Key Research Themes

To address this Grand Challenge WSU has identified four key themes.

Theme 1: Foundational technologies

Materials that optimize resource management, are environmentally friendly, and yield enhanced performance provide the foundation of advanced infrastructures that will improve the quality of life, as described above. 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. More effective sensors, lighter and stronger structural materials, multi-physics and multi-functional materials, and bio-based renewable materials are all included in materials advances necessary to develop the systems that will become commonplace. Functional materials, self-assembled structures, and pest resistant plants represent a type of "smart system" in and of themselves. In general, however, the foundational technologies of computational and data sciences use real-time information from sensors embedded in advanced systems, making them "smart." Machine learning includes the ability for a system to adapt to the environment and make decisions based upon what has occurred previously.

Theme 2: Components and Application of smart and sustainable systems

"Smart" systems are systems that provide automated reasoning about the system and take actions automatically to ensure the safety of the system and optimize performance. These systems rely on networks of sensors, actuators, controllers, communications devices, and computational data mining and decision-making 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. These applications can improve quality of life by adapting to the individual needs and activity patterns of the individuals who live in, utilize, and rely on these systems. Smart systems can monitor the health and wellbeing of both physical environments and human users and take actions as needed to maintain this wellbeing and ensure safety. The application of smart systems also requires massive computation capabilities. The Internet of Things and other sensor-rich system generate 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 machine learning and strategic data analytics, must be able to recognize actions and respond accordingly. Because of the availability of high performance computing, these smart and adaptive systems can now scale from lab-based experimental conditions to deployment in large, complex communities.

Theme 3: Adoption and implications of smart systems

Many of society's most pressing problems are collective, and solutions will require people to cooperate and coordinate. How might smart infrastructures be designed to enhance the ability of people and groups to solve collective problems? Individual and public acceptance and barriers to acceptance, human-machine interactions, economic disparities, privacy and usability are all important dimensions of smart technologies that need to be evaluated. How can smart infrastructures be designed so as to shift household and community norms, practices, and structures in ways that sustain rather than damage the natural environment? How can smart systems be implemented in ways that contribute to human flourishing? Answering these questions will prove as central to the success of smart systems and environments as the development of foundational technologies that underpin such systems and the application of those technologies in cities, factories, and farms.

Fundamental Research in Support of National Security

The security and protection of the nation's citizens and the infrastructure governing their wellbeing is the Federal Government's foremost responsibility. Over the years, the threats have become increasingly diverse and sophisticated due to rapid technological advances, globalization involving rapid movement of people and goods, and the continually changing geo-political landscape. As shown in the Figure, national security in the 21st

Century encompasses protection against very diverse threats.

National security needs will continually evolve in the future and, very often, in unpredictable ways. Hence, it is essential that as a nation we invest in fundamental research and education to address the diversity of national security needs well into the future. Academic institutions must continually advance the relevant science and technology frontiers to ensure an intellectually vibrant climate to attract the best young minds who will make novel and substantive contributions to the nation's security and wellbeing. Regarding national security needs, it is important to recognize that the research activities may need to transcend national boundaries and involve partnerships with other nations.

Washington State University is committed to innovation and excellence in fundamental research and education across a broad range of disciplines, summarized below, to be an academic research leader in support of national security. The research themes in this



challenge encompass both physical and life sciences. The specific topics selected had to satisfy two key criteria: a current research strength and significant potential for future growth and diversification.

Research Themes

Theme 1: Matter at Extreme Conditions

Study of matter at extreme conditions of pressure and temperature, and often at short time scales, is central to many fundamental and exciting scientific challenges in the physical sciences (condensed matter physics and chemistry, plasma physics, astrophysics, planetary science, materials science, and mechanics), and provides the foundational research for addressing national security objectives related to both military (conventional and nuclear security) and energy (fusion, mining, oil and gas production) needs. The intellectual endeavors associated with understanding extreme states of matter will continue to stimulate technological breakthroughs in advanced materials, computational capabilities, propulsion systems, sensor technologies, and space exploration. Looking ahead, there is the exciting prospect of tailoring and developing novel materials/structures and systems for specific applications involving extreme environments.

