Kansas State University

Expression of University Strengths

April 2015
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MEMORANDUM

DATE: April 22, 2015

TO: Members and Staff of the Kansas Congressional Delegation

FROM: Kirk H. Schulz, President Kansas State University

RE: Kansas State University Expression of Strengths Document

On behalf of Kansas State University, I would like to thank each of you for your work in Washington on behalf of the citizens of Kansas. Your guidance and help has helped the University to launch and enhance programs and research efforts over the years. We particularly appreciate the support you have shown Kansas State University in the past.

This document is presented to you as expressions of university strengths. The university Vice-Presidents, Provost, Deans, and Directors believe these initiatives represent the strengths of the university and match current federal initiatives and programs. In addition these initiatives are in step with K-State 2025. This is the University’s strategic plan with the goal to be recognized nationally as a Top 50 Research University by 2025.

If you have questions about any of these requests, please contact Sue Peterson, Director of Governmental Relations, at 785-532-6221 or skp@k-state.edu. She will provide you with whatever information you may require. You may also access this document electronically on the K-State Governmental Relations website at www.k-state.edu/govrelations/federal/.
Building the Future of Global Food Systems
Through the new “Food Systems Research and Education Facility”

The College of Agriculture and K-State Research and Extension are starting to plan a new Food Systems Research and Education Facility. This state-of-the-art building would house diverse programs related to agricultural and food systems. It would include cutting-edge research laboratories, modern greenhouses, specialized teaching laboratories, extension and distance education space, and classrooms.

Background
Kansas agriculture has been successful because of solid partnerships between producers, government, industry and Kansas State University. “Farm to Fork” agriculture employs more Kansans than any other sector of the state’s economy. As the biggest business in the state, agriculture is critical to Kansas’ future, and K-State is essential for continuing to grow this industry.

With an increasing world population and a growing middle class, Kansas is well positioned to benefit from the resulting increased food demand. However, we need to develop higher yielding crops, more intensive cropping systems, enhanced beef/dairy genetics and production, and improved processing and distribution systems that minimize food loss while maintaining the natural resource base for future production.

Description
Researchers and educators at Kansas State are internationally recognized in food and agriculture. Last year, the U.S. Agency for International Development selected K-State for three international centers to focus on postharvest loss, sorghum and millet, and wheat. The National Science Foundation also funded its first ever center for wheat genetics resources at K-State.

Recently, the National Academies of Science’s National Research Council published the rankings of doctoral programs in the United States. Most of K-State’s College of Agriculture programs were in the Top 10: Plant Pathology – No. 1; Agricultural Economics – No. 4; Entomology – No. 8; Food Science – No. 9; and Plant Sciences – No. 10. The Department of Animal Sciences and Industry was No. 5 in terms of research productivity.

In 2013-2014, the College of Agriculture/K-State Research and Extension expended $85 million in research, which was approximately half the total research expenditures at Kansas State University.

Relevance
College of Agriculture Teaching Excellence Faculty in K-State’s College of Agriculture have earned 13 national or regional Excellence in College and University Teaching Awards from USDA and the Association for Public and Land-Grant Universities, more than any other university in the nation. Not surprisingly, this teaching excellence has attracted more students.

During the past 10 years, the number of students in the college has increased by more than 1,000, reaching a total of 3,370 in fall 2014. In addition, almost 100% of College of Agriculture graduates find excellent jobs, most of them in Kansas (~65%). USDA expects the demand for these graduates will continue to grow.

For K-State to reach its 2025 goal of becoming one of the nation’s Top 50 public research universities, the College of Agriculture/K-State Research and Extension must continue to increase its research, teaching and outreach activities.

Current Agricultural Facilities Situation
The College of Agriculture has very few modern laboratories, greenhouses and other research or teaching intensive facilities. The last building constructed for plant-related research was Throckmorton Hall, completed in two phases (1981 and 1994). Other buildings housing animal, meat, food, grain and entomology studies range from 58 to 102 years old. While renovations have been made, these facilities cannot be retrofitted to meet modern research and teaching needs.

The College of Agriculture does have a few new state-of-the-art facilities, such as the flour mill and feed technology innovation center, and these were critical to securing the large USAID and USDA grants recently received. Funders notice new, cutting-edge research facilities and their capabilities. To increase our competitive edge, we need to invest in modern facilities.

To capitalize upon our existing strengths in food and agricultural research, we propose a new Food Systems Research and Education Facility (FSREF). The new building will also address the need for growth
required by the College of Agriculture/K-State Research and Extension and Kansas State University to meet the goals in their respective 2025 strategic plans.

A recent Space Needs Analysis for the college, conducted as part of the K-State campus master planning process, identified a serious need for an additional 231,572 square feet of usable research laboratory space. The new FSREF will only partially meet this need.

The FSREF would add about 110,000 square feet of usable state-of-the-art research laboratory space; an additional 50,000 square feet of modern greenhouse space to supplement the existing and aging greenhouse facilities; and nearly 40,000 square feet of usable space for teaching, extension and distance education.

Laboratory space would be configured in an open model. A relatively small amount of space will be fixed, while the remainder will be flexible, easily reconfigured space with moveable lab benches, cabinetry and other lab furniture accessories.

The new building will include an appropriate number of offices and conference rooms, as well as adequate space for our partners from the USDA Agricultural Research Service. This will continue our great research collaboration and synergy.

Research space would be allocated to work on the big issues facing Kansas agriculture and the food system (i.e. wheat, sorghum, beef, food safety, water, etc.). With enhanced facilities at K-State, Kansas will continue to produce more crops and livestock for consumers here and abroad, and Kansas agriculture will continue to lead the state’s economy.
Wheat Genetics Resource Center (WGRC): A Global Leader in Wheat Genetics Research

Background
- Temperature increases are projected to decrease wheat yields by 20-30%
- Demand for wheat is expected to increase by 60% over the coming decades

The WGRC at Kansas State University and public/private partners will leverage wild wheat genetic diversity to ensure the stability and profitability of future wheat crops. Genetic diversity is the raw material for developing new and improved crop varieties. Research at the WGRC will address the challenges of hot and dry climate conditions through adaptive breeding, leading to job creation and billions of dollars in economic impact.

Description
Over the last 100 years, scientists have collected wild wheat species from the harshest environments on earth. Over the last 36 years, the WGRC has assembled a wild wheat species working collection now housed at Kansas State University and the Kansas Wheat Innovation Center in Manhattan, KS. Contained in these wild wheats are naturally developed traits ranging from pest resistance, heat and drought tolerance, and other climate-related adaptation traits to end-user health and nutritional characteristics. Although the WGRC has made pioneering contributions in collecting this treasure trove for wheat improvement programs, limited technology, resources, and expertise impede the ability to efficiently and fully mine these genetic resources.

Addressing this need, Kansas and Colorado farmers, private corporations, Federal and State agencies, Kansas State University and Colorado State University have leveraged expertise and resources to form the WGRC Industry/University Cooperative Research Center (WGRC I/UCRC), a National Science Foundation (NSF) Research Center. The first of its kind in the plant sciences, this Research Center’s mission is to access and apply wild wheat traits to wheat breeding programs across the US and the world.

WGRC NSF I/UCRC research will lead directly to the development of world-changing wheat varieties, reaching every corner of the globe.

Relevance
With operational and infrastructure investment, the Center will greatly accelerate the genetic resources conservation program, bridging fundamental research to commercial applications in a shorter period of time.

Partners in Job Creation, Economic Development, Cutting-edge Technology and Innovation

Center Resources and Objectives
1. Collect, conserve, and distribute wheat genetic resources: The WGRC gene bank currently maintains 20,000 lines, including 4,000 wild wheat species strains, native to the Middle East, that may be extinct, and 16,000 unique genetic stocks. These collections are continuously expanding as the WGRC acquires, develops, and distributes new genetic and genomic resources to facilitate wheat genetics, genomics, and breeding research.

2. Develop improved germplasm with emphasis on drought and heat tolerance: Novel traits are continuously identified and incorporated into improved germplasm. Fifty-seven improved germplasm lines containing novel pest resistance genes have been released and made available to the wheat breeders across the globe.

3. Training and outreach: Over the past 36 years, the WGRC has trained 15 MS, 23 PhD, and 22 Post-Doctoral students. WGRC has sponsored 72 visiting scientists with formal appointments and publishes the Annual Wheat Newsletter for dissemination of research results.

In addition, the WGRC will focus on the identification and application of drought and heat tolerant wheat traits for the Southern Great Plains and other drought prone regions in the US.

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Food Animal Residue Avoidance and Depletion (FARAD) Program

Background/Description
The Food Animal Residue Avoidance and Depletion (FARAD) program is an integrated extension and applied research program that maintains the Food Animal Residue Avoidance Databank, which is designed to eliminate adverse drug and chemical residues from appearing in the edible tissues of food producing animals. FARAD helps keep food animals healthy and safe for human consumption through outreach activities that include a telephone hot-line (1-888-USFARAD), website for request by veterinarians for direct residue avoidance assistance (www.FARAD.ORG), and mobile applications for field use. FARAD is a veterinary tool designed to keep adverse levels of drugs and chemicals from contaminating milk, meat and eggs destined for human consumption. No other federal or private entity duplicates work carried out by FARAD. FARAD straddles the missions of USDA (agriculture research and extension) and FDA (food safety). FARAD is an integrated extension and applied research program that provides required, scientifically valid information on how to avoid drug, environmental and pesticide contaminant residues in milk, meat and eggs, thus helping to avert food safety crises. FARAD provides the scientific basis for determining the appropriate withdrawal period when drugs are used in an extra-label manner, a scenario often employed when veterinarians are trying to reduce antimicrobial resistance in animals they treat. The research component of this program involves development of mathematical models that predict withdrawal times and then can be used real time by veterinarians in field situations. FARAD publishes handbooks and journal digests of these data to increase availability to practitioners, as well as contributing technical manuscripts to the peer reviewed scientific literature of this field. FARAD is also used when food-producing animals are mistakenly exposed to environmental contaminants (pesticides or biotoxins, melamine, etc), or for example to nuclear fall-out two years ago from the Fukushima reactor disaster in Japan. FARAD provides veterinarians with a legal mechanism for determining withdrawal intervals for extra-label drug use or contaminant exposures. Because it is often not economically viable for pharmaceutical companies to pursue a drug label claim for minor species, FARAD is the only source for food safety and drug withdrawal information for veterinarians treating these particular species (sheep, goats, reindeer, elk, ducks, pheasant, quail, rabbits, fish shrimp, and honeybees). Veterinarians often must use drugs approved for both animals and humans to address animal health and welfare and to enhance public safety. PL 103-396, Animal Medicinal Drug Use Clarification Act (AMDUCA), authorized in 1994, permits veterinarians to prescribe drugs in an extra-label manner to treat conditions for which there are no effective approved drugs. AMDUCA requires a scientifically-derived withdrawal period for drugs used in an extra-label manner. FARAD is the only approved source for such information and in fact enables much needed drug usage in food animal practice. FARAD serves as the veterinarian’s clearing house for residue data.

Relevance National/Regional
The FARAD program was developed in 1981 by pharmacologists and toxicologists at four land-grant universities. Dr. Jim Riviere of the College of Veterinary Medicine at KSU is the national coordinator for this program with collaborators at the University of California-Davis, University of Florida and North Carolina State University. FARAD continues to serve as the primary resource for veterinarians to maintain a drug and chemical residue free food supply. In 2014, FARAD experienced a 20% increase in residue avoidance cases. FARAD personnel developed a protocol requested by a number of states to help divert some residue contaminated milk, not appropriate for direct human consumption, by defining limits for safe use in veal calf operations. The global veterinary drug residue avoidance database effort continues to be pursued, a development which would greatly impact the food safety community, and provide direct support for Kansas beef exporters.

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The Food Animal Residue Avoidance Databank is authorized in the Agriculture Action of 2014 (PL 113-79), Section 7307 [H7308] at $2.5 million. The program is scheduled to be funded for Fiscal Year 2014 at $1.25 million.
Great Plains Sorghum Improvement and Utilization Center

Background
This project is an effort to enhance the overall productivity and value of U.S. grain sorghum and improve its value as a food, feed, and bioenergy crop.

Description
The U.S. is a major producer of grain sorghum. Kansas and Texas are the largest producers, contributing to >80% of U.S. sorghum acreage and production. Despite the importance of this crop for farmers in drought prone environments and the many new opportunities for sorghum utilization in the bioenergy, bioproducts, and food industries, particularly gluten-free foods, relatively little public or private resources are being invested in research on genetic improvement, production, or innovative uses of the various types of sorghum. The trend towards less research and technology transfer efforts on sorghum threatens the economic stability of sorghum producers and fails to capitalize on the unique opportunities afforded by this crop. This is reflected in the continual decline in sorghum acreage in the U.S. and, particularly, in key sorghum producing regions of Kansas and Texas. In 2014, sorghum was planted on about 7.2 million acres across the U.S., down 940,000 acres from the 8.1 million planted in 2013. The decrease was caused by producers choosing to switch acreage to higher valued soybeans, particularly in areas with improved growing conditions from previous years of drought, like Kansas and Texas, the two largest sorghum producing States in the Nation. Sorghum is more resilient to drought and high temperature stress compared to corn. More strategic research is needed to increase the yield potential of sorghum under both irrigated and dryland conditions.

Kansas State University initiated the Center for Sorghum Improvement in 2001. In 2006, these efforts were expanded to a regional scale with the development of the Great Plains Sorghum Improvement and Utilization Center (GPSIUC). The GPSIUC extended the interdisciplinary concept to include K-State, Texas Tech University, and Texas A&M University, integrating the combined expertise and resources of these three universities. The focus of research was on genetic improvement, production systems to enhance water and nutrient use, innovative strategies to provide improved weed control, utilization of sorghum in human food products, animal feed, and as a bioenergy and industrial feedstock, plus marketing, and policy analysis in support of the US sorghum industry.

Relevance
Past surveys of sorghum growers identified their primary sorghum needs. Based on grower’s responses, the following objectives were identified:

- Improve yield potential, production efficiency, and food, feed and bioenergy value of sorghum, through plant breeding and genetics.
- Develop new uses for sorghum in food and non-food applications, emphasizing the sorghum grain’s desirable characteristics, such as absence of gluten.
- Identify more efficient production strategies that will enhance water and nutrient use, particularly nitrogen, and provide new options for the control of weeds and pests, to increase sorghum yield and profits.
- Expand research on sorghum as a bioenergy crop uniquely adapted to drier regions of the U.S.
- Provide market and policy analyses, and develop educational programs for sorghum-based products and production systems to increase profitability of all segments of the U.S. sorghum industry.

The GPSIUC is continuing existing research and education programs, particularly in genetic improvement, production efficiency, and sorghum utilization. Sorghum is one of the most drought and heat tolerant crops in the world, offering potential advantages as a food, feed, and bioenergy crop to the rural economies of the Great Plains. The wide diversity of sorghum types (sweet, forage, silage, biomass, grain) offer tremendous opportunity, but these resources need to be evaluated to identify the best suited varieties to meet the specific needs of food, feed, biofuel, and industrial uses. The absence of gluten in sorghum grain offers opportunities for the development of new food products for people suffering from gluten intolerance.

Systems for production, harvesting, transportation, and storage of sorghum products, feedstocks, and co-products have to be developed to meet the needs of the bioenergy industry, while optimizing the use of our natural resources, especially water and nitrogen in our dry climate, and protecting the environment.

To meet the growing demand from private industry and academia, it is important to train graduate students as sorghum scientists. Expanding training and research on genetic improvement, production and utilization will result in technologies and information leading to an increase in sorghum productivity and profitability, and improving the U.S. sorghum’s industry global competitiveness.

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Institute for the Health and Security of Military Families

Background
For American military personnel who have served in war, federal programs have long been in place to address physical injuries from bullets and bombs and psychological injuries of wartime trauma. In relatively recent times, however, veterans returning from war have faced difficulties neither anticipated nor addressed by federal programs. These include chronic health problems resulting from exposure to environmental hazards (e.g., chemical defoliants in Vietnam and a complex mix of neurotoxins in the Persian Gulf War) and Traumatic Brain Injury (TBI) encountered during deployment, as well as long-term health impacts (e.g., PTSD) on SMVF populations. Increasingly for today’s professional military (both active and reserve components), the aftermath of wartime service has consequences not only for veterans’ well-being, but for their families and communities.

Description
Kansas State University (KSU) is home to a unique cadre of scientists from diverse disciplines with an impressive track record in research, outreach, academic and clinical service programs addressing the health, well-being, and sustainment of service members, veterans and their families (SMVF), including:

- Programs and community support networks for military-connected children and youth, through local 4-H Clubs, schools and OMK youth/family camps
- Research and training programs on violence prevention in military families, quality childcare and childhood social emotional health
- Clinical programs for military personnel, veterans and families
- Research on the long-term effects of deployment and war-trauma on marriages, child and youth development, employment, and financial planning
- Cooperative Extension services to families of military personnel
- Online graduate programs for professionals who serve military families
- Research on the effects of high-intensity functional exercise training on the body composition, fitness and health of active duty military personnel as well as on barriers to physical activity participation for disabled veterans.

In addition to contributions made by researchers from colleges across the university, the Institute is the “tip of the spear” for K-State’s alliances with area military installations, the Kansas National Guard, Army Reserve, US Department of Veteran’s Affairs, the Department of Defense, and other state and national organizations.

Relevance National/Regional
Our current partnerships with the U.S. Departments of Agriculture and Defense have been primarily focused on outreach rather than on research funding for the study of military families. These outreach initiatives support significant programming underway at K-State and across Kansas. Proposals to other federal agencies, such as the Department of Health and Human Services, will expand the reach of the College of Human Ecology and its units. Expanding partnerships to support additional investment in relevant research would enable Kansas State University, the College of Human Ecology and the Institute for the Health and Security of Military Families to capitalize on the expertise available here.

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Pre-Harvest Food Safety and Security

Background/Description
The goal of this program is to develop strategies to identify and mitigate food-borne pathogens and antimicrobial resistance in beef production systems. Specifically, studies will focus on the ecology of Shiga toxin-producing Escherichia coli (STEC), both O157 and non-O157 serotypes, Salmonella, Campylobacter, and antimicrobial resistance elements in beef cattle and on the development and testing of on-farm mitigation strategies, with the ultimate goal of enhancing food safety and public health. Because of the economic importance of beef production and beef processing in Kansas, as well as Kansas State University's leadership in beef cattle research, it is logical for researchers to focus on food-borne pathogens and pre-harvest beef safety. The research outcomes will have major positive impacts on public health, animal well-being, and the economic prosperity of the state of Kansas and U.S.

Relevance National/Regional
The food supply in the United States is one of the safest in the world; however, food-borne illnesses do occur and frequently are associated with foods of animal origin. The College of Veterinary Medicine at K-State has an interdisciplinary research team to address scientific issues related to the four vital areas in pre-harvest food safety in beef cattle: STEC (O157:H7 and non-O157), Salmonella, Campylobacter, and antimicrobial resistance of food borne and normal gut bacteria. The team with microbiology, molecular biology, epidemiology and production systems expertise, with collaborations with researchers from other departments at K-State, and input from key industry stakeholders is generating valid and industry-relevant outcomes. The long-term research goals are to understand the ecology of food-borne pathogens in cattle and their environment and develop effective and practical strategies for comprehensive reduction or elimination of food-borne pathogens at the farm level.

Shiga toxin-producing E. coli (STEC): Healthy cattle are the major reservoir of STEC, with the organisms residing primarily in the hindgut. These bacteria are shed in the feces, which then serve as a source of contamination of beef, produce, and recreational and drinking water. Research efforts in the past have focused primarily on STEC O157:H7. Recently, there is increased recognition that six other STEC serogroups, O26, O45, O103, O111, O121, and O145, are also major public health concerns. According to the CDC, the non-O157 STEC serogroups account for twice as many illnesses as STEC O157. However, not much is known about the ecology of the non-O157 STEC in cattle and their environment, partly because methodologies to isolate and detect non-O157 STEC have not been developed. Data on prevalence and factors affecting fecal shedding of these serogroups in the cattle population are needed before strategies for their control can be developed.

Salmonella: The presence of Salmonella in beef cattle production systems can cause serious adverse effects in cattle as well as humans. In cattle, Salmonella can affect morbidity, mortality, production efficiency, and the economic well-being of cattle producers. Salmonella is a common cause of gastroenteritis in humans with outbreaks and infections often linked to consumption of contaminated beef, water or other foods. The emergence and dissemination of multi-drug resistant Salmonella are also major concerns for public health. The research goals are to understand the ecology and epidemiology of Salmonella in cattle.

Campylobacter: The species of Campylobacter cause enteritis and in some instances abortion in cattle. However, the importance of Campylobacter is as a food-borne pathogen that can cause sporadic cases and outbreaks of human Campylobacter infections. In the past, human infections have chiefly been attributed to poultry sources. Recently, cattle have been recognized as an important source of food contamination. The research goals are to understand the ecology and epidemiology of Campylobacter in cattle.

Antimicrobial Resistance: The use of antimicrobials in animal agriculture is considered a major contributor to the emergence and spread of antimicrobial resistance in the environment. The concern over antimicrobial resistance has important consequences for public health and food-animal industries, including restricted access to global markets. The goal is to monitor prevalence, amplification, and dissemination of antimicrobial resistance genes and bacteria that carry resistance genes in beef cattle.

The four issues outlined strengthen the need to understand the ecology and epidemiology of food-borne pathogens for effective pre-harvest intervention strategies so that cattle with fewer pathogens and lower antimicrobial resistance elements are presented for slaughter. Control strategies aimed at reducing the prevalence and concentration of these bacteria and their resistance elements in cattle feces, thus reducing the overall number of bacteria entering both food and environmental pathways, may be the most effective approach for reducing the overall risk of human infection and maximizing public health outcomes.

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1.6
The Center of Excellence for Food Safety Research in Child Nutrition Programs

Background
The United States Department of Agriculture’s Food and Nutrition Services (FNS) provides support for feeding more than 31 million children school lunch each day in 100,000 schools and about 12.1 million breakfasts in 89,000 schools. The safety of these meals is of great importance and there is strong Federal legislation to support food safety.

As part of an initiative of the Secretary of Agriculture, FNS established The Center of Excellence for Food Safety Research in Child Nutrition Programs at Kansas State University in 2011 to provide science-based support to improve the safety of foods provided through the FNS nutrition assistance programs, particularly those served in schools and child care settings.

Description
Faculty at Kansas State University has established the Center of Excellence and is conducting research to support food safety issues and concerns of FNS. The Center of Excellence provides researchers the opportunity to conduct food safety research that will have an immediate impact on child nutrition programs and the safety of food served. The goals of the Center of Excellence are to provide a multidisciplinary approach to basic and applied food safety research needs related to child nutrition programs and conduct applied studies to resolve food safety issues in schools and other child nutrition programs and convey those findings in a way that facilitates the transfer of knowledge to school foodservice directors and program operators, scientists, policy makers, educators, and practitioners.

The Department of Hospitality Management and Dietetics, in the College of Human Ecology, serves as the administrative home of the Center of Excellence. The Center has received funding for a four year period at $3.2 million. Continuation of the Center will depend on FNS priorities and funding availability. Further, FNS could decide to require us to compete for the grant after the fourth year of funding.

This cooperative agreement with FNS provides a funding mechanism for other projects. For example, in 2012-2013 we worked with the food safety education group in USDA Food Safety and Inspection Service in planning and implementing a research project to evaluate the effectiveness of one of their educational campaigns. Funding of $500,000 was provided to the Center through an interagency agreement.

Relevance National/Regional
K-State offers food safety expertise along the entire continuum of the food chain that is unparalleled in any university across the nation. Research results generated by the Center of Excellence have national relevance. Research focuses on current food safety practice. This applied research is used by FNS and the National Food Service Management Institute (funded by FNS) as the basis for developing educational programs. This strong relationship ensures that the research is translated in meaningful resources to have a positive impact on practice.

The Center developed an intensive immersion course on the food safety principles that undergird food safety. The course was pilot tested twice in 2013, offered three times in 2014, and is planned for three sessions in 2015. The course continues to be delivered to school foodservice practitioners to develop their understanding of food science as it applies in their school districts and to develop preventive programs and respond to any crises that might occur. Staff from USDA regional offices and state agencies also participate.

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Groundwater and Society: Developing Technologies to Conserve the Ogallala Aquifer

Background
A grand challenge for the 21st century is providing high quality water for Kansas, the USA, and the globe. Fresh water from surface and underground sources is increasingly in short supply in the Ogallala region of western Kansas. Aquifer and surface water depletion, limited precipitation, and population shifts to mid-sized communities in western Kansas have stretched community and regional water supplies. However, this region leads Kansas in crop production and comprises the core of the U.S. beef cattle feeding industry. The top eight Kansas agricultural counties are located over the Ogallala Aquifer and represent $4.7 billion in crops and livestock, or one-third of Kansas' total agricultural revenue.

Developing more comprehensive understanding of the nexus of water, food, and society is crucial. As demand for water resources continues to increase, improved water management practices for crop and livestock production and water supply assurance for communities will be critical for sustaining economic viability and population base of the region. The latest tools and technologies are available to analyze the impacts of water-use policy decisions on economies and society and to engineer politically acceptable solutions.

Description
An interdisciplinary team of faculty members at Kansas State University studies risks and consequences of groundwater use and scarcity and develops new technologies to help citizens effectively manage water resources. As a Land Grant University, K-State has water-related expertise in agricultural sciences, social demography, resource economics, agricultural systems analysis, water resources engineering, policy analysis, and computer science and technology.

Research: Agricultural sciences, engineering and public policy dimensions of water and society provide information critical to decision-quality actions.

Education: Curriculum in water management, plant genetics, and computational models trains the next generation of water scientists and managers.

Extension and Outreach: Engagement with agencies and stakeholder organizations identify alternative methods to minimize groundwater scarcity challenges and assist water managers implement new practices.

Relevance
This team:
1) Informs citizens, planning agencies and policy makers understand of technical aspects of water resource management and the economic, social and natural system impacts of policy strategies.
2) Develops more efficient irrigation technologies, improved scheduling procedures, and combined water and nutrient management. Research and extension efforts guide producers in efficient irrigation strategies for various types of irrigation systems, as well as transition towards limited irrigation and dryland practices.
3) Evaluates alternative food and feed grains, oil seeds, and energy crops for drought and heat tolerance, adaptation to no-till or strip-till production systems, and utility as feed for livestock or feedstock for liquid fuel production.
4) Develops and evaluates technology to utilize for wastewater-use from concentrated animal feeding operations. Technologies can decrease potential environmental impacts from wastewater re-use, such as runoff into streams and odor, while conserving fresh water.
5) Utilizes the latest technologies and computational forecasting tools to quantify and understand interactions and feedbacks between available water resources and societal needs and values. Collectively, this computational infrastructure can provide the scientific basis to support sound planning, state, county, and local analysis and decision-making to development of equitable and fair water policies.

While groundwater stores are vulnerable, water resources systems can be made more resilient in order to cope with the foreseeable future. Communities, businesses and agricultural interests worldwide are struggling to address problems in efficient water-use for efficient agricultural and industrial. This program provides science-based research to guide management and policy. Well planned conservation of water resources is critical to the economic viability and stability of western Kansas.

Western Kansas seeks long-term solutions to manage a depleting Ogallala and develop agricultural systems, engineering and policy solutions to sustain the aquifer for current and future generations. Water is a primary requirement for quality of life in drinking water, power generation, crop production, and industrial and municipal use). Without the water of the Ogallala Aquifer, Kansas communities will suffer.

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Child Health and Physical Activity

Background
Childhood obesity is a major public health issue facing the United States and the world. Prevention of childhood obesity is not likely to be solved by a simple solution. Rather, scientific consensus documents suggest that the causes are multifaceted and best understood by applying a human ecological model across the lifespan in research and practice. The College of Human Ecology at Kansas State University is uniquely positioned to address this important public health problem because it is one of a handful of institutions that houses programs specializing in the study and practice of physical activity, human nutrition and dietetics, food sensory analysis, family systems and therapy, and child development.

Description
Scholarly work currently underway includes:
1) Investigation of ways to make health behavior change easier for parents and families to incorporate into their lifestyles;
2) Experiments that incorporate community stakeholders in the process of creating health promoting communities,
3) Analysis of how food and physical activity choices specifically affect health outcomes in children of all ages.
4) Multi-state extension education projects focused on reducing childhood obesity.

Kansas State University has research facilities structured (physically and organizationally) to study child health issues.
1) The Hoeflin Stone House Early Childhood Education Center where children are observed at play and at mealtime.
2) The internationally recognized Sensory Analysis Center investigates how different aspects of food (taste, texture, smell, etc.) affects children’s food choices to better understand how to make healthy options the preferred choice of children.
3) The Center of Excellence for Food Safety Research in Child Nutrition Programs, provides scientific solutions to child food safety problems - especially food safety problems that are evident in school lunch rooms across the United States.
4) The newly established Physical Activity and Nutrition Clinical Research Facility supports cause-effect studies of how lifestyle choices impact the health of children, their parents, and adults.

5) The Youth Physical Activity and Nutrition Motivation Laboratory studies community-based childhood obesity prevention interventions.

The collaborations of College of Human Ecology Faculty have led to competitive grants totaling $12 million in funding to support childhood obesity, physical activity, nutrition, and community interventions to improve the health behavior of children.

Relevance National/Regional
The issue of child nutrition and health has national relevance due to its relationship with quality of life and cost of health care. Kansas State University is well positioned to conduct basic and applied research to support improvement of child nutrition and health.

We have the facilities needed to support clinical research of childhood nutrition, health, and obesity and we provide educational programs for school foodservicer professionals and other community practitioners whose work impacts the health of children.

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Healthy Cattle, Healthy People, Healthy Planet: Beef Initiative

Background/Description
Kansas State University is recognized as a leader in beef cattle production and health management research, outreach and education. The Kansas State University Beef Cattle Institute (BCI) is an international leader in beef cattle production education and outreach. The BCI has established the international online bilingual training center for beef producers, veterinarians, food processors and others involved in producing beef. The focus of this training is food safety, antimicrobial antibiotic avoidance, beef cattle health and well-being, employee training, employee retention, and beef cattle production practices. It is vital to understand the impact of management practices on subsequent safety from food-borne pathogens in the beef industry. This program could also enhance food security in the U.S. as an emergency notification system for all people involved in food animal production on foreign animal diseases. The BCI aims to develop an international training center to educate producers world-wide on the best management practices to raise affordable beef while promoting food safety, environmental stewardship and animal well-being.

We are seeking federal support to address emerging issues in the beef industry. The support will: 1) fund further development of an international bilingual training center to enhance beef food safety, minimize antimicrobial residues, improve the health and well-being of beef cattle and promote environmental stewardship through training of the rural workforce world-wide, 2) fund research to manage health and well-being of beef cattle through a living classroom, 3) provide support for effective communications with producers and consumers about best practices for beef production and prevention of the spread of food-borne pathogens, and 4) invest in the development of a program that could be adopted by other food animal industries in the U.S. and other countries world-wide.

EXPECTED OUTCOMES: Support will provide a far reaching, cost effective program that will: 1) enhance food safety from farm to fork, 2) decrease antimicrobial residues in beef, 3) improve cattle health and well-being, 4) increase job opportunity for English and Spanish speakers in the beef industry, and 5) benefit consumers by providing cost effective training that improves food safety, antibiotic residue avoidance and cattle health without increasing the cost of production or the cost at the counter.

Relevance National/Regional
Programs offered through the Beef Cattle Institute translate and communicate critical animal health and well-being information to the livestock industry. A safe beef supply for the nation begins in the grasslands and extends through the supermarket.

Kansas is home of the second greatest concentration of beef cattle per square mile of any state in the U.S. The beef sector generates over $7 billion annually in cash receipts. The beef industry is absolutely central to the state and the regional rural economies.

Unparalleled challenges and opportunities face the beef industry in the coming decade. Food security, food safety, antimicrobial avoidance and beef cattle health and well-being are dependent on the development of such a center in the United States. Support of this request will provide international leadership for the world’s One Health Initiative… the confluence of animal health, human health and environmental health.

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Healthy Relationships

Background
In 2011, 24,159 domestic violence incidents were reported to law enforcement agencies across Kansas, the most seen in the state in 20 years. In that same year, nearly one in four homicides in Kansas was partner violence-related. However, these statistics are unable to provide a complete picture as these numbers represent only the cases that are reported. It is estimated that almost half of the cases of domestic violence go unreported and therefore many more men, women and children suffer as a result of partner violence. Both the Centers for Disease Control and Prevention and organizations such as the Kansas Coalition against Sexual and Domestic Violence are calling for research on which to base the development and enhancement of prevention and intervention programs. Every person deserves the opportunity to have healthy relationships and to live lives free from the experience of intimate partner violence.

Description
Scholarly work underway includes research on:
1) ways to support healthy relationships across life-cycle transitions, across cultures, in emerging adulthood and in long-term relationships;
2) the impact of witnessing interparental violence on healthy relationship development in subsequent generations;
3) the impact of treating depression on intimate relationships;
4) romantic relationship factors linked with the management and course of diabetes;
5) the impact of relationship and/or fatherhood mobile applications in supporting healthy partner and/or or parenting relationships;
6) developing and testing a partner violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families;
7) developing and testing of various partner violence prevention programs in the USAF;
8) The impact of romantic relationships and parenting behaviors on child outcomes.

The collaborations of College of Human Ecology faculty have led to grants and contracts totaling over $9 million in funding to support research on building healthy relationships and preventing partner violence.

Relevance National/Regional
Healthy relationships enhance all aspects of life. Children who grow up in home with parents in healthy relationships do better in all aspects of life. Adults who are in healthy committed relationships have better physical health, fewer physical and emotional problems and are more financially successful.

K-State researchers in the School of Family Studies and Human Services in the College of Human Ecology are conducting basic and applied research to support healthy relationship development and to prevent intimate partner violence. They are receiving private, state and federal funding for their research and have received national and international recognition for their efforts.

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Pathways Analysis of Transboundary Animal Diseases to Assess Risks in United States Agricultural Industries and Worldwide Food Security

Description
In support of the National Bio and Agro-Defense Facility (NBAF), the National Agricultural Biosecurity Center (NABC) developed a defined, consistent, and reliable method for assessing pathways through which transboundary animal disease (TAD) agents might enter the US.

- In order to address threats arising from TADs, the pathways of potential introduction should be identified, understood and documented. An up-to-date template for investigating pathways along with an established process for information acquisition provides the framework for analysis.
- The 10-year old pathways analysis for Classical Swine Fever Virus (CSFV) using current science and data served as the initial study and model for this project.
- Pathways analysis for African Swine Fever Virus (ASFV), currently on the DHS/USDA priority agent list for research in NBAF, will serve as the second high-consequence disease approved for pathways analysis.
- Pathways analysis for Rift Valley Fever Virus (RVFV), also currently on the DHS/USDA priority agent list for research in NBAF, will be the third high-consequence disease approved for pathways analysis.

Background
The United States’ food and animal agriculture industry is highly integrated, open, global, and complex. Introduction of a high-consequence transboundary animal disease (TAD) into US livestock would have a crippling effect on the overall economy, international trade, and the public’s perception of food safety. To address potential threats arising from TAD introduction into the US, whether accidental or intentional, pathways of introduction must be investigated, understood, and documented.

The Department of Homeland Security (DHS), which will own NBAF, has developed a list of priority agents to be studied. Included in the list are CSFV, ASFV, and RVFV.

NABC recognizes a need for a defined, consistent, and reliable methodology for pathways analysis describing the potential routes of entry, impacts, and information gaps associated with introduction into the US of any high-consequence disease organisms.

Through pathways analysis, NABC provides information and analysis used by policy officials, animal health officials, and NBAF scientists to make more informed decisions concerning strategies to prevent or control the spread of high-consequence TADs. Initial pathways analyses focus on NBAF-targeted agents and can be effectively expanded to include World Organization of Animal Health (OIE) reportable diseases, other government agencies’ needs, and industry prioritized agents.

Relevance
Pathways analysis will assist policy officials making informed recommendations for strategic preparedness planning to optimize surveillance and response strategies. Pathways analyses for agents of concern will enable proactive strategies to manage and respond to TAD introductions/outbreaks. Knowledge gaps identified through pathways analysis will prove useful in determining future NBAF research needs.

Knowledge products created are relevant to agencies concerned with protecting US animal health and food safety, security, and defense. Potential users of pathways analysis include the USDA, DHS Science and Technology (DHS S&T), and livestock commodity groups such as the National Pork Board (NPB) and National Cattleman’s Beef Association (NCBA). NABC’s ability to work in the classified arena will provide a more robust analysis to U.S. Government agencies on potential threats.

Research on NBAF-targeted agents is relevant to US interests due to the critical importance of protecting the nation from devastating economic effects resulting from introduction and spread of TAD’s. Creation of a defined, consistent, and reliable methodology of pathways analysis provide infrastructure and capabilities for an agricultural knowledge center capable of serving NBAF, government, industry, and partnering agencies information needs.

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EPICENTER: Laboratory for a network science approach to predict and control the spread of infectious diseases

Background
Few events disrupt society and cause economic loss as severely as an out-of-control infectious disease. Terrorist activities or natural causes can produce an epidemic that may result in human deaths, the disposal of herds, and the destruction of crops. Fundamental to EPICENTER’s mission is the conviction that epidemic dynamics and intervention strategies must be derived while accounting for underlying complex networks that describe multiple and dynamic interconnections among involved systems.

Description
EPICENTER, a laboratory within Kansas State University’s College of Engineering, provides resources to build, analyze, and simulate data-driven computational models for biomedical and biological systems represented as complex networks.

Research at EPICENTER challenges scientific boundaries by addressing the impact of (1) heterogeneity, (2) interdependence, and (3) stratification of networks in spreading processes. These three characteristics abound in natural and man-made infrastructures and networks, but fundamental questions remain unanswered regarding interconnected and stratified/multilayer networks.

Projects within EPICENTER
EPICENTER has successfully conducted several research projects since its inception in 2007. Current projects include:

- Predictive models of infectious diseases: This project aims to develop innovative multiscale computational models and tools to describe potential transmission cycles of zoonotic pathogens that could be introduced into the United States. Data generated by these models will be used to produce an operationally relevant predictive model that estimates the timing and spatial extent of emerging disease and the transmission risk to humans. Studied diseases include Ebola, Rift Valley fever, and Japanese Encephalitis.

- Spreading processes over multilayer and interconnected networks: The research goal is to establish mathematical tools and techniques in order to understand the role of multilayer and interconnected topologies in spreading processes. For example, a multilayer network is a physical contact network in which a disease can propagate among individuals and an online information dissemination network in which information can propagate among those same individuals. In zoonotic diseases, interconnected networks include the network of animals and the network of humans in which a virus can transfer from one population (network) to another.

- Integrated models of disease spread, supply chain logistics, and communication networks: The objective of this project is to develop integrated models that capture interdependencies between disease dynamics, supply chain logistics, and communication networks. For example, the spread of disease is influenced by the movement of animals, plants, and food products through the supply chain. Effective management of this movement and deployment of countermeasures such as vaccines, require effective risk and crisis communication plans that engage multiple stakeholders. Stakeholders also constitute a network through which information is transmitted. The integrated modeling approach is expected to yield new insight in order to prevent, mitigate, and respond to infectious disease outbreaks.

Relevance
The National Agricultural Biosecurity Center (NABC), the Institute for Computational Comparative Medicine (ICCM), the Center of Excellence for Emerging and Zoonotic Animal Diseases (DHS CEEZAD), the planned National Bio and Agro-Defense Facility (DHS NBAF), and EPICENTER are all located in Manhattan, Kansas, thus making Kansas the national leader in developing countermeasures to naturally-occurring and intentionally-introduced plant, animal, human, and zoonotic diseases.

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Increasing the capacity of College of Architecture, Planning and Design to advance development of rural towns through university-community-professional partnerships

Background
Small rural towns have challenges that are unique to their locations and situations. The vitality of these towns is challenged, among other things, by decaying public and private building stock and related infrastructure. This is compounded by diminishing resources, aging and/or dwindling population bases, and a lack of opportunities for growth, education, recreation, and community development. University-led teams have a unique set of skills to address these endemic problems.

For the past three years, the Small Town Studio at Kansas State University has been proffering design, development, and community-building services to small, rural towns across Kansas. The paradigm of the Small Town Studio’s work involves three constituencies, playing to the strengths of each group. University student and faculty teams have the time, basis of work, and knowledge base to devote to early pre-development exercises, including information-gathering and dissemination, community engagement, project definition, initial design proposals, and logistical work including consensus-building and the development of project funding, steps often difficult for town residents. Citizens of these towns, however, offer a great deal to the process of project development. They offer a wealth of historical and current information; they critique and guide student designs; they provide enthusiasm and communication; and they often pitch in to help complete projects. The third constituency is affiliated design and construction practitioners, who provide expertise, official documentation and other professional services.

The work has strong benefits for all concerned. Architecture students are able to study and design in a real context, sharpening their skills at interfacing with clients and the public, pre-design activities such as project formulation, and logistical concerns such as project implementation and management. These are all highly valuable traits in emerging professionals. Small rural towns receive close, high quality design and research services as well as real outcomes including economic development and realized designs. Practicing professionals receive fees associated with projects moving forward into production, and ensure high-quality built design for the town.

Relevance
Funds are sought to promulgate the Small Town Studio’s approach into a standing center to link the needs of Kansas communities with the resources of KSU’s CAP+D and other units across the university. Precedents for such a rural design and development center can be found in other Midwestern states, including Nebraska and Iowa; more broadly community and urban design centers have been established across the US. Most of these are university-led centers, due in no small part to the resource-strategic advantages of such a model.

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Big Data Analytics Institute: A Center of Excellence for Large-Scale Informatics in Business, Engineering, Science, and Education

Background
Vast amounts of data currently inundate researchers in all fields of study, but the data deluge especially impacts and challenges university researchers. A consistent, university-wide, large-scale resource able to provide high performance and efficient, flexible data access is therefore vital to those working to analyze and use this data. Attaining this type of resource and resulting data access will equip Kansas State University (KSU) for future research opportunities and satisfy compliance and data governance requirements for federal funding agencies. Although large datastores are essential for education and economic development, near-term shortfalls of nearly 200,000 trained data scientists able to utilize big data, and convert it to $300B in economic growth, are projected.

Information is currently generated as massive, high-dimensional, often heterogeneous data sets with complex correlation structures and/or nontraditional formats, typified by high volume, velocity, and variety. **Big data** refers to data sets characterized above and big data analytics are techniques for discovering patterns, unknown correlations, and large-scale inference methods for reliable variable selection and prediction. Cutting-edge research in social sciences, life sciences, physical sciences, and education generates petabytes of data that are transformatively collected, transmitted, stored, processed, and analyzed, thereby revolutionizing how scientists, engineers, businesspeople, and educators approach complex problems. High-dimensional data are generated in diverse fields, including agriculture, astronomy, climate science, ecology, energy, genetic analysis, geospatial sciences, and plant and animal health. These data are often generated in real time and require rapid analysis. Web-based sources also provide new realms of massive data to explore: linked data, spatial data, and natural language text, with applications to search, business intelligence, social media, digital humanities, and digital arts. This offers potential for improved decision support and informed policy making.