Theme 2: Science of Nuclear Nonproliferation

Rising demand for clean energy has led to increasing worldwide interest in civil nuclear power and nuclear fuel cycle development, but peaceful use of nuclear technologies is tarnished by historical military applications, large-scale accidents, and ineffective waste management practices. Basic research in the chemistry of reprocessing and developing a scientific basis for nuclear safeguards is essential for ensuring safety and security as the use of nuclear technologies expands around the world. Also, innovations in nuclear forensics analysis and identification of new signatures of nuclear technologies enable advances in national security capabilities and verification of declared activities. Furthermore, study of the impact of the radiation environment on the chemistry and physics of materials supports the development of advanced reactor systems, state-of-the-art sensors for radiation environments, and improved waste forms.

Theme 3: Promoting Global Health Security by Strengthening Infectious Disease Surveillance

Health security, the protection from threats to health, is recognized as one of the most important non-traditional security threats around the globe. In resource-limited nations, health security applies not only to human health but also to animal health because animals not only provide direct economic and nutritional sustenance for humans, but also serve as reservoirs for zoonotic and emerging diseases to humans. Ebola in particular has exposed the

fragility of the world's capacity to detect and respond to infectious disease threats. Risks of global interconnectedness together with constantly emerging organisms require a dramatic increase in health systems' abilities to prevent, detect and respond to infectious disease threats throughout the world, especially in resource-limited countries. A health threat anywhere can easily turn into a health threat everywhere.

Theme 4: Promoting Global Food Security – Leading through Research and Development

There is no doubt that the health of farmers and their communities are tied to the health of the environment they live. Food insecurity and environmental degradation has reached alarming proportions in developing countries around the globe. The situation is characterized by frequent food shortages either man made or caused by natural disasters. This is reflected in high prices causing hunger and starvation which affects millions people every year. When food insecurity turns into civil unrest the US National Security states "...we will leverage our leadership in promoting food security, enhancing resilience, modernizing rural agriculture, reducing the vulnerability of the poor..." Land holdings are shrinking in size and becoming more fragmented. Traditional practices that preserved the biodiversity of natural resources are dying out and marginal areas have been brought under cultivation. Continuous cropping is now the norm, often in monocultures with little or no fallowing and few inputs. The rising demand for agricultural land has caused serious water pollution and deforestation. Adapting to these conditions is fundamental to the wellbeing of the farmers responsible for not only their health but the health of their environment. Several success stories show how research and extension programs have improved on-farm yields and output for small-scale farmers, a group that represents 85 percent of the world's farming community. Community-led efforts have conserved soil, water, forests, and biodiversity for use by current and future generations. And market-based interventions have strengthened the ability of small-scale farmers and foodinsecure consumers to gain access to production inputs, rural services, and agricultural commodities.

Appendix 2

Proposal components (maximum of 10 pages, plus abstract, budget, references). Page guidelines below are suggested, but all topics identified must be addressed.

- Abstract
- Project aims (1 page)
 - Multi-disciplinary research: Include long term (> 10 year) Grand Challenge question and associated focused research topic up to 5 years in duration.
 - Infrastructure: Include description of proposed infrastructure.
- Project Significance: a) for university and b) for Grand Challenges, including multi-disciplinary nature and replicability/scalability. Also include why WSU is uniquely suited to do this work. (1 page)
- Implementation Strategy: Timeline and tactics needed to implement, with supporting evidence to demonstrate achievability, including nature of institutional impact relevant to the strategic plan.
 - Strategies/methodology, including supporting evidence for effectiveness of the proposed implementation strategy/methodology. (4 pages)
 - Suitability of the team to execute the proposal at scale and in a timely fashion. (1 page)
 - o Assessment plan/milestones for each year of the duration of the project. (1 page)
 - Expected outcomes related to generation of additional outside financial support and/or establish/demonstrate a strong capacity for public engagement and outreach to underserved communities locally, nationally, or internationally through ongoing partnerships. (1 page)
 - Expected student involvement and other important outcomes. (1 page)