Description
This initiative proposes development of an interdisciplinary Center for Data Analytics at KSU, Manhattan, staffed primarily by data scientists from the Departments of Mathematics and Statistics in the College of Arts and Sciences and faculty associated with KSU’s Institute for Computational Research in Engineering and Sciences (ICRES) in the College of Engineering. These faculty, in collaboration with campus researchers, will provide the requisite skills for designing big data studies; collection, storage, and retrieval of big data; modeling and analysis of such data; and interpretation of results. New tools for data modeling, integration, and mining, statistical machine learning, and information visualization will be developed and disseminated to the broader community.

A fundamental goal of the Center will be development of innovative curricula for undergraduate and graduate students to engage in large-scale data science and computational applications such as data mining and visualization, recommendation, or pattern recognition. The Center will contribute collective expertise to applications of STEM such as precision agriculture, bioinformatics, health and medical informatics, security, and enhancement of secondary education. It will also provide significant advancements for federal and state initiatives on STEM workforce development.

Relevance
Establishing a Kansas Center for Data Analytics is well-aligned with KSU 2025 goals related to graduate and undergraduate education and research, including research experiences for undergraduates. The Center will focus on university strengths and critical needs, particularly biosciences, animal health, data mining, and informatics at KSU. In addition, utilizing cluster hires and/or joint appointments will strengthen and expand research funding opportunities university-wide. The Center will also facilitate corporate partnerships with industry in the Kansas-Missouri Animal Health Corridor. The KSU Olathe campus offers a convenient venue for business engagement and/or professional development related to big data. KSU’s ICRES has consistently developed and influenced cyber-infrastructure for research and education. With existing collaborations between leading national and international research organizations and the anticipated arrival of NBAF, ICRES can form alliances with and attract many cyber-enabled bioscience and biotech companies. This project will stimulate these endeavors, provide a vital research test bed, and establish a regional center in which to train a future cyber-enabled workforce.

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Center for Big Data Analytics
Development of a Center of Excellence for Large-Scale Inference in Business, Science and Education

Background
Information nowadays is generated as massive, high-dimensional data sets with complex correlation structures and/or nontraditional formats, and arriving with unprecedented velocity. For example, cutting edge data from the social sciences, life sciences, physical sciences, and education generate massive amounts of data (the so called Data Deluge). These data are being collected, transmitted, stored, processed and analyzed in a transformative way revolutionizing how scientists, engineers, business people, and educators approach complex problems. Applications of high dimensional data problems are pervasive in ecology, plant and animal health, agriculture, energy, and climate predictions. Astronomical transmissions and the geospatial sciences generate streaming data with demands for real time analysis. Yet another source for today’s massive data sets is Web based, providing new realms of data to explore including online searches, social networking activities and financial transactions, all with potential for advantageous business decisions and informed policy making. Big Data is the term given to such data sets as characterized above, and Big Data Analytics refers to techniques for the discovery of patterns, unknown correlations and the large-scale inference methods for reliable variable selection and prediction.

Data scientists, a term applied to people equipped to draw insights from large quantities of information, naturally includes statisticians and applied mathematicians. Using the technology associated with Big Data, statisticians and applied mathematicians search for features in massive data sets while working to avoid false discovery, bias and confounding, build mathematical/statistical models that explain and predict phenomena complete with measures of uncertainty, and design experiments to elicit data with useful information content. The interdisciplinary nature of much of today’s research motivates and supports advances in Big Data science.

However, and notably, classical methods of inference are not well-suited for Big Data applications. Further, although there has been much creative development of methodology to accommodate the analysis of Big Data in recent years, there exist significant limitations of current large-scale inference techniques (cf Large-Scale Inference by Efron, Cambridge University Press, 2010). Indeed, the importance of Big Data Analytics has been exemplified by the administration’s recently announced Big Data research and development initiative, including solicitations supported by the National Science Foundation and National Institutes of Health (www.nsf.gov/funding/pgm_summ.jsp?pims_id=504767&org=DMS&from=home).

Description
Based on the preceding interest and needs, it is proposed to develop a Center for Big Data Analytics on the Manhattan campus of Kansas State University. It is envisioned to be an interdisciplinary center staffed primarily by data scientists from the Departments of Mathematics and Statistics in the College of Arts & Sciences, working with subject matter scientists from across campus for the research and development of new tools for Big Data Analytics, as well as providing consulting support for specific Big Data analysis projects. Center participants would be expected to publish in top tier venues, secure private and public research funding and play a vigorous role in securing workforce grants. Therefore, a fundamental goal of the center would be the development of innovative curricula for undergraduate and graduate programs for students to engage in large-scale data-driven science. More specifically, the center would provide a step forward for NSF and NIH’s mission on STEM workforce development. In fact, a 2011 report projected a necessary increase of nearly 200,000 professionals with expertise in data science (a 50% increase) by 2018. (www.mckinsey.com/insights/mgi/research/technology_and_innovation/big_data_the_next_frontier_for_innovation).

The Departments of Mathematics and Statistics will have a combined faculty of 50 in 2013. Our faculty are graduates from top Mathematics and Statistics programs with some faculty having expertise in high dimensional data analysis, data mining, compressive sensing, random matrices, machine learning, and computational mathematics. Indeed, our faculty has a diverse range of specialties appropriate to a Land Grant Institution. Such expertise is completely consistent with the proposed center but does not constitute a necessary critical mass of faculty specialists needed to support the creation of new algorithms, software, and networking capabilities, as well as new approaches for security and privacy protocols. In order to develop and run a prominent Center for Big Data Analytics, it is thus requested that we expand our faculty numbers in the research specialties that lie in the intersection of mathematics, statistics, engineering, and computer
science. For example, wavelet packet transforms as tools for dimensional reduction in the context of hyperspectral imagery in medicine is now a breakthrough tool in applied mathematics, requiring both specialists in applied Fourier analysis and modelers who can connect real-world situations with mathematical abstractions, along with a forum where collaboration can develop. We also propose to hire staff scientists and expand our graduate and undergraduate assistants base so as to focus some of our most talented students on research projects in Big Data Analytics. Timelines for these hires would occur in the short (1 to 5 years) and intermediate (6 to 10 years) terms. Considering the interdisciplinary and multidisciplinary nature of the envisioned center, such growth could well utilize joint appointments and/or cluster hires. It is estimated that $1.5-3M, including start-up needs, would be required for such faculty growth, while the university supercomputer (Beocat) would constitute the major computing platform in conjunction with emerging technologies for Big Data Analytics. Also, during the time span mentioned above, the center would require renovation/expansion within current facilities or migration to other buildings consistent with the University Master Plan.

National/Regional Relevance
The establishment of a Center for Big Data Analytics is in perfect alignment with K-State 2025: A Visionary Plan for Kansas State University with the goal of being recognized as one of the nation’s Top 50 Public Research Universities. In particular, the center is in concordance with the stated theme of research, scholarly and creative activities, and discovery. In addition, the opportunity to offer instructional programs at the undergraduate and graduate level in Big Data science would greatly enhance recruitment of students interested in the tools for today’s data-driven sciences and business. For example, such a center would aid in the recruitment and subsequent cross training of graduate students enrolled in either of the Mathematics or Statistics Department’s Graduate Certificate programs in Applied Mathematics and Applied Statistics. Such themes also are consistent with College of A&S and department strategic plans.

The interdisciplinary nature of the center allows a focused approach to university strengths and critical needs. In particular, the activities of the proposed center would mesh well with the renowned bioscience and animal health environment at K-State, including initiatives at the College of Veterinary Medicine, ongoing work at the Biosecurity Research Institute, and future efforts at the planned National Bio and Agro-defense Facility. Several Statistics faculty are well established as collaborators with scientists involved with high dimensional genomics research on campus in the Division of Biology and the College of Veterinary Medicine. The creation of the center with cluster hires and/or joint appointments would strengthen and expand research funding opportunities for all in the biosciences. In addition, the center would facilitate corporate partnerships with industry in the Kansas-Missouri Animal Health Corridor. The K-State Olathe campus offers an appropriate venue for such engagement involving professional development and/or business related Big Data issues. A Big Data initiative at K-State would also be in consonance with the Mathematics Department’s Center for the Integration of Undergraduate, Graduate, and Postdoctoral Research, which involves workforce training for a diverse group of undergraduates, and data mining research projects for graduate students at the Center for Quantitative Education. To reach the K-State 2025 goals on retention and graduation will require developing models of student success using Big Data Analytics.

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Description
The Great Plains Center for Urban Watersheds (GPCUW) is a nexus of research, application, and outreach focused on sustainable green infrastructure and urban stream restoration in the communities of Kansas, the Midwest and Great Plains. GPCUW research focuses upon sustainable stormwater management, natural stream channel design and restoration, and innovative water conservation techniques in the cities and towns of Kansas. GPCUW communication joins teaching, service learning, and outreach with entrepreneurial opportunities between Kansas State University, Kansas State, Olathe, and those involved with sustainable water infrastructure in Kansas communities. GPCUW facilitates the development of new technologies and refinement of current practices for sustainable water planning and management. GPCUW practices rigorous and sustained monitoring of stormwater management, stream restoration, and water conservation measures for this is how we learn, improve, invent, and move closer to sustainability.

Background
Kansas communities are facing water supply shortages, the necessity of replacing aging water infrastructure, and the need for cost-effective, sustainable water conservation measures. Seventy percent of Kansas population (most of which is in eastern KS) relies on surface water for all or part of their water needs. Three of the five major river basins that supply water to the cities and towns of eastern Kansas show potential for shortages within the next fifteen years (perhaps sooner given current climate change and drought predictions). The remaining basins rely heavily upon reservoir storage which continues to decrease due to accelerated erosion and sedimentation. Thus the need for water conservation is real and pressing. Most Kansas communities are addressing the replacement of aging, water related infrastructure as a result of design life expiration or due to CSO’s (Combined Sewer Outflows), as well as searching for less expensive, longer lasting ways of handling stormwater in newly developing areas. Cities, towns, environmental planners and engineers, architects and landscape architects are in great need of green, sustainable water solutions. Yet, little research has been conducted regarding green infrastructure, natural channel design restoration, or innovative water conservation strategies in the Midwest. Information from the eastern US and the Pacific Northwest is often employed to design measures and practices for the dramatically different climatic, geologic, and biotic conditions and regimes of Kansas. Few of these measures are being monitored to gauge efficacy or applicability. Currently there is little to no extension or outreach to assist communities, agencies, or private entities regarding green infrastructure and water conservation. The requisite interdisciplinary expertise and experience are here at Kansas State; the coordination, synergy and conveyance of GPCUW allows for the application of this expertise.

Relevance
In 2009 the American Reinvestment and Recovery Act allowed the Kansas Department of Health and Environment to fund 15 “Green Infrastructure” projects for a total of $35M. Of these, 13 were in cities across Kansas and provided for the installation of one or more green infrastructure technologies or measures such as “constructed wetlands, rain gardens, bioswales, infiltration basins, bioretention cells, water harvesting, and green roofs”. These innovative, green technologies are being implemented throughout Kansas and the Midwest yet there is no research hub focused upon gauging efficacy or developing the most place-appropriate and sustainable measures. The need for the Great Plains Center for Urban Watersheds – its work of developing new technologies and practices for sustaining the water resources of Kansas is as real and urgent as the issues it will address. The sharing of new knowledge through education, extension, service-learning and innovative public-private partnerships is the mission of a land grant university. GPCUW at Kansas State University and Kansas State-Olathe will focus and facilitate a more resilient and sustainable water future for the communities and people of Kansas, the Midwest and Great Plains.

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Global Institute and National Center for Aerospace Diversity, Innovation and Education (I-CADIE)

Background/Description:
The Global Institute and National Center for Aerospace Diversity, Innovation and Education (I-CADIE) is a collaborative effort between government, industry and academia. It addresses emerging global challenges, long term educational sustainment, and the development of a technically skilled and diverse workforce in the aviation industry.
The aerospace industry encompasses both manned and unmanned aviation and touches every aspect of Science, Technology, Engineering and Math (STEM) related need. Why important? By 2030 the aviation industry in particular will require:

- 460,000 new commercial airline pilots
- 650,000 new commercial airline maintenance technicians
- The largest demand for pilots and technicians will be in the Asia Pacific region with an expected need for 182,300 pilots and 247,400 technicians.
- China alone will need 72,700 pilots and 108,300 technicians

I-CADIE addresses current and future industry STEM opportunities for disadvantaged and underrepresented minorities. It will sustain opportunity by developing and maintaining a highly skilled and technical workforce.

Engaging untapped or underutilized resources, I-CADIE will address unfolding demographic changes that will influence the US over the coming decades. Emerging solutions include aviation industry workforce development, STEM related education and talent creation, workforce dynamics and demographics, and opportunity for collaborative partnering.

Our interactive approach spans an educational environment from K-12, higher education and opportunity for lifelong education in relevant environments. Working across traditional and non-traditional approaches, I-CADIE will address and meet the interrelated needs of government, industry, and academia. Enabling relevant educational opportunities it will remain responsive to emerging needs, now and in the future. It supports and sustains U.S. technology strength and competitive advantage in the global aviation industry.

Relevance
I-CADIE will build on and expand core strengths by providing viable solutions for critical immediate, emerging, and long-term needs. Our responsive educational approach will lay the foundation for our future, both from an academic and industry perspective.

The National Aeronautics Research and Development Plan of February 2010 states that “the Federal government must continue to advance U.S. technological leadership in aeronautics by fostering a vibrant and dynamic aeronautics community that includes government, industry, and academia.” Also, the Future of Aviation Advisory Committee (FAAC) issued 23 consensus recommendations, one of which stated that “…Aviation-related research and development investments are vital for a high technology economy…” Our approach to education, engagement and outreach will be a catalyst and key enabler.

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1 Pilot & Technician Study Boeing 2011
2 http://www.whitehouse.gov/sites/default/files/microsites/ostp/aero-rdplan-2010.pdf
3 http://www.dot.gov/faac
Preparing Future STEM Faculty from Underrepresented Groups

Background
Kansas State University is committed to recruiting students from under-represented groups for undergraduate and graduate degrees. Progress has been made in recent years at the undergraduate level and to a more limited extent in doctoral programs in the STEM disciplines. Despite the progress K-State has made to create a more inclusive educational environment, disparities remain and will continue to grow with changing demographics unless major initiatives are implemented. K-State has the demonstrated infrastructure to support this initiative. Currently K-State coordinates twelve undergraduate research experiences during the summer that recruit a substantial number of students from the target populations; supports a developing scholars program to provide first generation and minority students research experience; a McNair scholars program that provides research and academic support services for the same target group of students; and successful multi-year mentoring programs for female faculty members and students in the STEM disciplines. Thus, we have a core group of faculty members who would support this initiative by serving as mentors to selected doctoral students.

Description
Nationally a significant gap exists between the numbers of doctoral graduates from underrepresented groups and the demand for these graduates to fill positions in higher education, industry, and government. This gap is especially great in the STEM disciplines. With an increasingly diverse population, it is imperative that universities educate more students from underrepresented groups to fill this gap and serve as role models and leaders in the future. New and dynamic models for career development programs are needed to train the next generation of faculty members who can serve as role models for both undergraduate and graduate students in institutions of higher education and as researchers and leaders in industry and government.

A comprehensive program, “Preparing Mentors in the STEM Disciplines to Educate the Future Workforce in Science and Technology,” will prepare participants for the multifaceted roles (teaching, research, mentoring/advising, service and outreach) of junior faculty in the STEM disciplines that they will be expected to perform while serving as role models for the next generation of minority students. An emphasis will be placed on involvement in interdisciplinary research projects. Specialized workshops will also be provided to facilitate current faculty members in more effectively mentoring both undergraduate and graduate students in the STEM disciplines. The outcome of this initiative is to begin addressing the major gap in supply and demand for faculty from minority populations in all STEM disciplines.

Relevance National/Regional
The United States is becoming increasingly diverse; however, this diversity is not reflected in the STEM workforce and higher education. The Commission of Professions in Science and Technology (December 2008) reported that approximately one third of the U.S. population between the ages of 18-24 are underrepresented minorities. The U.S. Bureau of Labor predicts that 50% of the college-aged population will be students from underrepresented groups by 2050. For both women and underrepresented minorities, participation declines as the degree level increases. For example, only 26% of the STEM doctorates are awarded to women and 6% to individuals from underrepresented groups. This results in a void in faculty mentors for under-represented minorities. Previous research has found that these students identify most with faculty who look like them and share common backgrounds. Diversity in higher education is essential in ensuring balance, providing new perspectives, and reaching students at all levels.

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Innovation through Design and Cross-generation, Cross-sector, Cross-disciplinary Learning and Discovery

Background
K-State’s campus in Olathe which opened in 2011 is largely funded through a local sales tax administered by the Johnson County Education Research Triangle Authority. With a mandate for research and graduate education in food, animal health and related sectors, the vision of the campus is to be a ‘solution finder for businesses’. Programming is being developed to be nimble and responsive to the needs of regional businesses through innovative educational and R&D opportunities.

Description
The campus received approval for a new School for Applied and Interdisciplinary Studies in January 2015 and is developing university wide partnerships and integrating education and research through new, inter- and cross-disciplinary approaches. With increasing need for (1) innovation and entrepreneurship; (2) graduates who are workforce ready; and (3) businesses that have to be globally competitive; K-State Olathe is filling a niche by connecting different stakeholders from community, government, industry and education. Pilot programs are linking the creativity of K-12 with the target student population for K-State Olathe which is working professionals in the 25-50 year old range. Eventually, the goal is to connect these two age groups with the experiences and expertise of older professionals (working and retired) to stimulate co-learning and discovery that foster entrepreneurial partnerships. Early phase retirees have a lot of expertise that we hope to connect to younger learners. Early phase retirees also have ideas and discretionary dollars that can stimulate collaborative pools of seed funding for start-up operations. Diverse groups will connect to develop and share ideas, and work on real life business problems at the K-State Olathe campus.

One of our educational innovations is through Design Thinking. DT is an approach for creative solution finding by ‘building up’ ideas and directed brainstorming. In the 1990s, DT launched the d-School at Stanford University and sprouted companies like IDEO and Frog Design that are now global innovation consultancies. DT is an interactive and experiential approach, and provides a basis from which the K-State Olathe campus will promote educational innovation and help big and small companies with new ideas for process, product and/or technologies. We have already started various programs using this approach and have hired a Design Thinker in Residence.

Relevance (Regional and National)
In its 2014 report “Prosperity at a Crossroads: Targeting Drivers of Economic Growth for Greater Kansas City”, the Brookings Institute concluded that the greater Kansas City region continues to have an economic dependence on manufacturing, transportation and financial services. However, it is becoming less competitive and not fueling high performance. Not unlike many other urban regions across the U.S., greater Kansas City is not creating sufficient new industries or commercial applications or enough innovation and talent in science and technology. The report further recommended that by connecting sectors, engaging in broad, data-driven discussion and decision-making as well as defining a ‘unified economic agenda’, there are very real opportunities for driving growth. In working with communities across the state of Kansas and the nation, higher education has an opportunity to engage with community, private sector and government to define new paradigms for workforce development and sustainable, knowledge driven economic growth.

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EPICENTER: Laboratory for a network science approach to predict and control the spread of infectious diseases

Background
Few events disrupt society and cause economic loss as severely as an out-of-control infectious disease. Terrorist activities or natural causes can produce an epidemic that may result in human deaths, the disposal of herds, and the destruction of crops. Fundamental to EPICENTER’s mission is the conviction that epidemic dynamics and intervention strategies must be derived while accounting for underlying complex networks that describe multiple and dynamic interconnections among involved systems.

Description
EPICENTER, a laboratory within Kansas State University’s College of Engineering, provides resources to build, analyze, and simulate data-driven computational models for biomedical and biological systems represented as complex networks.

Research at EPICENTER challenges scientific boundaries by addressing the impact of (1) heterogeneity, (2) interdependence, and (3) stratification of networks in spreading processes. These three characteristics abound in natural and man-made infrastructures and networks, but fundamental questions remain unanswered regarding interconnected and stratified/multilayer networks.

Projects within EPICENTER
EPICENTER has successfully conducted several research projects since its inception in 2007. Current projects include:

Predictive models of infectious diseases: This project aims to develop innovative multiscale computational models and tools to describe potential transmission cycles of zoonotic pathogens that could be introduced into the United States. Data generated by these models will be used to produce an operationally relevant predictive model that estimates the timing and spatial extent of emerging disease and the transmission risk to humans. Studied diseases include Ebola, Rift Valley fever, and Japanese Encephalitis.

Spreading processes over multilayer and interconnected networks: The research goal is to establish mathematical tools and techniques in order to understand the role of multilayer and interconnected topologies in spreading processes. For example, a multilayer network is a physical contact network in which a disease can propagate among individuals and an online information dissemination network in which information can propagate among those same individuals. In zoonotic diseases, interconnected networks include the network of animals and the network of humans in which a virus can transfer from one population (network) to another.

Integrated models of disease spread, supply chain logistics, and communication networks: The objective of this project is to develop integrated models that capture interdependencies between disease dynamics, supply chain logistics, and communication networks. For example, the spread of disease is influenced by the movement of animals, plants, and food products through the supply chain. Effective management of this movement and deployment of countermeasures such as vaccines, require effective risk and crisis communication plans that engage multiple stakeholders. Stakeholders also constitute a network through which information is transmitted. The integrated modeling approach is expected to yield new insight in order to prevent, mitigate, and respond to infectious disease outbreaks.

Relevance
The National Agricultural Biosecurity Center (NABC), the Institute for Computational Comparative Medicine (ICCM), the Center of Excellence for Emerging and Zoonotic Animal Diseases (DHS CEEZAD), the planned National Bio and Agro-Defense Facility (DHS NBAF), and EPICENTER are all located in Manhattan, Kansas, thus making Kansas the national leader in developing countermeasures to naturally-occurring and intentionally-introduced plant, animal, human, and zoonotic diseases.

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Integration of Research, Training, and Education in Biosafety and Biocontainment

Background
In the late 1990’s, Kansas State University made a programmatic commitment to the area of food safety and security. As a land grant institution with a major focus on food animal husbandry, KSU made food animal health and welfare a priority. The State of Kansas made a strong investment in KSU’s research priorities by funding the construction of the Bioscience Research Institute (BRI). Further, the Department of Homeland Security has acknowledged KSU’s leadership within this area and named Manhattan as the home of the National Bio and Agro-Defense Facility (NBAF).

Description
The Kansas State Graduate School seeks to develop, deploy and manage an education and training program, focused on meeting an area of national need, by establishing a path of graduate study focused on cultivating the next generation of biosafety and biocontainment professional. This program will address critical workforce development needs in a profession that has recently been scrutinized during congressional oversight. An investment in biosafety and biocontainment education and research will support a program with national, regional and global implications.

This program will be based at the Biosecurity Research Institute (BRI) which is a state-of-the-art enhanced BSL-3 and BSL-3Ag research facility. In addition to actual research areas, the program will utilize the 10,000 square foot educational wing to provide hands-on training activities in a pathogen free integrated laboratory training suite. This allows students to gain foundational skills in a realistic work environment without the risk of biosafety concerns or biocontainment breaches. The BRI also includes world-class high-definition video capture and streaming technology allowing the training suite and research areas to broadcast live video or serve as filming studios. Students can view laboratory techniques and monitor disease progression in challenged animals without the need to enter high-risk research spaces.

Opportunities will be created for individuals seeking a career in biosafety and biocontainment as well as providing essential understanding for professionals seeking a career in high-consequence infectious disease research. The program will benefit doctoral students seeking research careers in the biosciences by coupling research with training in biocontainment practices and procedures. Similarly, a postdoctoral fellowship program will provide both short- and long-term training in containment research beyond the doctorate. These two activities will be integrated with a broader program to provide technical support staff, who will fill biocontainment workforce needs nation-wide, with skills to work in the BSL-2, 3, and 3Ag environment safely and securely. The technical support overlay also includes training building maintenance and management professionals on the unique aspects of working in a biocontainment facility.

This initiative also provides the framework to synergistically link and integrate the biosafety and biocontainment research/educational investments, infrastructure, resources, expertise, and missions of the K-State main campus, K-State Olathe campus, and the NBAF. This extension additionally lays the foundation for the development of collaborative graduate education programs with federal institutes such as NIH’s National Biosafety and Biocontainment Training Program (NBBTP).

Relevance Regional/National/International
Utilizing KSU’s world-class resources to educate tomorrow’s biosafety and biocontainment professions will provide our students with a competitive edge as they apply for technical or faculty positions. Additionally, the program would provide necessary training and experience for the future workforce at NBAF and biotech companies in the expanding animal health corridor.

With thousands of BSL-2 and BSL-3 laboratories in the United States, a graduate level research and educational program for biosafety and biocontainment professionals would provide valuable hands-on skills to ensure safe and secure operations.

Research and training agreements with the U.S. Department of Agriculture, the Department of Homeland Security, Australia’s Commonwealth Scientific and Industrial Research Organization, and Kenya’s International Livestock Research Institute provide unique opportunities for students, staff, and faculty to gain experience for NBAF and related projects that complement existing programs.

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Center for Technology Development: Product and Technology Development for the Advanced Manufacturing Industry

Background
"America’s ability to make things underpins America’s ability to innovate, compete, and create good jobs. U.S. manufacturers perform 70 percent of all private-sector R&D and account for 60 percent of U.S. exports and the majority of U.S. industry patents. Over the last six decades, innovation - in new products or new processes - was central to three-quarters of the nation’s economic growth."

Universities need a systematic process to partner with manufacturing companies to develop technologies and bring new products to market. This translational research capability is critical to leveraging research investments to grow innovation-based manufacturing companies.

Kansas State University seeks to expand its capability to collaborate with industrial partners in product and technology development by building on the following unique technology development assets:
- The Advanced Manufacturing Institute (AMI) has completed more than 2,500 technology development projects with 500 businesses across the nation. AMI employs an integrated business/technology development approach that facilitates collaborative industrial projects and partnerships.
- Nationally recognized tools to facilitate open innovation through opportunity recognition, innovation analytics, and network weaving.
- Distinguished faculty researchers and productive laboratories conducting advanced manufacturing related research across the university, including one faculty member currently serving as an NSF Program Director for an Advanced Manufacturing program.
- An EDA-funded innovation accelerator focused on animal health and food processing industries located on the K-State Olathe campus.

Relevance
In order to improve the competitiveness of U.S. manufacturers, federal agencies have been directed to: 1) strengthen advanced manufacturing research and development; 2) support the education of a highly skilled manufacturing workforce; and 3) spur innovation in new products and processes.

Description
K-State will achieve these objectives by building the Center for Technology Development (CTD). The CTD will forge strategic university/industry partnerships that will accelerate industry-focused research and innovation, commercialize technology, and bring new products to market. The CTD will integrate K-State’s advanced manufacturing and technology development capabilities and engage industrial companies in mutually beneficial projects that generate new technologies and products and help technology-based companies to grow.

The CTD will be a unique university, industry, and government partnership that will facilitate open collaboration between advanced manufacturing researchers, industrial scientists, and engineers. It will leverage faculty expertise and encourage collaboration between colleges, between K-State and industry, and between design and manufacturing.

Efforts will be concentrated in areas that support university and government priorities. The CTD will use AMI’s industrial partnering experience and project management expertise to establish and manage collaborative technology development partnerships.

The CTD will produce proof-of-concept artifacts, prototype device and processes and harden technologies for targeted uses. Ideas will be transformed into reality, students will be engaged in creating and developing products, applications for new technologies will be defined and developed, and university technologies and inventions will be developed and hardened for specific market uses.

To realize the full potential of the CTD requires an investment to expand faculty and doctoral student involvement, enhance advanced manufacturing and realization laboratories, and expand CTD’s geographic and industrial reach.

The CTD will help K-State realize its goal to become a Top 50 Public Research University by supporting and developing an advanced manufacturing industry sector that is critical to economic vitality. The CTD will:
- increase the value of industrially sponsored research and intellectual property generated;
- develop an innovation workforce by expanding student involvement in the CTD;
- catalyze industrial partnerships to jointly develop new technologies and products.

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*http://manufacturing.gov/welcome.html
Networking, Security and Resiliency for Critical Infrastructures

Background

Daily societal activities increasingly depend on interdependent critical infrastructures such as power grids, telecommunication networks, transportation networks, food networks, and water distribution networks. In contrast to isolated systems, interdependent networked systems demonstrate emergent behaviors caused by unpredictable, rare, non-linear interactions between numerous social, physical, and cyber components. Because infrastructure systems are large, they are often decentrally controlled through cyber systems. However, even if decentralization and self-organization theoretically reduce failure risk, interdependencies can lead to disruptive and massive cascading failures.

Interdependent and multilayer networks characterize critical social and engineered infrastructures, but a thorough understanding of their behaviors through fundamental results is still lacking. For example, the Smart Grid concept includes application of advanced computer, communications, and power technologies to obtain a highly automated, responsive, and resilient, transmission and distribution infrastructure. At the distribution level, the Smart Grid integrates distributed renewable generation sources with energy storage and provides demand response management to customers through dynamic pricing. At the transmission level, communication architecture creates an intelligent infrastructure that can detect and mitigate faults faster than they can propagate, thus providing utility operators with improved efficiency and reliability. Although ongoing efforts to design a next-generation communication network within the Smart Grid framework are in progress, lack of flexibility and programmability of network equipment has impeded experimentation with new schemes. Consequently, power operators are reluctant to adopt untested solutions.

Description

This project has two primary goals. The first goal is to study interdependencies between critical infrastructure networks and provide fundamental insights on the impact of these interdependencies related to reliability of the coupled system with the ultimate intent to increase reliability by developing analytical tools to measure and adapt system interdependencies. The second goal is to address key issues in order to allow rigorous experimentation and analysis of networking solutions in the real-world environment. For a Smart Grid example, large-scale experiments that incorporate resources from the Smart Grid Lab at Kansas State University (KSU), KSU networking resources, and the Global Environment for Network Innovations (GENI) test bed can be performed. A hybrid simulator has been created that integrates continuous-time behaviors of the power system with discrete event behaviors of the communication network. This platform has demonstrated performance impacts of the communication network and the power system when the physical infrastructure is designed to maximize robustness. Furthermore, this platform was utilized to demonstrate that an OpenFlow communication network could perform equal to or better than its traditional counterpart. The goals of this research initiative are to successfully compete in programs such as DOE’s Academic Collaboration for Cybersecurity of Energy Delivery Systems (CEDS) Research and Development for the Energy Sector, or NSF’s NeTS.

Relevance National/Regional

Numerous critical infrastructures in Kansas and the United States rely on secure networking and communications. In Kansas, power and networking companies have demonstrated endorsement by sponsoring KSU’s Electrical Power Affiliate’s Program (EPAP). This research has also received national contributions from Raytheon BBN Technologies, KanREN, Internet2, National Science Foundation, and National LambdaRail.

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Virtual Interactive Design Education

Background
In addition to the successful synthesis model of learning with problem-oriented studios in design-based education, traditional subject-oriented approaches are common in many of the specific knowledge areas. In traditional lecture-based approaches, students are treated as passive recipients with linear and fragmented teaching presentations that provide little opportunity for learning the holistic nature of their discipline. The Unified Learning Model (ULM) is based on three core principles: learning requires working memory allocation (attention); working memory’s capacity for allocation is affected by prior knowledge; and, working memory allocation is directed by motivation. These three principles guide a complete model of learning that synthesizes what is known from research in brain function, cognition, and motivation. Integration of serious gaming into these subjects and utilizing the ULM will provide the basic evidence to support institutionalization of an approach to education that is potentially transformative for student learning.

Description
Active project-based learning is proven more likely to meet educational objectives when compared to traditional lectures. Serious games (those in which education is the primary goal) may provide an effective virtual interactive environment employing contextually rich interactive simulations and promoting a holistic approach to design education. The cutting-edge synthesis of ideas and concepts from the cognitive, motivation, and neurobiological sciences within the ULM, combined with virtual serious games will provide an integrated project-based pedagogy throughout the curriculum, increasing critical thinking and practice of students.

Relevance
Contextually rich interactive simulations have proven effective at improving the educational experience in fields like health care and military operations. In a 2009 workshop, the National Academy Committee on Engineering Education recognized the need to enhance engineering curriculum through creative uses of instructional technologies. Tashiro (2009) found that further research was necessary to determine if serious games will become a valuable tool for education and professional development. While architectural and design education are known for their studio/problem-based approach to integrative professional education, the subjects supporting the studios are, in many instances, taught through passive and traditional means.

Project-based learning is student-centric model where students acquire knowledge through activity and experiential learning. This approach has proven to be an effective pedagogical model in higher education to develop thinking and creativity. Research is needed to determine if the synthesis of problem-based learning through a serious-game virtual interactive environment, coupled with the Unified Learning Model, can be more effective as a teaching and learning approach to the support areas of professional education in areas such as engineering, architecture, and design.

Sound pedagogical ideas must be merged with the astounding capabilities of new and emerging technologies in a new model of learning that provides opportunities for learning in project-based disciplines. Game-based learning may assist in building a diverse workforce and increasing opportunities for innovation while encouraging critical decision-making strategies. Simulations incorporated in the serious games can provide project-based experiential learning leading to better prepared graduates entering the workforce.

Simulations have been shown to improve skills and safety in medical techniques; and studies regarding generational attributes suggest incoming students learn more efficiently using simulation games. A recent report by a Blue Ribbon Panel of the National Science Foundation calls for an “overhaul our educational system to foster the interdisciplinary study that SBES requires.”

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Bringing the Critical Zone Observatory Paradigm to Konza

Background
The Earth’s Critical Zone (CZ) is the thin outer veneer of our planet from the top of the tree canopy to the bottom of our drinking water aquifer—the region of Earth that supports almost all human activity. But population growth—and the associated demands for food, fuel and clean water—combined with climate and environmental change are placing ever increasing pressures on this “critical zone”. Understanding, predicting and managing intensification of land use while mitigating and adapting to rapid climate change, biodiversity decline and sustained provision of key ecosystem services is now one of the most pressing societal challenges of the 21st Century. The Critical Zone Observatory Network aims to make this step change in observation and is the US contribution to a global initiative that includes over 60 research sites on six continents.

K-State aims to join this network by building on the Konza Prairie Long-Term Ecological Research (LTER) program, a comprehensive ecological research, education and outreach initiative centered on one of the most productive grasslands in North America—the tallgrass prairie.

Description
The research builds on significant previous investment in ecological and hydrological research, not only within the LTER but also more broadly (e.g. the Ogallala aquifer). The K-State initiative is an ideal complement to the existing CZO network, because it can address a number of issues that cannot be addressed by other CZOs.

A region with areas largely unmodified by human activities. Grasslands, rangelands, steppe, tundra, savanna and shrub-grasslands cover 40% of the Earth’s land surface. North American tall grass prairie covered ~67 million ha in the US prior to 1800s. Today, less than 5% of these grasslands remain and these are concentrated in the Flint Hills of Kansas and Oklahoma.

A region of ecological transition. From east to west, tall grass gives way to mixed grass to short grass, and these ecological transitions are sensitive to small changes in climate and soil type, all of which impact on CZO processes (weathering, hydrology, geomorphology, etc.).

A region of high climate gradients. The region lies at the confluence of areas predicted to undergo contrasting change in climate (drier to the southwest, wetter to the northeast). Rising temperatures will lead to increased demand for water and energy, which constrains development, stresses natural resources, increases competition for water and requires new management practices.

A region with significant water challenges. Groundwater serves as the main source of water to irrigate the Critical Zone in western Kansas. Water balance across the region is delicate and aquifer depletion is predicted at current extraction rates. 30% of the groundwater has been pumped and another 39% will be depleted over the next 50 years given existing trends. Recharge supplies only 15% of the current pumping and would take an average of 500 to 1,300 years to completely refill the aquifer.

A CZO in the Konza region would (i) add to the range of lithologic gradients being investigated by the CZO network; (ii) introduce significant Permo-Carboniferous sequences of alternating limestones and shales; (iii) bring an unglaciated peri-karst weathering history into consideration and (iv) provide the opportunity to examine the consequences of global climate change in an area that could be one of the most dynamic and sensitive to climate variability and change in the United States.

Relevance
This initiative will bring several K-State departments and colleges together (Biology, Agronomy, Geography, Geology, Engineering) to work collaboratively on this cutting-edge research problem that is not only timely but of great importance to society.

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1 http://www.konza.ksu.edu/knz/pages/home/home.aspx
2 Steward et al (2013) www.pnas.org/cgi/content/short/1220351110
Operations Research: Applied and Theoretical Advances across Multiple Sectors

Background
Grand challenges related to water, energy, security, health, and food systems involve optimal allocation of scarce resources, balance of multiple decision objectives, and understanding of complex systems. Operations research provides a quantitative framework to confront these issues.

Description
Kansas State University (KSU) faculty are uniquely qualified to address theoretical and applied research questions that advance the discipline of operations research and create solutions to urgent societal challenges. This work is generating new scientific knowledge in response to critical opportunities in one or more of these three areas: (1) How can optimization methods be more effectively integrated with methods from social and natural sciences to make it possible to understand complex systems holistically?; (2) How can algorithms be designed to more effectively process data or solve optimization problems that support decision-making?; and (3) How can these advances in modeling and solution techniques be translated into decision-support frameworks that can be implemented in practice?

Several current operations research projects illustrate these overarching opportunities and the potential for fundamental and practical impact:

Harnessing the decision-making power of big data: The evolution of computers and communication technology has produced an abundance of powerful devices capable of unprecedented data capture. Resulting data sets are massive but messy. KSU researchers are developing methods to turn raw data into relevant information for decision makers in manufacturing, service, and health care industries.

Improving solution times for integer programs: Integer programs are used to identify optimal decisions and policies in sectors such as transportation, financial services, healthcare, and government. However, current methods are limited in their ability to solve integer programs, even when using the most advanced technology, which leaves decision makers with suboptimal strategies. KSU researchers are discovering novel techniques to solve integer programs by utilizing graphs and hypergraphs. They are creating new cutting planes, developing new branching procedures, and generating polynomial time algorithms to lift variables, all of which allow large integer programming problems that arise in practice to be solved.

Measuring and mitigating the impact of decentralized decision making in humanitarian response systems: Government, military, private, and nongovernmental organizations face immense challenges in the aftermath of a disaster. Disasters highlight complications inherent in decentralized supply chains, or those in which multiple stakeholders take actions that impact the overall system. Proactive supply chain engineering can prevent inefficiency, redundancy, and missed opportunities. KSU researchers are using advanced analytics to improve efficiency and effectiveness in decentralized decision environments.

Modeling stakeholder decisions regarding water resource management: Water resource management is a critical throughout the United States and particularly in Kansas. Farmers, landowners, community members, and policymakers each have a role in responsibly utilizing water. Current work at KSU will lead to a novel integrated human and natural systems model to simulate the impact of water use policies, agricultural and community decision-making, and ecosystems dynamics on the overall water system.

Optimizing the design of high-speed railroad ties: High-speed rail is a multi-billion dollar industry used by numerous countries for passenger and freight transport. As demand for this technology increases, the need for improved railroad design also increases. Current efforts at KSU involve use of operations research models to inform design of rail ties that can withstand the pressure of high-speed transport and be manufactured in bulk for a reasonable cost.

Improving healthcare systems: Seventeen percent of U.S. gross domestic product is spent on healthcare, and opportunities abound to improve efficiency, effectiveness, and equity. KSU researchers are applying techniques such as data envelopment analysis modeling, information systems modeling, and mathematical optimization to design improvements for complex health systems. To date, this work has improved work flow in a local intensive care unit and improved nurse and surgery scheduling processes.

Relevance
Tools for optimal quantitative decision-making touch every sector. In particular, new models, algorithms, and decision-support frameworks contribute to state and national key initiatives regarding water, health, transportation, and food systems.

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2.13
Developing a Better Understanding of Controls on the Quality of Water Resources

Background
The availability of water is a key variable that influences our ability to sustain growth of human populations, industry, and agriculture in the USA and worldwide. Population growth, human activities, the natural variability of the hydrologic cycle, and climate change all pose challenges to ensuring that water supplies of sufficient quality are available.

Understanding the fundamental chemical, biological, and hydrological controls on water resources is essential to our ability to meet future water resources challenges.

Description
A team of students and faculty in the Department of Geology are working to expand our knowledge of water quality and ensure that a diverse workforce is available to meet future demands for water scientists and managers.

Research: studies faculty members and students are actively engaged in include:
1) Management strategies for protecting our drinking water resources – ongoing studies in Kansas, but also international sites
2) Investigation of environmental controls on aquifer microbiology. Aquifer microbes strongly influence the quality of water resources. In turn, aquifer environments represent a fundamental control on the activity of the microbial populations they host.
3) Controls on the mobility of toxic trace elements, including arsenic, manganese, tungsten, selenium. These solutes are hazardous to human health even at very low concentrations. Factors that control their mobility directly influence their ability to accumulate in water and disperse throughout a water resource.
4) Controls on water quality in urban and rural reaches of a freshwater stream over time. Human activities and natural processes affect the quality of water in our streams. The nature and magnitude of these effects vary seasonally and with the type of setting.
5) Investigating the consequences of CO$_2$ injection into the subsurface and its impact on water resources. Involves injection of 50,000 metric tons of CO$_2$ into the deep saline aquifer at Wellington Oil Field, KS, including pre- and post-injection monitoring and analysis of water and head gas from the shallow unconfined freshwater aquifers. Variations in dissolved gases, organic constituents, isotopic fractionations, trace and major elements are being combined to develop a model to predict the consequence of CO$_2$ injection in the years to come.

Education: Geoscience courses that train future water scientists include introduction to geochemistry, water resources geochemistry, hydrogeology, geochemical and biogeochemical modeling, geomicrobiology, environmental geology.

Extension and Outreach: Geoscience faculty and students promote water science to middle school students and underrepresented groups through participation in the Kansas Louis Stokes Alliance for Minority Participation (KS LSAMP), the K-State Developing Scholars Program (DSP), and the K-State program Girls Researching Our World (GROW). Additionally, our researchers participate in the K-State Urban Water Institute and Natural Resources Educational Sources as a Secondary Major.

Relevance
Groundwater resources in western Kansas and much of the USA are dwindling and yet expected to be relied on more heavily in the future. These resources are hydrologically linked to surface water bodies. To ensure sufficient supply of quality resources in the future, we need to consider both settings.

Our efforts will better enable us to:
1) predict and manage consequences of future environmental change, including those caused by human activities, climate change and land-use pattern changes;
2) limit human impacts to surface water resources in urban and rural areas;
3) develop strategies to remediate contaminated water supplies; and
4) preserve ecosystem services that help cleanse water supplies naturally.

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National Center for Information Assurance and Security

Background
Technology is rapidly creating a highly networked world in which software pervades every aspect of society. Consequently, cyber-attacks represent a major threat to our nation that endanger mission-critical systems and the lives and assets those systems protect. Trillions of dollars and the well-being of millions of people currently depend on the correct operation of software. Recent reports to the National Academy of Sciences have urged development of software with evidence of correctness ("correctness certificates") that can be automatically verified by a third party. In response to these challenges, the U.S. Department of Defense (DOD) has developed a “System Assurance Strategy” that emphasizes security throughout the life cycle of a project and requires DOD programs to account for system vulnerabilities. Researchers at Kansas State University (KSU) have a world-renowned reputation for developing software design tools and technologies that result in the construction of safe, secure systems.

Description
The Center for Information Assurance and Security (CIAS) has a long history of research, teaching, and outreach in the cybersecurity area:
- In 2010, CIAS was designated as a National Center of Academic Excellence for Research in Cyber Security (CAE-R) by the National Security Agency (NSA) and Department of Homeland Security (DHS).
- Since 1999, CIAS researchers have collaborated with partners such as Rockwell Collins, Lockheed Martin, Boeing, HP, Honeywell, Microsoft, and Idaho National Lab to develop techniques for designing large-scale, secure, mission-control systems. Many new collaborations for cyber-security research and education are currently being explored.
- CIAS has contributed substantially to the building of tools to secure the U.S. national infrastructure:
  - The Argus group in CIAS has developed tools to address the defense aspects of cyber warfare. Researchers at National Institute of Standards and Technology (NIST) which maintains the National Vulnerability Database (NVD) are using some of those tools to develop security metrics.
  - A team of CIAS researchers received a 2003 NASA Turning Goals into Reality (TGIR) award for their work on techniques to verify software system functioning.
  - The DOD and its major contractors build complex, software-controlled, highly networked systems by integrating hundreds of suppliers and commercial off-the-shelf components. However, current design techniques, acquisition procedures, and vulnerability assessment capabilities are inadequate and often result in security vulnerabilities and cost over-runs. CIAS researchers have developed tools to efficiently design and assemble large software systems at low cost.
- CIAS researchers have received several prestigious awards, including four CAREER awards from the National Science Foundation.

The proposed project will enhance CIAS capabilities in order to address challenges that confront the next generation of complex cyber-physical systems. The project will (1) tackle challenges for designing “zero-failure” mission-critical systems at lower cost and decreased completion time, (2) develop cyber-defense solutions to protect the U.S. critical infrastructures, and (3) partner with local, state, and national agencies and industry to educate people concerning cyber-security challenges. CIAS is uniquely poised to address these challenges because of the following specific efforts:
- Utilizing partnership with various federal agencies, CIAS will develop threat assessment tools that holistically encompass system security management. Enabling techniques based on automated correlation and threat analysis will be researched in order to generate high-confidence alerts.
- CIAS will develop collaborations with companies specializing in cyber-security and bio-security in order to build a vibrant regional center and provide an attractive environment in which those companies would desire to expand to Manhattan, Kansas.
- A shortage of cyber-security engineers has been consistently cited as a potential threat to U.S. national security. CIAS has led development of and will continue to develop educational material for security.

Relevance
KSU’s CIAS has a world-renowned reputation of developing technologies that lead to the creation of secure software systems. Because of existing collaborations with leading cyber-security companies and the anticipated arrival of National Bio and Agricultural Defense Facility (NBAF), CIAS has the potential to form alliances with and attract a multitude of cyber- and bio-security companies to Manhattan. This project will stimulate these endeavors and establish a regional center in which the future cyber-security workforce can be trained.

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Development of Researchable Databases that can be utilized by DOD, Academia and others for Research Projects

Description
The objective of this initiative is to define and establish a process for creating, populating, and maintaining researchable databases that can be used by DOD, academia, industry and other interested parties for research purposes. This would include unclassified and classified data. The initial effort would be to gather and process to all data materials related to the National Guard Agribusiness Development Teams (ADT) that were formed and deployed to Afghanistan. The processes and database infrastructure developed would be one that could be used in the gathering and establishment of a wide variety of datasets that would be of value to multiple research interests such as DOD, academia and others. The initiative will leverage the Kansas State University (KSU) Biosecurity Research Institute (BRI), Libraries and the National Agricultural Biosecurity Center (NABC) infrastructure and capabilities. The objective is accomplished through the following activities:

- Develop and maintain information technology infrastructure, unclassified and classified, to support multiple databases that could be made available to support research.

- Process development for acquiring the data to establishing the researchable databases.

- Process development for including information stakeholders and potential users for determining how data is stored and made available to support research and discovery.

- Process development for efficiently and properly cataloging data for maximum research benefit with a goal of having as much structured data as possible. The process would take into account the wide variety of data sources that could be included. The data would be in multiple formats including paper, photographs, electronic, etc.

- Identify and obtain other datasets (government, academia, industry, etc.) that could be added to the researchable databases to facilitate research and information products. Tagged, labeled and supervised datasets would be of significant interest to Global Food System focused research.

Background
The United States has a global footprint of data generation that includes military, academia, industry and others. Large amounts of data are accumulated in various forms and historically have not been able to be widely utilized because of a variety of reasons such as curation, common formatting, lack of cataloging, of system compatibility, and general lack of access issues, etc. Because much of the data, even though gathered, is generally not available for research, redundant collection efforts of the same data occurs which adds cost and impacts the timeliness of research products. The ongoing availability of appropriate datasets would also increase the opportunities for the conducting and utilization of the resulting research in a timely manner. An enhancement of this initiative would be identifying data gaps and working with interested partners in filling those data gaps.

Relevance
This would support United States efforts world-wide and would significantly support military, academia and other interests by providing datasets that could be used in support of research and information needs. The datasets could also include data that would be of value to industry when researching and gathering information for future business decisions.

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Real-Time Monitoring of Biosafety Level 3 and 4 Exhaust Flow Purity

Background
Hazards due to industrial accidents, nuclear plant accidents, or accidental releases of biological or chemical agents from a laboratory can be prevented or minimized if precautionary measures are established and necessary equipment and trained personnel are available to respond. A majority of spaces that require strict airflow filtering use High-Efficiency Particulate Absorption (HEPA) filters. Filters used in Nuclear, Biological, and Chemical (NBC) applications currently require manual periodic inspection; unfortunately, however, this method detects the potential release of dangerous substances only after the release occurs.

The proposed effort will utilize current collaboration between the Institute for Environmental Research (IER) and the Biosecurity Research Institute (BRI) which are both located at Kansas State University (KSU).

The IER is an interdisciplinary research center focused on interactions between humans and their environment. It is comprised of 6,500 square feet of laboratory space, encompassing eight computer-controlled environmental chambers and an environmentally controlled, 11-row mock-up of a wide-body aircraft cabin for use in studying air distribution, air quality, contaminant transport, and decontamination. IER faculty and staff have particular expertise in airflow, filtration, particulate detection, and novel experimental design.

The BRI at Pat Roberts Hall at KSU is a unique biocontainment research and education facility. Comprised of 113,000 square feet of lab, education, and administrative space, this BSL-3, ABSL-3, and BSL3-Ag facility offers abundant research and education opportunities in bioscience. The BRI supports collaborations between KSU researchers and other academic, federal, and private researchers. BRI faculty and staff have particular expertise in livestock, insect, and plant pathogens that threaten food supplies and health.

Description
The proposed research and development effort aims to design and prototype a system to monitor, capture, and remediate biological hazards caused by accidents or equipment failure and link this system to air handling controls for rapid shutdown of air flow through the laboratory.

In conjunction with on-call research from other disciplines including physics, computer science, agriculture, mechanical, and chemical engineering, the IER and BRI will focus on known principles of optical detection using laser light combined with current and emerging particle-counting technologies while maintaining airflow system integrity. Novel, highly tunable ionic liquid-coated HEPA filters will be developed for the specific capture and remediation of target compounds. The objective is to obtain a low cost, low maintenance system that is easily retrofitted on the downstream side of current air handling equipment in NBC (particularly BSL-3 and 4) containment facilities.

Additional funding in the amount of $1,000,000 is needed to advance these efforts.

Relevance
Hazards are real or potential conditions that can cause injury, illness, or death; damage to or loss of equipment or property; or damage to the environment. Hazards can be intentionally or inadvertently caused by hostile forces or the accidental release of chemical or biological agents (e.g., natural disaster, accidental release by governmental or commercial sectors).

Due to their explosive, chemical, or biological natures, hazardous materials cause safety, public health, or environmental concerns that require concentrated effort to detect, manage, mitigate, and remediate. The new National Bio Agro-Defense Facility (NBAF) is currently being constructed in Manhattan, Kansas. Its collocation with KSU provides unparalleled opportunity to advance the science and safe operation of facilities used for experimentation with and storage of hazardous substances, particularly biological pathogens. The capability this effort will provide does not currently exist; therefore, this research will provide increased safety and surety in biosecurity laboratory operations.

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Aluminum Nitride for High-Power Electronics and Ultraviolet Light-Emitting Diodes

Background
Aluminum nitride is an undeveloped semiconductor that offers promising new solid-state device capabilities and high energy-saving efficiencies compared to silicon, the most common, well-known semiconductor. Aluminum nitride’s physical, optical, and electrical properties are superior to silicon for high-power electronic devices and ultraviolet (UV) light-emitting diodes (LEDs), two technologies poised to develop into multi-billion dollar per year industries within five to seven years. Kansas State University (KSU) and the start-up company Nitride Solutions Inc., leaders in producing high quality aluminum nitride single crystals and thin films, propose to team together to move beyond materials synthesis to device fabrication and the development of systems incorporating these devices.

Description
Funds are sought to support research to solve lingering technical challenges related to material synthesis, device fabrication, device characterization, and electronic system design that incorporates aluminum nitride devices. Funds are also sought to provide education and training necessary to produce qualified researchers to accelerate the growth of this new industry. Funds will support KSU faculty and students, in partnership with Nitride Solutions, to develop advanced manufacturing technologies for aluminum nitride-based solid-state devices. Funding is request to help establish a Kansas-based advanced solid-state device industry that will create jobs and bring Kansas technological recognition.

These funds will support research to create high purity, low defect density materials, develop practical device fabrication processes, and design electrical circuits to support new devices. Funds will also support education to produce engineering students with specialized talent, technical skills, and entrepreneurial spirit needed for this burgeoning industry to thrive.

Relevance
Although silicon has the properties needed for low-power electronic devices for computers, mobile phone, and photovoltaics, its properties are not well-suited for high-power switches and transistors, as are used in electrical conditioning in power supplies, motor controllers, and power distribution systems. Because aluminum nitride can withstand higher voltages, currents, and temperatures than silicon or silicon carbide (the current choice for power electronics), its devices can switch more than 10 times the power while they can be made more than 6 times smaller than comparable silicon devices. In addition, aluminum nitride devices can operate 200 degrees hotter while providing all advantages at increased energy efficiencies.

Aluminum nitride is the only semiconductor which is suitable material for making deep UV LEDs. UV LED light sources are essential for biological contamination detection, and for killing pathogens in air and water. Aluminum nitride-based UV light sources also directly impact a broad array of defense technologies. Biological detection, identification, diagnosis, therapy and elimination, hostile fire identification (HFI) systems, superior light detection and ranging (LIDAR), three-dimensional (3D) imaging through smoke, short-range free-space communication, and target recognition are critical military applications enabled by aluminum nitride-based UV light sources. As in all defense-related material platforms, this technology will filter down to commercial and private use for anticollision systems in cars, faster wireless communication, and a multitude of future products.

Since 1997, KSU has been a research leader of the synthesis of nitride semiconductors. In fact, former KSU students founded Nitride Solutions in order to capitalize on this technology. Proposed funding would support the next step in the manufacturing chain by developing technology to create electronic devices and UV LEDs from aluminum nitride. Ultimately, aluminum nitride electronic devices will be deployed in electric vehicles, wind turbines, elevators, computer power supplies, solid-state UV light sources for non-chemical disinfection of water and food, and environmental monitoring.

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Performance and Innovation in Building Envelopes

Background
Innovation in building envelopes is essential to reducing building energy use and embodied energy. While the HVAC-R research field has been a subject of focus for engineers and scientists, direct collaboration between architects, engineers, and manufacturers is necessary to confront the multimodal performance challenges of the building envelope. The proposed project represents a model of innovation built upon the broad applied knowledge of the architectural discipline and that is expanded by way of collaborative inquiry among engineers, scientists, and manufacturers using the most advanced technologies for fabrication and testing.

Description
The project involves graduate architecture students engaging practicing architects and consultants to explore a particular environmental issue (i.e. thermal transfer or daylight control) impacting performance in the building envelope. In parallel, the research team collaborates with a manufacturer of building components to understand how these environmental performance issues can be addressed in manufacturing and building product development.

The project is currently in its pilot year (AY 2013-14), working specifically on the use of ventilated building cladding to reduce summer heat gain in buildings. Graduate architecture students from Kansas State University are conducting the research in collaboration with BNIM, a nationally recognized practice, and Zahner, a leading manufacturer of innovative envelope systems. Students have used computer analysis and instrumented mockups, built with the support of Zahner, to develop, test, and integrate innovative building skins that can reduce cooling season energy use. Leading architects from BNIM are participating directly as research guides and experts in the integration of envelope systems.

Relevance
The project aims to advance innovation in sustainable technology by addressing the complex and interconnected issues that define the performance of buildings: integrating issues of physics and energy transfer, resistance to weather and climate, structural performance, embodied energy of materials, and the comprehensive impact of architecture for building users and owners. Architectural decisions are driven frequently by aesthetics and economics on the other hand. This research project recognizes the deeply integrated nature of performance in the building envelope and the need for interdisciplinary, out-of-the-box innovation linked with emerging technologies for manufacturing and testing to solve this pressing issue in the sustainability of buildings.

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Center for Attosecond Nanophotonics

Background/Description

The proposed Center for Attosecond Nanophotonics (CAN) will develop from a synergistic overlap between two strong subfields in the Physics department, namely Atomic-Molecular-Optical (AMO) physics and Nanomaterials. This highly innovative center offers promise for new discoveries by combining advanced photonics, nanoscience and soft matter systems. It is a collaboration unlike any other in the world.

The J. R. MacDonald laboratory (JRML) in the K-State physics department is a large AMO physics laboratory, supported by the US DOE and its predecessors since 1969. JRML was the first US laboratory to produce single attosecond (billionth of a billionth sec; comparable to the extremely short time taken by electrons in an atom to change energies) light pulses. Currently, the JRML group is known for its leadership in ultrafast laser science and is well positioned to be the nucleus for a leading attosecond nanophotonics center in the US.

The Nanomaterials group at K-State has excellent synthetic and materials characterization capabilities. Scientists in this group have extensive experience in the synthesis of nanoparticles and their assembly, nanowires, and graphene. The major theme of this research is to create a new class of nanoparticle solids in which the nanoparticles act as the “atoms” of the material and thereby mimic atomic and molecular materials found in nature.

It is thus timely to extend the application of ultrafast and intense optical pulses to the new arena of nanoscale matter in the Center for Attosecond Nanophotonics. The proposed Center will use light sources with unprecedented properties, applying them to nanoscale matter that research has shown to be a treasure box of new phenomena. This novel combination is certain to yield exceptional new physics given the extremes of intensity, time and length scales.

K-State Physics department has a strong culture of solving practical problems and “producing products”. The department has recently received a major private gift for the purposes of creating innovation and entrepreneurship and promoting opportunities for interdisciplinary research. Some recent intellectual property disclosures from our department include Detonation Graphene Nanosheets, Fiber Lasers, and Electrochemical Nanowires. Explorations are currently underway for applications in sub-cellular force sensors, laser-based chemical detection and remote sensing, and optical telecommunications.

We are confident that CAN’s novel science will lead to next-generation opto-electronic technologies that could enable high speed computing using light interfaced with electronics. The light sources that will be developed in the center can be applied for biomedical imaging and opto-genetics as well. Two leading companies in high power ultrashort lasers such as KMLabs (Boulder, CO) and Thales (Paris, France) have already shown interest in collaboration with the scientists in the center. We envision establishment of spinoffs companies of new laser and imaging technology as a result of these collaborations.

At present, the physics department is limited by space and cannot accommodate the necessary physical environment for attosecond studies of nanoscale particles and structures (which require temperature stability, a vibration-free environment, etc.). While we are successful in acquiring multi-million dollar laser equipment through resources available from Federal funding agencies, infrastructure for the new center CAN requires other Federal funding resources.

In summary, the proposed development of a federally funded world-class research center CAN will cultivate a research and teaching environment that accommodates the synergy of our niche research areas. CAN’s fundamental research output can be translated into a powerful engine of innovation and entrepreneurship. Students involved with CAN will be encouraged to have an entrepreneurship focus and in collaborations with K-State Business School and Institute for Commercialization will be introduced to various aspects of intellectual property, technology transfer, and the process of innovation. Trained this way, these student innovators, who are by definition the foremost authorities on their discoveries, will facilitate and shorten the time needed for research outcomes to be transferred into a marketable product.

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Networking, Security and Resiliency for Critical Infrastructures

Background
Daily societal activities increasingly depend on interdependent critical infrastructures such as power grids, telecommunication networks, transportation networks, food networks, and water distribution networks. In contrast to isolated systems, interdependent networked systems demonstrate emergent behaviors caused by unpredictable, rare, non-linear interactions between numerous social, physical, and cyber components. Because infrastructure systems are large, they are often decentralised controlled through cyber systems. However, even if decentralization and self-organization theoretically reduce failure risk, interdependencies can lead to disruptive and massive cascading failures.

Interdependent and multilayer networks characterise critical social and engineered infrastructures, but a thorough understanding of their behaviors through fundamental results is still lacking. For example, the Smart Grid concept includes application of advanced computer, communications, and power technologies to obtain a highly automated, responsive, and resilient, transmission and distribution infrastructure. At the distribution level, the Smart Grid integrates distributed renewable generation sources with energy storage and provides demand response management to customers through dynamic pricing. At the transmission level, communication architecture creates an intelligent infrastructure that can detect and mitigate faults faster than they can propagate, thus providing utility operators with improved efficiency and reliability. Although ongoing efforts to design a next-generation communication network within the Smart Grid framework are in progress, lack of flexibility and programmability of network equipment has impeded experimentation with new schemes. Consequently, power operators are reluctant to adopt untested solutions.

Description
This project has two primary goals. The first goal is to study interdependencies between critical infrastructure networks and provide fundamental insights on the impact of these interdependencies related to reliability of the coupled system with the ultimate intent to increase reliability by developing analytical tools to measure and adapt system interdependencies. The second goal is to address key issues in order to allow rigorous experimentation and analysis of networking solutions in the real-world environment. For a Smart Grid example, large-scale experiments that incorporate resources from the Smart Grid Lab at Kansas State University (KSU), KSU networking resources, and the Global Environment for Network Innovations (GENI) test bed can be performed. A hybrid simulator has been created that integrates continuous-time behaviors of the power system with discrete event behaviors of the communication network. This platform has demonstrated performance impacts of the communication network and the power system when the physical infrastructure is designed to maximize robustness. Furthermore, this platform was utilized to demonstrate that an OpenFlow communication network could perform equal to or better than its traditional counterpart. The goals of this research initiative are to successfully compete in programs such as DOE’s Academic Collaboration for Cybersecurity of Energy Delivery Systems (CEDS) Research and Development for the Energy Sector, or NSF’s NeTS.

Relevance National/Regional
Numerous critical infrastructures in Kansas and the United States rely on secure networking and communications. In Kansas, power and networking companies have demonstrated endorsement by sponsoring KSU’s Electrical Power Affiliate’s Program (EPAP). This research has also received national contributions from Raytheon BBN Technologies, KanREN, Internet2, National Science Foundation, and National LambdaRail.

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Large-Scale Integration of Clean Technologies in the Power Grid

Background
Increased global demand for energy and dwindling fossil fuel reserves are beginning to cause concerns regarding global warming, climate change, and sustainability, resulting in strong worldwide interest in clean energy technologies, such as wind and solar energy, and electric vehicles. Total worldwide wind power capacity has increased from 24 Gigawatt (GW) in 2001 to 318 GW in 2013; the United States share surpassed 65 GW in 2013. Similarly, solar energy capacity in the U.S. increased from less than 1 MW in 2000 to about 18 GW in 2014. On the consumption side, over 100,000 electric vehicles have been sold in the U.S. since 2013. Despite many benefits of the clean energy, integration of these systems into the power grid can lead to a new set of technical challenges such as power plant scheduling to accommodate fluctuating wind and solar power, mitigating power quality issues due to higher usage of power electronics converters, reducing maintenance cost while providing high reliability and availability of wind turbines, and integrating high levels of rooftop solar photovoltaic (PV) generation and electric vehicles.

Government and industry have funded several research projects at Kansas State University (KSU), making KSU a leader in power engineering research and education in the State of Kansas. The proposed research aims to leverage prior research and strength in power systems and cyber-physical systems to seek innovative solutions for increasing penetration of clean technologies into the power grid.

Description
Objectives of the proposed multidisciplinary research include removing barriers and developing human capital through education in order to advance sustainable energy pathways associated with electricity generation and its use in transportation while utilizing synergy between clean electricity generation and consumption. Faculty, students, industrial companies, and government agencies will collaborate for successful commercialization.

The research will investigate enhancement of wind turbine efficiency and durability, energy forecasting, integrated planning, reconfigurable grid-interactive converters, and integration of advanced cyber and communication technologies for optimized operation of the system as a cyber-physical system with high penetration of renewable resources. Higher efficiency and long-term reliability are crucial in order for wind turbines to compete directly with natural gas. Accurate forecasting will allow better characterization of the stochastic nature of renewable resources, thereby leading to more efficient planning and operation. The investigation will allow opportunity to build models and tools that will facilitate more effective utilization of existing renewable resources and integration of a significantly larger amount of additional renewable generation into the power grid.

The research will include solid-state converters, which have become enabling technology to realize a wide range of critical technologies such as grid-tied wind and solar energy systems, electric hybrid vehicles, etc. They can significantly enhance flexibility and controllability of the power grid; consequently, transferring the existing energy infrastructure to the next generation with extraordinary features.

Research related to power distribution networks will focus on large-scale integration of solar rooftop generation and electric vehicles with on-site storage. Life cycle analysis will be used to consider air quality and climate change impacts using triple bottom line of social, environmental, and economic concerns.

Public education will be included in order to increase understanding of the benefits of electric cars, wind and solar energy. The requested amount for the project is $4,000,000 to be used by KSU for research, education, and outreach. A significant portion of the funding will be used to involve undergraduate and graduate students in research projects.

Relevance
In an effort to reduce dependence on foreign oil and reduce carbon emissions, the U.S. government has made promotion of clean technologies a top priority for the past 10 years. In his inauguration address in 2012, President Obama renewed his commitment to renewable energy and emission reductions. The proposed research will leverage collaboration with Fort Riley, Kansas, which is under a federal mandate to utilize renewable energy to reduce carbon emissions. World leadership in research and education related to clean energy generation and utilization advances the K-State 2025 plan to be a top 50 research university.

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Bio /Agro Security Innovation System – BASIS

Background
The Bio /Agro Security Innovation System – BASIS – is designed to be a highly networked technology development ecosystem. It is expected to catalyze bio/agro security innovation in and around the Department of Homeland Security’s (DHS’s) National Bio and Agro-defense Facility (NBAF) currently under construction in Manhattan, Kansas via enhanced engagement, the creation of new partnerships and increased public and private-sector investments.

The already evolving ecosystem consists of a network of capabilities, services and know-how that work together to provide a variety of benefits and outcomes upon which all BASIS stakeholders depend — access to innovation, talent and training. Active participants are anticipated to interact with each other in a synergistic manner which should enhance the missions of all the constituents, particularly, long-term.

BASIS Vision: To protect the nation’s health and food supply through an integrated, advanced bio/agro security innovation system.

BASIS Mission: To create a highly networked bio/agro security innovation system for the diagnosis, treatment and prevention of high-hazard infectious diseases that threaten the U.S. BASIS is designed to: (1) materially enhance public-sector/private-sector cooperation and collaboration; (2) leverage stakeholder knowledge and capabilities; (3) accelerate the advancement/transition of technologies and products into the marketplace; and (4) enable skilled worker training, talent development and regional economic growth.

BASIS Strategy: To catalyze and enhance bio/agro security innovation for America’s livestock industry.

- Engage stakeholders: First of all, undertake the systematic engagement of private sector, producer/industry, university and government stakeholders for the purpose of understanding their innovation, talent and training needs, plus their capabilities and major challenges.
- Align stakeholder’s capabilities and needs: Second, identify and catalog natural alignments that exist within the stakeholder network and determine which of those alignments can provide a foundation for more significant, committed BASIS partnerships.
- Enable connectivity: Third, enable stakeholder interests and needs to be connected with other stakeholder capabilities for the purpose providing a new framework by which to protect animal health, public health and the food supply while at the same time enhancing economic growth.
- Advance foundational partnerships: Fourth, secure key partnerships, identify specific shared goals within each of these, ascertain progressive benchmarks for success, and help operationalize each partnership.
- Enrich, enhance and evolve strategic stakeholder alliances: Fifth, mature ecosystem alliances that support regional economic growth and further develop the partnerships nationally/internationally if/when appropriate. And, finally, evolve the strategy to reflect dynamic market conditions and global events for the enrichment of all BASIS public/private partners.

Relevance
Accelerating the delivery new technologies into the marketplace to meet the needs of America’s livestock industry will help ensure the safety and security of animal health, public health and the global food supply. It will also serve as an engine of economic growth locally, regionally and beyond.

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**EPICENTER: Laboratory for a network science approach to predict and control the spread of infectious diseases**

**Background**
Few events disrupt society and cause economic loss as severely as an out-of-control infectious disease. Terrorist activities or natural causes can produce an epidemic that may result in human deaths, the disposal of herds, and the destruction of crops. Fundamental to EPICENTER’s mission is the conviction that epidemic dynamics and intervention strategies must be derived while accounting for underlying complex networks that describe multiple and dynamic interconnections among involved systems.

**Description**
EPICENTER, a laboratory within Kansas State University’s College of Engineering, provides resources to build, analyze, and simulate data-driven computational models for biomedical and biological systems represented as complex networks.

Research at EPICENTER challenges scientific boundaries by addressing the impact of (1) heterogeneity, (2) interdependence, and (3) stratification of networks in spreading processes. These three characteristics abound in natural and man-made infrastructures and networks, but fundamental questions remain unanswered regarding interconnected and stratified/multilayer networks.

**Projects within EPICENTER**
EPICENTER has successfully conducted several research projects since its inception in 2007. Current projects include:

- **Predictive models of infectious diseases**: This project aims to develop innovative multiscale computational models and tools to describe potential transmission cycles of zoonotic pathogens that could be introduced into the United States. Data generated by these models will be used to produce an operationally relevant predictive model that estimates the timing and spatial extent of emerging disease and the transmission risk to humans. Studied diseases include Ebola, Rift Valley fever, and Japanese Encephalitis.

- **Spreading processes over multilayer and interconnected networks**: The research goal is to establish mathematical tools and techniques in order to understand the role of multilayer and interconnected topologies in spreading processes. For example, a multilayer network is a physical contact network in which a disease can propagate among individuals and an online information dissemination network in which information can propagate among those same individuals. In zoonotic diseases, interconnected networks include the network of animals and the network of humans in which a virus can transfer from one population (network) to another.

**Relevance**
The National Agricultural Biosecurity Center (NABC), the Institute for Computational Comparative Medicine (ICCM), the Center of Excellence for Emerging and Zoonotic Animal Diseases (DHS CEEZAD), the Planned National Bio and Agro-Defense Facility (DHS NBAF), and EPICENTER are all located in Manhattan, Kansas, thus making Kansas the national leader in developing countermeasures to naturally-occurring and intentionally-introduced plant, animal, human, and zoonotic diseases.

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Fusion Centers and their roles in global food and water security

Description
A global paradigm for the peaceful coexistence of nations is the security of the food and water supplies by which nations sustain their citizens. The National Agricultural Biosecurity Center (NABC), through its interactions with both the intelligence community at large and the Department of Homeland Security (DHS) funded state-wide Fusion Centers has been working to make this paradigm a reality.

This paradigm is underpinned by both classified and unclassified work, and involves a close cooperation/collaboration between the NABC and the Kansas Intelligence Fusion Center (KIFC). Subject matter experts, largely based within the University science environment, are linked synergistically with intelligence community analysts. The objective of this initiative is to continue to enhance the capabilities of NABC to provide food and agricultural subject matter expertise (SME) to DHS and (KIFC) in both an unclassified and classified role.

NABC brings several assets to this conversation. It has established a SCIF and has identified the SME’s to support the university’s role in safeguarding food and water security. Beginning in 2005, NABC entered into a strategic relationship with DHS and the KIFC to leverage expertise in support of efforts toward global food and water security.

Background
Many of the Homeland Security Presidential Directives (HSPD) identify improved information sharing as a key component of Homeland Protection. These HSPD’s also identify that much of critical areas that must be protected are under the control and/or oversight of state and local governments, and the private sector. These critical infrastructure and key resources provide the essential services that underpin American society and national security and thus it must be protected from disruption from natural, accidental, or deliberate events. Improving information sharing constitutes a cornerstone of our national strategy to protect the American people and our institutions and to defeat terrorists and their support networks at home and abroad. The National Commission on Terrorist Attacks upon the United States (the 9/11 Commission) identified the breakdown in information sharing as a key factor contributing to the failure to prevent the September 11, 2001 attacks.

Since the tragedy of 9/11 local, state, tribal, and federal officials across the country have been working hard to restore public order and confidence, and to identify those responsible for the vicious terrorist attacks on the United States of America. These officials have also been working to find ways to prevent or mitigate future terrorist acts, which has led to the development of a number of strategies and programs designed to strengthen domestic security. Many of these strategies focus on improving ways to combine relevant information from disparate databases, in order to maximize the usefulness and quality of available information.

Improvements in communication, information sharing, and analysis must continue for those gains that have been made to be realized going forward. Specific assets have been deployed in Kansas, which serve as a national model. The State Legislature authorized The Adjutant General for Kansas (TAG) to establish the Kansas Information Fusion Center (KIFC) and directed the KIFC be housed in a Sensitive Compartmented Information Facility (SCIF). Placement of the KIFC in a SCIF enables the KIFC to access classified threat information pertaining to the Nation. This ensures the KIFC has the best information available to predict, prevent, and respond to threats facing its citizens. NABC provides the agriculture/food component of the federal, state and local mission of the KIFC to protect the nation by providing a multi-discipline, information sharing network designed to gather, analyze, and disseminate information in a timely manner.

Relevance
At the Federal level, the Intelligence Community, led by the Department of Homeland Security (DHS) and the Federal Bureau of Investigation (FBI), participate in several joint fusion centers. This carries down to 76 regional, state and local fusion centers that bring together not only the governmental and law enforcement representatives but also private sector and academia. As with disasters, the point of the spear for Homeland Security is the maintaining of fully functional fusion centers staffed with fully trained and cleared experts.

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Development, management, and maintenance of data, programs, and response plans critical for National Bio and Agro-Defense Facility (NBAF) reporting, assessments and documentation

Description
The objective of this initiative is to establish and maintain data, programs and response plans required for responsive DHS NBAF reporting, assessments and documentation purposes. The initiative will leverage Kansas State University’s (KSU’s) Biosecurity Research Institute (BRI) and National Agricultural Biosecurity Center (NABC) infrastructure and capabilities, and integrate activities of KSU with DHS. The objective is accomplished through the following activities:

Development and maintaining of pertinent data in a responsive manner that is to be used in support of NBAF programs, response plans and risk based decision tools. This would also include the necessary data for reporting, assessments and ongoing documentation purposes to meet DHS requirements.

Development and maintaining of emergency response plans at the state and local level to ensure support of DHS NBAF specific emergency response planning and documentation.

Development and maintenance of activities to support the four phases (Mitigation, Preparedness, Response and Recovery) of emergency management. Mitigation and Preparedness are critical for minimizing the effects of a negative event and promoting rapid Response and Recovery phases. This would require but not be limited to activities such as training and exercising in support of emergency planning and response.

Support and maintain information technology infrastructure and architecture and secure communications infrastructure needed to support the areas of interest outlined in this initiative.

Promote capabilities to conduct threat and vulnerability analysis of foreign disease agents in a biocontainment laboratory environment using foreign animal, plant, foodborne and zoonotic disease to support threat characterization analysis.

Background
The research infrastructure provided by the NBAF is necessary for continuing protection of the U.S. food and agriculture industries. These highly integrated, global, and complex industries are inherently vulnerable to foreign animal, emerging, and zoonotic disease outbreaks that could threaten economic stability, food security, and the Nation’s public health. DHS has the responsibility and the national stewardship mandate to detect, prevent, protect against, and respond to terrorist attacks within the U.S. (Homeland Security Act of 2002, 6 U.S.C 182). DHS shares these responsibilities, as they apply to the defense of animal agriculture, with the U.S. Department of Agriculture (USDA); hence, a coordinated agricultural research strategy (as called for in the Homeland Security Act of 2002 and Homeland Security Presidential Directive 9 (HSPD-9), “Defense of U.S. Agriculture and Food,” January 30, 2004) has been developed. HSPD-9 also specifically identified the need for “safe, secure, and state-of-the-art agriculture biocontainment laboratories that support research and develop diagnostic capabilities for foreign animal and zoonotic diseases.” The NBAF will provide the infrastructure needed to satisfy the need for these modern biocontainment laboratories.

Safety and security are of paramount importance in the planning, design, construction, and operations of the NBAF. From selection of the site to the design of the facility and, finally, the operation of the NBAF, DHS is committed to understanding the associated safety and security risks and mitigating those risks through the necessary design, engineering, operational protocols, and response planning efforts.

Relevance
In support of DHS and NBAF, this initiative significantly enhances the development and maintenance of the necessary data to support DHS’s needs for assessments, reports and other decisions. In addition, this will support DHS in the development of training, plans and exercises in the broad scope of the four phases of emergency management.

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Real-Time Monitoring of Biosafety Level 3 and 4 Exhaust Flow Purity

Background
Hazards due to industrial accidents, nuclear plant accidents, or accidental releases of biological or chemical agents from a laboratory can be prevented or minimized if precautionary measures are established and necessary equipment and trained personnel are available to respond. A majority of spaces that require strict airflow filtering use High-Efficiency Particulate Absorption (HEPA) filters. Filters used in Nuclear, Biological, and Chemical (NBC) applications currently require manual periodic inspection; unfortunately, however, this method detects the potential release of dangerous substances only after the release occurs.

The proposed effort will utilize current collaboration between the Institute for Environmental Research (IER) and the Biosecurity Research Institute (BRI) which are both located at Kansas State University (KSU).

The IER is an interdisciplinary research center focused on interactions between humans and their environment. It is comprised of 6,500 square feet of laboratory space, encompassing eight computer-controlled environmental chambers and an environmentally controlled, 11-row mock-up of a wide-body aircraft cabin for use in studying air distribution, air quality, contaminant transport, and decontamination. IER faculty and staff have particular expertise in airflow, filtration, particulate detection, and novel experimental design.

The BRI at Pat Roberts Hall at KSU is a unique biocontainment research and education facility. Comprised of 113,000 square feet of lab, education, and administrative space, this BSL-3, ABSL-3, and BSL3-Ag facility offers abundant research and education opportunities in bioscience. The BRI supports collaborations between KSU researchers and other academic, federal, and private researchers. BRI faculty and staff have particular expertise in livestock, insect, and plant pathogens that threaten food supplies and health.

Description
The proposed research and development effort aims to design and prototype a system to monitor, capture, and remediate biological hazards caused by accidents or equipment failure and link this system to air handling controls for rapid shutdown of air flow through the laboratory.

In conjunction with on-call research from other disciplines including physics, computer science, agriculture, mechanical, and chemical engineering, the IER and BRI will focus on known principles of optical detection using laser light combined with current and emerging particle-counting technologies while maintaining airflow system integrity. Novel, highly tunable ionic liquid-coated HEPA filters will be developed for the specific capture and remediation of target compounds. The objective is to obtain a low cost, low maintenance system that is easily retrofitted on the downstream side of current air handling equipment in NBC (particularly BSL-3 and 4) containment facilities.

Additional funding in the amount of $1,000,000 is needed to advance these efforts.

Relevance
Hazards are real or potential conditions that can cause injury, illness, or death; damage to or loss of equipment or property; or damage to the environment. Hazards can be intentionally or inadvertently caused by hostile forces or the accidental release of chemical or biological agents (e.g., natural disaster, accidental release by governmental or commercial sectors).

Due to their explosive, chemical, or biological natures, hazardous materials cause safety, public health, or environmental concerns that require concentrated effort to detect, manage, mitigate, and remediate. The new National Bio Agro-Defense Facility (NBAF) is currently being constructed in Manhattan, Kansas. Its collocation with KSU provides unparalleled opportunity to advance the science and safe operation of facilities used for experimentation with and storage of hazardous substances, particularly biological pathogens. The capability this effort will provide does not currently exist; therefore, this research will provide increased safety and surety in biosecurity laboratory operations.

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Identifying Corrective Actions from Agricultural Response (ICAAR) and Planning and Curriculum for Food and Agriculture Emergency Response

Description
Identifying Corrective Actions from Agricultural Response (ICAAR) / Food, Agriculture, and Veterinary Defense (FAVD)

- Review of agriculture related After Action Reports/Improvement Plans (AAR/IP) from emergency response exercises or incidents and addition of identified corrective actions to a searchable ICAAR database.
- Provide corrective action database for access and use by agriculture emergency response planners nationwide to share lessons learned.
- Lessons learned from the AAR/IP’s highlight gaps identified in emergency response training exercises or actual events and are cross-matched with existing training programs offered by DHS. Deficits in training availability are identified and reported to DHS.

Planning and Curriculum for Food and Agriculture Emergency Response

- Development of the Livestock Emergency Response Plan (LERP) toolkit to ensure a risk-informed planning process by stakeholders involved in agriculture emergency response.
- Integrate format and curriculum of the existing Food Emergency Response Plan (FERP) toolkit and USDA/APHIS FADPrEP documents with the recently developed Livestock Emergency Response Plan (LERP) toolkit.

Background
Department of Homeland Security (DHS) – Office of Health Affairs (OHA) has identified two key Food, Agriculture, and Veterinary Defense (FAVD) needs, each of which is being addressed through projects performed by the National Agricultural Biosecurity Center (NABC) at Kansas State University (K-State).

Lessons Learned Information Sharing (LLIS): Review and analysis of AAR/IP’s from training exercises or agriculture-based incidents are integral to the continuous evolution of agricultural emergency response. Lessons learned and their associated corrective actions serve no purpose if their value is left buried within the text of an exercise or incident report.

Once lessons learned have been identified and corrective actions made available to agriculture emergency response planners, identified needs may be addressed by matching them to training available within existing educational programs of DHS.

Planning and Curriculum for Food and Agriculture Emergency Response: Currently, no uniform planning process for the development of emergency operation plans for the defense of food and agriculture exist. FAVD branch within DHS/OHA seeks to promote a common understanding of the fundamentals of risk-informed planning and decision making. Such an understanding will allow for the development of integrated, coordinated, and synchronized emergency operation plans through the integration of a uniform planning process, across the Food and Agriculture Sector by National, State, local, tribal and territorial government entities.

Relevance
Lessons Learned Information Sharing (LLIS) / Food, Agriculture and Veterinary Defense (FAVD): The needs of the agricultural community in response to an emergency situation often mirror the urban response. However, there are also many needs and solutions that are unique to an agricultural setting. Information available from NABC lessons learned analysis combined with a searchable corrective action database will allow agriculture emergency response managers to review lessons and corrective actions from tabletop and field exercise AAR/IP’s and then incorporate them into their own emergency response plans.

Planning and Curriculum for Food and Agriculture Emergency Response: A common format and instructional curriculum for risk-informed planning and decision making will allow for the development of integrated, coordinated, and synchronized emergency operation plans across the Food and Agriculture Sector by National, State, local, tribal and territorial government entities.

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Background
With the proliferation of UAS technology comes the enablement of a myriad of applications which potentially benefit from the availability of an aerial sensor. Many of these applications share common technical challenges associated with data collection. One common challenge is identifying a reliable, cost-effective means of collecting aerial imagery that is both ortho-rectified and scalable in order to provide end-users with actionable-intelligence in support of making reliable resource management decisions which often require the need for exact volume and linear measurements. If successful in solving this challenge this may be a significant commercialization prospect for Kansas State University Salina.

One government agency that has a need to solve this problem is the Bureau of Land Management (BLM) located within the Department of the Interior (DOI). In the fall of 2014, Kansas State University Salina responded to a BLM solicitation and was subsequently chosen to partner with the BLM to solve this problem under a Cooperative Ecosystems Studies Unit (CESU) agreement.

Description
The ultimate goal of this project is to identify low-cost, commercially available systems that can collect data that will result in finished ortho-products, which are precisely scalable through a new scaling technique independent of ground surveys called “camera station scaling”. The tasks associated with this effort include:

1) **Hardware Selection** – Identification and testing of low-cost, commercially available, electric VTOL small UAS that are suitable for stereo image capture and/or precise measurement of relative camera station location.
2) **Payload Development** – Modification of commercially available cameras for stereo image capture and their associated mounting and interfacing with the autopilot, including camera triggering techniques.
3) **Operational Testing and Procedures** – Refinement of stereo and single image capture flight profiles to achieve optimal results.
4) **Data Analysis** – Initial research and development of camera station scaling techniques and processing tools.

Although the collection and analysis of remotely sensed data has been the focus of much research over the last decade, significant limitations in the methodology remain. Three main components to UAS data collection are: 1) the hardware to carry, locate, and actuate the sensor(s), 2) the sensor itself and its calibration, and 3) the collected data and its associated processing, ortho-rectification, analysis, and dissemination. All of these components have their inherent challenges and limitations; this project addresses these challenges.

Initial trials are underway; upon selection of the necessary test sUAS platforms, KSU will obtain the necessary approvals from the FAA to conduct flight operations. The next step will be to conduct airworthiness reviews of the systems using KSU’s internal airworthiness review processes and file applications for Certificates of Authorization (COAs) for locations at the Crisis City Training Center outside of Salina, Kansas.

Relevance
As mentioned, many applications across the spectrum of existing industries will benefit from this work. The ability to make cost-effective, precise measurements independent of ground survey control points from a UAS will increase the efficiencies of a host of applications such as infrastructure inspection and monitoring, surveying, energy exploration, and many more. Positive results here will yield significant time and financial resource savings that will help drive the success of the UAS industry.

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Prairie Studies Initiative

Background
Kansas State University is situated in the Flint Hills, an eco-region that includes a majority of the remaining tall grass prairie in the United States. The importance of grassland as intact ecosystems is poorly understood, except by experts; consequently grasslands are not always properly stewarded. Grasslands provide many crucial ecosystem services, including biodiversity and provisions of drinking water. Grasslands support food production livelihoods that have global importance: ranching and farming. Unfortunately, less than four percent of grasslands worldwide are protected; nearly fifty percent of grassland ecosystems worldwide have already been destroyed.

K-State 2025 goals reaffirm the university’s land grant commitment to be a center for teaching, research, and service that benefit Kansans, the nation and world. Because of the important role Kansas plays in global food systems, fully understanding this place – the tallgrass prairie and high plains of Kansas – is critical. Meaningful dialogue between science and technical fields on the one hand, and the arts and humanities on the other is necessary if K-State is to incentivize creative research and equip students to participate in 21st century democracy.

Description
The Prairie Studies Initiative (PSI) is a collaborative venture of K-State faculty, staff, and students from a range of disciplines. PSI creates incentives and support structures for the study of the cultural and ecological dimensions of the prairie, challenges to sustaining grassland ecosystems, and visions for new futures for these important landscapes and the people who live and work in them. PSI does not fund research; it is still incumbent on faculty and students to seek external funding for their projects. But PSI offers support for networking, workshops, fellowships and collaborations to bring in presenters.

PSI meaningfully engages the arts/humanities with explorations in science, technology, and engineering in programs and projects that pair experts from diverse fields of study. PSI programs enrich the intellectual life of the campus by focusing on the meaning, identity, and value of the Flint Hills eco-region. The Beach Museum of Art serves as a locus for many of PSI’s public offerings, with McCain Performing Arts as a frequent collaborator. These university venues are designed to welcome public audiences. PSI has developed a park-like native plant garden, The Meadow. A touch screen table inside the museum provides information about the plants in this small park and connects it with research at Konza Prairie Biological Station and the work of artists in the museum’s collection who have explored the prairie. The museum hosts an annual PSI art-science residency titled Open AIR. Additional programs have included film screenings, panel discussions, workshops, and conference presentations.

PSI will seek funding to provide fellowships for faculty; organize symposia to share outcomes of PSI; and fund a coordinator position. Currently under development is a website that aims to serve as a portal for prairie-related expertise and programs in our region and at peer institutions.

Relevance
PSI supports 2025 aims to make K-State the site of world-class research and to provide scientific and technical education enriched by critical thinking and cultural awareness that distinguishes K-State from other schools with technical and agricultural strengths. Art and science each bring distinctive tools and practices to research. Understanding how to employ the full range of these tools can enhance the work of both scientists and artists. Improved communication can make research questions and discoveries meaningful to wide audiences.

PSI highlights opportunities for international and multicultural work. The grasslands of Central Asia, Africa, South America, and Australia offer rich possibilities for comparative studies and shared discoveries. The changing demographics and cultural profiles of regions in Kansas also call for the perspective of place-focused studies. Place-based teaching and research can reveal a 360 degree view of the past, present, and potential future of a defined region.

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Investigating Place Using Digital Toolset

Background
Historically, the process of design, construction, and post-occupancy observation and evaluation has formed the basis of informing future decisions in design for the built environment. Efficiencies in time and resources are projected through the use of parametric and information modeling of projects, performance and simulation-based design, digital fabrication, and algorithmic design and interface development.

Emerging technologies and computational tools continue to alter the process of design, methods of project delivery, and manufacturing techniques that profoundly impact design and architectural innovations. Building information modeling (BIM), environmental information modeling (EIM), alongside performance-oriented simulations and increased automations in decision-based prototyping increase the capacity for optimizing designs toward specific economic, social, and environmental goals; offering a unique opportunity to respond to and influence particular areas that are critical to ongoing research and developments across disciplines.

Description
This project builds upon the existing experiences and research of multiple trans-disciplinary faculty to develop a digital toolset as a process-oriented approach to the investigation of place design. The toolset builds upon the understanding of how place, history, climate, and ideals of occupants may be combined with simultaneous investigations of materiality, object and space to propose cohesive environments that can be subsequently envisioned and modeled for effective evaluation and iteration.

Parametric modeling as a means to develop space and product that can respond to given criteria can additionally simulate systems for design thinking. Simulations of variabilities within interior and exterior spaces are structured with variable decision points that allow a particular product to be “custom fit” to a space and project on a large scale the idea of “mass-personalization.” This advocates for a revolution similar to that of the industrial revolution; where the entire way of life at every scale was reconstructed and reorganized, from product design and production to consumption and recycling.

This project develops a formative and evaluative toolset to address attributes and how proposed designs can help support these attributes.

Relevance
Parametric design systems provide a means for developing design thinking while also engaging the ability to explore, discover, optimize and achieve user-oriented parametrically-defined design solutions as well as engaging in materialization and fabrication processes; speculating on how these activities will fold into a design process that explores the role of “user” with new eyes. As the age of information passes in to the age of choice, designers are developing models that enable users to participate in the design process. While the models vary in complexity, from those that simply engage aesthetic to those that drive sustainable agendas, the user can now set the parameters that the models act against.

Products can be explored that become part of a holistic system but are adapted to different sites and functions, creating a sense of identity per space while achieving unity and connection throughout a community. Not only in design education, but as a model for complex systems-oriented decision matrices, this approach has far-reaching implications for multiple fields.

Development of this stage of the project will lead to evaluation metrics that can be employed throughout an investigation to render immediate feedback and implications. Initially, the project is seen as a model to inform education; subsequently, as a decision paradigm for complex environments.

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Preparing STEM Teachers: Responding to New Challenges

**Background**

The National Science Board issued a report in 2010 strongly stating the need for quality education of the future STEM workforce. Key recommendations that relate directly to the preparation of teachers in STEM fields include: providing professional development opportunities for teachers, principals, counselors, and other key school staff; supporting research-based STEM preparation for teachers; and fostering peer-to-peer connections and collaborations with the scientific research community. Besides this call to action, here are three new challenges in preparing STEM teachers in the nation’s teacher preparation programs.

1. **Unmet needs for endorsed and highly qualified math and science teachers.** Over the next decade, schools will need 200,000 or more new math and science teachers nationally. In Kansas, the shortage of math and science teacher is expected to reach critical levels with the potential retirement of 36% of Kansas teachers eligible to retire in five years.

2. **The reform of science and math standards in K-12 education (the Next Generation Science Standards, NGSS).** NGSS updates content and represents a shift in the way STEM education has been conceptualized and implemented, necessitating a change in the approach to preparing science and mathematics teachers.

3. **The adoption of Common Core State Standards, (CCSS).** The new CCSS provide a clear understanding of expected student outcomes, which provide new guidelines and expectations for preparing teachers.

**Description**

The College of Education (COE) at K-State is responding to these challenges by implementing activities to increase the number and quality of STEM teachers for Kansas schools:

- An NSF-funded scholarship program, K-State TEACH, focuses on K-State science majors who want to become certified teachers is a collaboration between the COE and the College of Arts and Sciences (physics, geology, chemistry and biology).

- Collaboration with the local school district to conduct summer STEM camps for middle school students, funded by DoDEA.

- The Center for Science Education has the mission of improving the quality of science, math, and technology teaching and learning throughout Kansas, the region, and the nation. In consideration of NGSS and CCSS, the Center is preparing to expand its mission and reach.

- A dual degree program was approved in 2013 that enables undergraduate students to complete a STEM major and become a licensed middle/high school STEM teacher in four years.

- The college is implementing a Teacher Education Initiative, funded by the Kansas Board of Regents, focused on designing an enhanced Graduate Certificate in Teaching and Learning to recruit and prepare STEM graduates to become STEM teachers. In addition, this project is designing courses and providing professional development to support currently licensed teachers wishing to gain an additional license in science or mathematics.

- The Center for Intercultural and Multilingual Advocacy (CIMA) is providing professional development to ESL teachers to improve their capacity to teach math and science to ESL students.

- The math education faculty, the Department of Mathematics, and CIMA have developed several proposals to NSF for the development of culturally-responsive math instruction strategies, which include extensive professional development for Kansas’s math teachers.

- Math education and mathematics faculty have been conducting successful summer mathematics professional development institutes for Kansas teachers for the past 11 years.

Efforts planned for the near future are: recruiting veterans into STEM teacher certification programs; an endowed chair in science education; expansion of the STEM faculty in the college; focused efforts on recruiting STEM preservice teachers; workshops and webinars on NGSS; and collaboration with the College of Engineering related to engineering education.

**Relevance**

STEM teacher education relates to the College’s 2025 plan, Theme II, with a goal of increasing the number of STEM graduates by 50% in the next 10-15 years. These activities also relate to K-State 2025, Themes II and III.

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Troops to Teachers: Recruiting and Supporting Preparing post-9/11 Veterans to Become K-12 Educators

Background
The College of Education at Kansas State University is committed to a military/veteran focus as part of our work. The needs and strengths of military personnel, veterans and their families have been systematically addressed by the faculty of the College of Education, who educate teachers, principals, superintendents, adult educators, school counselors, special educators, postsecondary advising and college student personnel services staff. Our military initiative, ED-OPS, is a college-wide program that has been in place for several years. The focus of the initiative is military-connected learners at all education levels, recognizing especially that veterans in college face challenges in adjusting to a college culture that differs greatly from the highly structured military culture. Therefore, we are designing programs and conducting research related to military-connected learners.

- The college became one of the first 100 universities to join Operation Educate the Educators, a nationwide Joining Forces initiative that was given guiding principles set forth by the American Association of Colleges for Teacher Education and the Military Child Education Coalition.
- The school counseling program has developed a Certificate of Competence in Counseling Military-connected Students for school counselors and candidates in counselor education graduate programs based on the theoretical and research framework and best practices in parent/family counseling and education strategies and interventions.
- The Military Child Education Coalition awarded the College of Education the 2014 LTG (Ret.) H.G. “Pete” Taylor Higher Education Partnership of Excellence award in recognition of our work with school partners in educating military-connected students.
- A faculty-developed leadership-training program, the Command Team Spouse Development Program—Brigade, awarded the Malcolm Knowles Award for Outstanding Program in Adult Education in 2010.
- The college produced a widely-disseminated documentary, A Walk in My Shoes: Military Life (http://coe.ksu.edu/about/military/militarylife.html) in which seven people currently connected to the College of Education – retired soldiers, spouses, a child and educators – share their perspectives on the rewards and challenges of being connected to the military. Topics include the realities of deployments for the family and the soldier, Post Traumatic Stress Disorder (PTSD) and the social/emotional needs of military-connected children.

- Our adult education graduate program is active at Ft. Leavenworth and has awarded over 600 graduate degrees to officers at the Command and General Staff College in the past twenty-five years.
- Faculty and graduate students conduct research related to timely topics in education; several recent dissertations have addressed military and veterans’ issues, such as the impact of deployment on school behavior, creativity and cognitive development in military courses, effects of stress in the military classroom, military faculty self-efficacy, and faculty development at military colleges.
- We have focused experience in working with military- and former military-connected adult learners and we have an award-winning teacher preparation program. Therefore, K-State’s College of Education has the potential to make a significant contribution to remediating the shortage of teachers in Kansas and across the country.

Description
The College of Education at Kansas State University has the capacity and commitment to recruit, support and prepare former military personnel to become K-12 teachers via our outstanding teacher preparation program. A special emphasis is on science and math teachers, and our current National Science Foundation funded program provides fellowships for individuals with math or science degrees to become teachers. We also have in place a cooperative dual-degree for those interested in concurrent math or science and education degrees. Although these programs do not focus primarily on former military personnel, they are actively recruited to the programs. The college is seeking funds to develop a full veteran-focused recruitment and teacher preparation program that is designed specifically for former military personnel who seek to become teachers.

Relevance
This initiative is aligned with the K-State and College of Education commitment to serve military and their families. In addition, these endeavors align with K-State’s 2025 themes I - IV, and three of the College’s 2025 goals, one of which relates specifically to engagement in issues, activities, and research related to the military.

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Promoting Health through the Built Environment

Background
At no time in history has our world been faced with the complexity and vast array of environmental and health care problems, and yet been so connected to each other. The intricate web of connection forges an imperative responsibility to find solutions to many of the issues propagated by industrialized nations. Conservation of the environment and the stewardship of these resources in the design of our communities and buildings is a fundamental contribution to society and economic development.

New knowledge is presented every day regarding the fragile and delicate relationship between the natural and designed environment with humans. Areas include the sensory impact on early childhood development; childhood obesity and obesity in general (at epidemic proportions in this country); the influence of the interior environment on musculoskeletal issues, indoor air quality, productivity, and reduced absenteeism, each are areas ripe with potential to impact individuals through design.

Evidence-based design is raising the awareness of the impact of design in all areas, and the opportunity to contribute to the body of knowledge – in interior architecture, product design, and furniture design – is profound. With the pursuit of new knowledge come new opportunities for fresh collaborative ventures and exploration. As an example of evidence-based design on designers’ access to quality information to affect design, in a ten-year period (1998 – 2008), the number of credible peer-reviewed articles regarding healthcare design grew from 84 to over 1,200.

Relevance
The Pentagon's Defense and Veterans Brain Injury Center reports having diagnosed 229,106 cases of mild to severe traumatic brain injury from 2000 to the third quarter of 2011, including both Iraq and Afghan vets. These wounded veterans have special medical needs that the civilian health care system is insufficiently trained to handle. The growing number of returning wounded, often with catastrophic injuries, tests the health response of the Department of Defense (DoD) facilities infrastructure. These wounded warriors not only need assistance in healing physically, but also need help in integrating back into the society they left behind when they went to fight the war.

Current work collaborates with wounded warriors, medical staff from Fort Riley, and rehabilitation specialists to investigate, propose, and initially evaluate innovative solutions to the design of rehabilitation facilities and their impact on the healing of wounded warriors and their integration back into society.

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known as the "Baghdad boil"), malaria, memory loss, migraines, sleep disorders and tuberculosis as potential deployment health conditions the Iraq and Afghanistan veterans may endure.

Description
The war in the Middle East has caused much suffering and pain for all parties involved, although the tragic loss of life is not the only direct aftermath of these wars. Bond (2012), notes that over the past decade of conflict, tens of thousands of America’s wounded have been injured in combat. The success stories of battlefield medicine advances is the increased rate of survival from injuries that in previous conflicts, resulted in death. The survival rate for U.S. service members wounded in Iraq has reached 90%, higher than in any previous war. (p. 30). Given this large number of survival rate, it is not surprising that these veterans come back with severe injuries. Unfortunately, not all injuries are visible or physical. The Department of Veterans Affairs lists chronic fatigue syndrome, depression, fibromyalgia, hearing difficulties, hepatitis A, B and C, Leishmaniasis (also
Breaking the Barriers: Aging in Place

Background
As the demographics of the United States and indeed the world increasingly shift toward the elderly population, a need to understand implications of the built environment upon the quality of life of older individuals and provide accessible and affordable solutions exist. While strides toward increased attention to the conditions designed in existing and new congregate care, assisted living, and other specific facilities aimed at housing those with decreased functioning due to age or disease is on the rise; affordable alterations to the inventory of current housing for those same individuals with lower economic means is relatively stagnant.

Description
Rather than expecting humans to adapt to their environment, changing their behavior or actions due to the fixed nature of the building housing them; this project aims to redesign existing living environments toward the needs of its aging inhabitants and allowing effective aging-in-place measured through quality of life and economic models.

Medical terminology can be confusing and overwhelming to the general public. Initial steps of comprehending the characteristics associated with each aging ailment and translating medical literature regarding ailments to design features implemented with low cost has been accomplished. Building upon that understanding and utilizing a trans-disciplinary model of process, and including rapid prototyping, multiple models of interventions can be envisioned, tested and brought to fruition, creating an aesthetically-pleasing, ailment-specific, safe living space. In the end, a few well-designed changes can mean the difference between residents staying put or forced to move to special care facilities (and incurring the significant impact to their personal financial condition and subsequent need to employ Medicare financial support).

Many adults wish to maintain their independence, often in the homes in which they’ve lived for many years. Social services and senior home care services are available in most communities to support mature adults aging in place. However, these familiar environments themselves often create physical barriers for those suffering from specific age-related ailments. To overcome these barriers, design of the environment to support and enable people as they age (whether their choice stems from financial or personal situations) to remain in their home is the impetus of the approach presented here and exemplified through the research, design, prototyping, and testing of products seamless to the home environment.

Relevance
Most people age 75+ have at least one joint affected by arthritis. In 2003-2005, 50% of adults 65 years or older reported an arthritis diagnosis and that percentage has continued to rise. Women are impacted 2-3 times more than men by Rheumatoid Arthritis. Most hearing loss begins between 40-50 years. Over twenty-eight percent of those individuals age 65 and older have a measurable hearing impairment and by age 85, 50% of individuals have a hearing impairment. One-in-two women and one-in-eight men 50-plus years of age will have an osteoporosis-related fracture. Depth perception begins to decline during the 50’s, and a 60-year-old person may require 2 to 3 times as much light as a 20 year old; with the amount of light required doubling for each 13 years after the age of 20.

While available alternatives of retirement housing, independent living, congregate care, assisted living, skilled nursing, specialized nursing facilities, and nursing homes, are plentiful in many urban areas of the country, many individuals and families prefer to age-in-place within their existing community. Arthritis, cardiovascular diseases, diabetes, hearing impairment, mental disorders, muscular loss, neurological diseases, osteoporosis and vision impairment are nine ailments determined to impact the built environment for those wishing to age-in-place, and which this project mitigates through products and interventions.

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Developing Educational Leadership in K-12 Schools, Districts and 2-Year Postsecondary Schools and Colleges

Background
In an era dominated by higher standards and greater accountability for America’s schools, the K-State response is to prepare great leaders at all levels who know how to implement change. The College of Education (COE) at K-State is utilizing partnerships for educational leadership development that will have wide and lasting impact in Kansas and across the nation. The programs and the activities in the College are lead by the Department of Educational Leadership, which includes preparation of K-12 school leaders as well as faculty who specialize in adult education. This group uses a partnership model for collaborating with schools and other educational organizations to provide leadership training that touches the lives of thousands of learners and hundreds of schools. We believe that partnering for a new generation of leaders produces better results by focusing on the different leadership needs associated with different community and school contexts. This foundational premise accounts for the success of current programs and informs the design of future programs.

Description
The COE at K-State is creating models and implementing educational and professional development activities to increase the number and quality of educational leaders in Kansas schools at all levels. These include:

• Educational Leadership Academies in Junction City and other large school districts working with economically and socially diverse populations have provided graduate education and leadership development opportunities for school principals across the state. K-State’s academies have operated since 1987 and have drawn national praise, having prepared over 500 school leaders at principal and superintendent levels.

• The Kansas Educational Leadership Institute (KELI) emerged from collaborative planning by six major Kansas professional entities interested in developing and supporting leadership for Kansas schools and districts in the 21st century. Partners in this effort are: Kansas Association of School Boards, Kansas State Department of Education, Kansas School Superintendents Association, Kansas Leadership Center, Kansas State University, and United School Administrators. KELI supports 26 first year Kansas superintendents a year. These superintendents participate in seminars, a mentoring program, and leadership coaching and academic work. The KELI mission and model are unique in the country.

• COE has a long history of collaboration to provide educational leadership opportunities at Fort Leavenworth with the Command and General Staff College (CGSC). The Adult Education Program has awarded 787 graduate degrees in a cohort Master’s program to officers at the CGTSC during their 25-year history. The program has also awarded 10 doctorates to faculty and faculty developers at CGSC.

• K-State faculty, graduate students and school partners are collaborating on research that demonstrates the efficacy of our school leadership models and programs. More funding is being sought to provide support for the extensive and rigorous research and evaluation that is needed to promote this K-State model into a nationally recognized and adopted exemplary practice.

• Among the new avenues being considered for educational leadership development in Kansas include professional development and mentoring for a new generation of 2-year and technical college leaders based on the successful Academies and KELI models.

• The education leadership graduate program is actively seeking funds to enhance professional development of school leaders in such topical areas as computer science.

Relevance
Preparing successful educational leadership is the primary mission of the College’s Educational Leadership Program and relates to the College’s 2025 plan, Themes III (provide quality graduate education that prepares students for leadership), and IV, (increase service to communities through systematic engagement). These activities also relate to K-State 2025, Themes III and IV.

Contacts
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Prairie Studies Initiative

Background
Kansas State University is situated in the Flint Hills, an eco-region that includes a majority of the remaining tall grass prairie in the United States. The importance of grassland as intact ecosystems is poorly understood, except by experts; consequently grasslands are not always properly stewarded. Grasslands provide many crucial ecosystem services, including biodiversity and provisions of drinking water. Grasslands support food production livelihoods that have global importance: ranching and farming. Unfortunately, less than four percent of grasslands worldwide are protected; nearly fifty percent of grassland ecosystems worldwide have already been destroyed.

K-State 2025 goals reaffirm the university’s land grant commitment to be a center for teaching, research, and service that benefit Kansans, the nation and world. Because of the important role Kansas plays in global food systems, fully understanding this place – the tallgrass prairie and high plains of Kansas – is critical. Meaningful dialogue between science and technical fields on the one hand, and the arts and humanities on the other is necessary if K-State is to incentivize creative research and equip students to participate in 21st century democracy.

Description
The Prairie Studies Initiative (PSI) is a collaborative venture of K-State faculty, staff, and students from a range of disciplines. PSI creates incentives and support structures for the study of the cultural and ecological dimensions of the prairie, challenges to sustaining grassland ecosystems, and visions for new futures for these important landscapes and the people who live and work in them. PSI does not fund research; it is still incumbent on faculty and students to seek external funding for their projects. But PSI offers support for networking, workshops, fellowships and collaborations to bring in presenters.

PSI meaningfully engages the arts/humanities with explorations in science, technology, and engineering in programs and projects that pair experts from diverse fields of study. PSI programs enrich the intellectual life of the campus by focusing on the meaning, identity, and value of the Flint Hills eco-region. The Beach Museum of Art serves as a locus for many of PSI’s public offerings, with McCain Performing Arts as a frequent collaborator. These university venues are designed to welcome public audiences. PSI has developed a park-like native plant garden, The Meadow. A touch screen table inside the museum provides information about the plants in this small park and connects it with research at Konza Prairie Biological Station and the work of artists in the museum’s collection who have explored the prairie. The museum hosts an annual PSI art-science residency titled Open AIR. Additional programs have included film screenings, panel discussions, workshops, and conference presentations.

PSI will seek funding to provide fellowships for faculty; organize symposia to share outcomes of PSI; and fund a coordinator position. Currently under development is a website that aims to serve as a portal for prairie-related expertise and programs in our region and at peer institutions.

Relevance
PSI supports 2025 aims to make K-State the site of world-class research and to provide scientific and technical education enriched by critical thinking and cultural awareness that distinguishes K-State from other schools with technical and agricultural strengths. Art and science each bring distinctive tools and practices to research. Understanding how to employ the full range of these tools can enhance the work of both scientists and artists. Improved communication can make research questions and discoveries meaningful to wide audiences.

PSI highlights opportunities for international and multicultural work. The grasslands of Central Asia, Africa, South America, and Australia offer rich possibilities for comparative studies and shared discoveries. The changing demographics and cultural profiles of regions in Kansas also call for the perspective of place-focused studies. Place-based teaching and research can reveal a 360 degree view of the past, present, and potential future of a defined region.

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Institute of Museums and Library Services
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Research on Culturally Responsive Teaching and Learning

Background
The College of Education (COE) recognizes our important and continuing work of preparing our students for the increasingly “diverse and changing world”. Significant work is being done in the college that positions us as a national and international leader in addressing culturally responsive teaching and learning through our programs and our research. The COE’s longstanding commitment to diversity can be seen throughout the collective work of its departments, centers, and programs since the early 1990s. Guiding these initiatives is the College mission of "Preparing educators to be knowledgeable, ethical, caring decision makers in a diverse and changing world."

Description
The COE is creating educational programming and conducting social science research related to pedagogical practices that are culturally relevant and are informed by the context of the learner and the educator through a number of programs, projects and research endeavors:

- The Midwest Equity Assistance Center (MEAC) provides technical assistance, professional development and information about race, gender and national origin equity to educational agencies in the region and is the predominant regional source of best practices for culturally responsive education. This includes the new C4 Database that houses exemplary lesson plans that integrate both the National Diversity Standards and the Common Core Standards. In collaboration with the Kansas Department of Education, MEAC is working to review the Accreditation System for bias and sensitivity related to diversity.
- The Center for Intercultural and Multilingual Advocacy (CIMA) implements programs and conducts research that has national and international significance. CIMA originated the BESITOS program model that has supported 95 bilingual/bicultural students to graduation and placement in ESL education. Of these, 35 have gone on to graduate school with 21 to date completing and serving in Kansas. CIMA has supported over 500 migrant students in obtaining GED’s, and has served over 98 migrant students in post-secondary education. Several CIMA programs have won national and international awards. In addition, CIMA researchers have produced highly ranked books and peer-reviewed publications.
- The College is a partner in the Kansas Louis Stokes Alliances for Minority Participation (LS-AMP) funded by NSF. This award funds four colleges at K-State who partner with community colleges in Kansas designated as Hispanic Serving Institutions (HSI). This pipeline project promotes the recruitment, retention and graduation of underrepresented minorities in STEM. College faculty provide expertise and professional development for their partners related to culturally responsive practices in recruitment, retention, and teaching. We are also engaged in research related to these best practices.

Examples are:


Relevance
Our current and planned work in this area aligns with tall Themes of the College’s 2025 plan as well as to the mission of the College. These activities also relate to K-State 2025, Themes I, II and III.

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U.S. Department of Education: Office of Elementary and Secondary Education (Deb Delisle, deb.delisle@ed.gov, 202-401-0113); Office of English Language Acquisition (Libia S. Gil, libia.gil@ed.gov, 202-453-6562).
Operations Research: Applied and Theoretical Advances across Multiple Sectors

Background
Grand challenges related to water, energy, security, health, and food systems involve optimal allocation of scarce resources, balance of multiple decision objectives, and understanding of complex systems. Operations research provides a quantitative framework to confront these issues.

Description
Kansas State University (KSU) faculty are uniquely qualified to address theoretical and applied research questions that advance the discipline of operations research and create solutions to urgent societal challenges. This work is generating new scientific knowledge in response to critical opportunities in one or more of these three areas: (1) How can optimization methods be more effectively integrated with methods from social and natural sciences to make it possible to understand complex systems holistically?; (2) How can algorithms be designed to more effectively process data or solve optimization problems that support decision-making?; and (3) How can these advances in modeling and solution techniques be translated into decision-support frameworks that can be implemented in practice?

Several current operations research projects illustrate these overarching opportunities and the potential for fundamental and practical impact:

Harnessing the decision-making power of big data: The evolution of computers and communication technology has produced an abundance of powerful devices capable of unprecedented data capture. Resulting data sets are massive but messy. KSU researchers are developing methods to turn raw data into relevant information for decision makers in manufacturing, service, and health care industries.

Improving solution times for integer programs: Integer programs are used to identify optimal decisions and policies in sectors such as transportation, financial services, healthcare, and government. However, current methods are limited in their ability to solve integer programs, even when using the most advanced technology, which leaves decision makers with suboptimal strategies. KSU researchers are discovering novel techniques to solve integer programs by utilizing graphs and hypergraphs. They are creating new cutting planes, developing new branching procedures, and generating polynomial time algorithms to lift variables, all of which allow large integer programming problems that arise in practice to be solved.

Measuring and mitigating the impact of decentralized decision making in humanitarian response systems: Government, military, private, and nongovernmental organizations face immense challenges in the aftermath of a disaster. Disasters highlight complications inherent in decentralized supply chains, or those in which multiple stakeholders take actions that impact the overall system. Proactive supply chain engineering can prevent inefficiency, redundancy, and missed opportunities. KSU researchers are using advanced analytics to improve efficiency and effectiveness in decentralized decision environments.

Optimizing the design of high-speed railroad ties: High-speed rail is a multi-billion dollar industry used by numerous countries for passenger and freight transport. As demand for this technology increases, the need for improved railroad design also increases. Current efforts at KSU involve use of operations research models to inform design of rail ties that can withstand the pressure of high-speed transport and be manufactured in bulk for a reasonable cost.

Improving healthcare systems: Seventeen percent of U.S. gross domestic product is spent on healthcare, and opportunities abound to improve efficiency, effectiveness, and equity. KSU researchers are applying techniques such as data envelopment analysis modeling, information systems modeling, and mathematical optimization to design improvements for complex health systems. To date, this work has improved work flow in a local intensive care unit and improved nurse and surgery scheduling processes.

Relevance
Tools for optimal quantitative decision-making touch every sector. In particular, new models, algorithms, and decision-support frameworks contribute to state and national key initiatives regarding water, health, transportation, and food systems.

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Center for Rural Transportation Research and Education

Background
Since 1989, the College of Engineering has actively participated in the Kansas Department of Transportation (KDOT) Kansas Transportation Research and New Developments Program (K-TRAN). The K-TRAN program provides approximately $400,000/year in state funds to support applied transportation research projects involving faculty and students from civil, mechanical, industrial, and electrical engineering, as well as from economics, sociology, and geology. KSU also has been the contractor in many pooled funds programs in which several state agencies combine their resources to fund multi-year research projects of mutual interest. In addition, the College of Engineering and the Department of Civil Engineering have a long history of excellence in creating and delivering technology transfer programs for transportation and workforce development, including specialty conferences, distance education programs, workshops, and training courses. In 2006, KSU was designated a Tier II University Transportation Center (UTC) under the USDOT Research and Innovation Technology Administration’s (RITA) University Transportation Centers Program, with funding of approximately $450,000 per year through FY 2011. During the period 2005-2011, the KSU UTC generated over $2.3M in new research funding, awarded 42 scholarships, and provided financial support for 42 GRA positions. Establishment of the KSU UTC allowed consolidation of KSU’s transportation-related research and technology transfer programs to a single administrative unit. In addition, establishment of the UTC allowed expansion of the college’s transportation research program to include a substantial education component, including scholarships, assistantships, and travel grants to attract and retain highly qualified students. KSU will compete for UTC funding in future grant solicitations from the USDOT Office of the Assistant Secretary for Research and Technology (OST-R). In the meantime, the Center seeks additional/alternate funding to maintain KSU’s current transportation research programs and to elevate the transportation research program to national prominence.

Description
Research, education, and technology transfer activities of the Center will focus on identifying and deploying rural transportation systems and infrastructure innovations aimed at decreasing transportation project delivery, enhancing transportation system safety, promoting economic development, and protecting the environment. The Center has the following unique facilities, services and programs to achieve its mission: Civil Infrastructure Systems Lab, Annual Kansas Transportation Engineering Conference, Traffic Assistance Services for Kansas (highway safety training programs), pavement laboratory technician certification program (Superpave), Kansas Annual Bridge Workshop, Center for Roundabout Research and Education and a mobile Transportation Lab.

Relevance
The theme of the proposed Center for Rural Transportation Research and Education is “Safety and Sustainability of Rural Transportation Systems and Infrastructure.” This theme and corresponding Center expertise encapsulate three areas of concern widely recognized as critical challenges facing the United States: safety, sustainability, and infrastructure. Funding is requested to allow KSU to expand its influence and contributions in order to discover and implement solutions to problems related to the safety and sustainability of U.S. rural transportation systems and infrastructure. In addition, the Center can provide expertise to support other federally supported programs and centers currently in place at KSU. For example, transportation center expertise in transportation network modeling and simulation, emergency evacuation planning, and traffic control could be a valuable asset for advancing KSU’s agricultural bio-security programs. Other research focus areas will include rural economic development, alternative transportation project funding sources, use of agricultural by-products in roadway paving materials, and rural highway dust abatement programs.

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Small Unmanned Aircraft Systems Standards Validation

Background
In February 2012, the FAA Modernization and Reauthorization Act (FMRA) was passed by Congress requiring the FAA to integrate Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS) by September 2015. Successful integration of UAS requires many technological and regulatory hurdles to be addressed. One of these hurdles is demonstrated airworthiness of unmanned systems to operate in a congested airspace environment.

On August 29, 2013, Kansas State University – Salina signed a Memorandum of Agreement (MOA) with the FAA to validate the industry consensus standards for small UAS (sUAS) – defined as aircraft weighing less than 55 lbs. The validation of the industry consensus standards developed by the ASTM F38 Committee on Unmanned Aircraft Systems will demonstrate the capability of these standards to address airworthiness concerns for sUAS. This effort is titled as the sUAS Standards Validation Project. This project is now in phase 2, application and sequencing having successfully completed phase 1- planning. We have partnered with Wichita State University’s NIAR and are working closely in partnership. The FAA is pleased with progress thus far thus our hope for further follow-on projects is high, the next being building a safety plan.

Description
K-State Salina and the FAA are working together to validate the industry consensus standards for sUAS by applying for a restricted category airworthiness certificate for an example sUAS using the ASTM standards as the certification basis. This process requires a detailed review of all documentation relating to the aircraft design and equipment along with justification for why the aircraft is safe to operate in the NAS.

K-State Salina is working closely with the FAA’s UAS Integration Office (D.C.) and the Small Airplane Directorate (Kansas City) in reviewing and determining the acceptability of the ASTM standards for sUAS as a certification basis.

Relevance
The integration of UAS into the NAS is expected to bring a multi-billion dollar market to life with new opportunities for a myriad of commercial applications of unmanned systems. Currently, the use of UAS is currently restricted to only recreational, research, and governmental functions. If the ASTM standards can serve as a certification basis, then commercial UAS operations ranging from precision agriculture to pipeline inspection would be authorized by having an aircraft with a FAA airworthiness certificate.

Additionally, the FAA is anticipating the release of a Notice of Proposed Rulemaking (NPRM) for a new regulation covering sUAS soon with anticipated rules for larger UAS airspace integration in the pipeline. Future proposed rules may reference the industry consensus standards developed by the ASTM F38 Committee as the approved aircraft design criteria. However, the FAA will be unwilling to issue a Notice of Availability (NOA) that cites the ASTM standards unless those standards have first been validated by an independent organization. The current research at K-State Salina will provide this independent standards verification.

Furthermore, it is expected that the sUAS Standards Validation Project will identify portions of the ASTM standards that are too robust, and therefore difficult to comply with; or too weak and thus unlikely to ensure an appropriate level of safety. The work at K-State Salina will likely result in significant revision of the internationally developed ASTM standards that will effect a large existing and potential market.

The FAA has expressed a desire, pending adequate funding, for turning the sUAS Standards Validation Project into a much larger scope effort that would begin with a “clean sheet” aircraft design that is taken through flight testing and ultimately certified as the first commercially operable, non-military sUAS. However, prevailing federal fiscal policy will dictate the future growth in scope in this regard.

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Rail Infrastructure Durability and Sustainability

Background
Railways are the backbone of our nation’s economic system, allowing for swift, economical and fuel efficient movement of agricultural products, coal, and finished goods. Keeping freight moving requires efficient train networking and reliable track systems. Kansas State University has multi-disciplinary expertise in railway track systems, and is investigating methods of improving the safety and durability of concrete railroad ties under current contracts with the Federal Railroad Administration totaling over $3.2 Million. The KSU departments involved in this research include Civil Engineering (CE), Mechanical and Nuclear Engineering (MNE), and Industrial and Manufacturing Systems Engineering (IMSE).

Description
The overarching theme of this work has been enhancing our understanding of how different materials and fabrication processes interact to affect the railway durability. Kansas State University has pioneered the development of a laser-speckle imaging (LSI) device that can be used in rugged environments. This patented device has led to the development of a system for imaging concrete railroad ties to determine if they are properly stressed at the manufacturing plant to prevent cracking and failure in track.

Researchers are also currently working on methods to determine how the raw materials and manufacturing processes affects durability in cold, wet climates found in Kansas and northern climates. As such, KSU has recently installed a large environmental chamber dedicated to the investigation of full-sized concrete railroad ties under freezing and thawing thermal cycles, and is the only existing facility of its kind in the United States.

The use of LSI techniques and full-scale freeze-thaw testing of concrete railroad ties has positioned Kansas State University at the forefront of railroad track systems durability research. Under the proposed center, these existing technologies will be leveraged and deployed to improve the durability and sustainability of the US rail infrastructure.

Funding for the Rail Infrastructure Durability and Sustainability Center will have the following objectives:

- **New Railway Infrastructure Environmental Test chamber.** Long-term durability of railroad ties under repeated loads from heavy coal and other freight loads should be tested under extreme weather conditions, including hot and cold temperatures, wet and dry conditions, and varying sub-grade materials and temperatures. Existing test infrastructure that has been developed under current concrete railroad tie research funding will be enhanced to create the the nations first climate-controlled full-scale test chamber for railroad track systems.

- **Durability of Railroad Ties Under Different Loadings.** Concrete railroad ties made with different reinforcing materials have the potential to provide longer life, increasing the sustainability of the railroad infrastructure. Concrete ties with material-related durability problems stemming from chemical reactions between the aggregate and cement may also decrease the service life of ties. Testing to determine the reduction in service life in these ties will help determine the interplay between material problems and loading.

- **Deployment of Existing Laser-Speckle Technology.** KSU researchers will demonstrate the application of the newly-developed LSI technology at concrete railroad tie plants in the United States and assist with the implementation of the technology in concrete tie manufacturing plants for improved quality assurance. This technology will allow for the optimal components (concrete mixtures and prestressing reinforcement) to be selected for maximum durability.

Relevance National/Regional
Railways play an increasing role in our nation’s economy, with sharp increases in rail traffic in recent years. Heavy-haul and high-speed rail lines use concrete railroad ties because in spite of their higher initial cost, their increased durability. Improved materials and test methods for railroad tie systems, and development of reliable test procedures for new ties and components, will help prevent derailments and increase the lifespan of current railways.

Agency Contact Information
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Background
As of fall 2012, the USAID Collaborative Research Support Programs (CRSPs) are now called Feed the Future Food Security Innovation Labs (FTF SILs), as part of the Feed the Future Food Security Innovation Center (FSIC), under the amendment “Title XII - Famine Prevention and Freedom From Hunger” to the Foreign Assistance Act of 1961.

Description
The establishment of the Innovation Labs is creating new partnerships between U.S. and developing-nation universities across the globe with a focus on building human and institutional capacity.

It is evident:
• No country can grow without educated leaders, scientists, entrepreneurs, doctors, teachers, nurses, engineers, and other high-skilled drivers of economic growth. Lack of well-educated citizenry is a major impediment to international development; it undermines U.S. development assistance efforts and makes private sector engagement costly and difficult.
• Unfortunately, USAID investment in higher education is significantly imbalanced with similarly important investment in basic education. APLU supports robust funding of education, both basic and higher.
• A World Bank study shows the returns to higher education investments are substantial. Contrary to prevailing thought, the poorer the country the greater the return on investment to higher education. In fact, the poorest world region, Sub-Saharan Africa, shows the highest rates of return from investments in higher education at 21.9%, which is nearly double that for primary and secondary education in the region.
• The Innovation Labs are a two-for-one investment. They solve critical agricultural problems that impact food security and poverty through research conducted collaboratively between U.S. and developing country students and scientists while also building the developing country capacity to solve their own problems in the future.
• More than 60 U.S. universities throughout the nation are engaged in the Labs. This global engagement increases the reach of U.S. research institutions, creates linkages that facilitate U.S. economic ties with developing countries and fosters economic growth in developing countries that benefits their economy and ours.

The Innovation Labs are tackling the world’s most challenging agricultural development problems and sharing scientific knowledge throughout the developing world on issues such as productivity, yield, climate resiliency, and human nutrition. To remove dependency on development assistance it is essential to train a workforce of well-educated citizens to enable the transition to independent economic growth.

Through Feed the Future, the U.S. Government contributes to this global effort, working hand in hand with partner countries to develop their agriculture sectors and improve global food security. Putting “whole-of-government” into practice, Feed the Future draws on the agricultural, trade, investment, science, development, and policy resources and expertise of departments and agencies across the U.S. Government. In just a few years, this U.S. Government initiative is already delivering results that are helping reduce poverty and hunger while also improving nutrition for millions of children and families around the world.

SUSTAINING PROGRESS
On September 18, 2014, members of both the U.S. Senate and House of Representatives introduced authorizing legislation to codify and strengthen US AID’s Feed the Future’s comprehensive approach to cultivating the transformative potential of agriculture-sector growth.

The legislation codifies the U.S. Government’s commitment to the productivity, incomes and livelihoods of small-scale producers, particularly women, by working across agricultural value chains and expanding farmers’ access to local and international markets. It strengthens the initiative’s existing accountability mechanisms and establishes parameters for robust Congressional oversight, monitoring and evaluation of impact toward this commitment.

Both bills call for a strategic approach emphasizing:
• Coordination through USAID, of a whole-of-U.S.-Government approach that currently includes the participation of 10 additional federal agencies
• A foundation in country strategies, ownership and engagement
• The harnessing of science, technology and innovation
• Leveraging of unique partnerships in development, including private sector and research institutions
- A focus on women’s economic empowerment and nutrition
- An expansion in the capacity of local organizations and institutions
- Resilience approaches to ensure that chronically vulnerable populations are linked to market systems so they can truly escape poverty
- Engagement in consultative processes with critical external stakeholders, including civil society and the private sector.

**Relevance**
Kansas State University is currently leading four USAID Feed the Future Security Innovation Labs.

They are the:
1) Applied Wheat Genomics Innovation Lab
2) Reduction of Post-Harvest Loss Innovation Lab
3) Sorghum and Millet Innovation Lab, and the
4) Sustainable Intensification Innovation Lab.

Kansas State University is the only university in the U.S. to have successfully competed for four of the new innovation labs.

Kansas State University also will continue its work with other existing and new USAID Feed the Future Food Security Innovation Labs, as it continues its leadership in global food systems.

**Agency Contact Information**
Robert B. Bertram
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Background
The National Plant Diagnostic Network (NPDN) is a critical component of our national plant health infrastructure and has become a model for university-government-industry partnerships. Funded through the Food and Agricultural Defense Initiative (FADI), NPDN addresses national agricultural biosecurity imperatives through enhanced detection and diagnostic capability for new diseases and pests. The agricultural and natural plant systems that we rely upon for food, feed, fuel, timber and fiber are under increasing pressures from a long list of biological invasions associated with the massive imports of plants and plant products into the U.S. These biological invasions threaten both domestic production systems and our agricultural export industries. NPDN operates in all 50 states and US territories through five regional centers, and reports detections to the NPDN National Data Repository. The U.S. is dependent upon exports to stimulate an economic recovery. Plants and plant products contribute one half to two thirds of U.S. agricultural exports worth over $60 billion annually. The European Union, Australia, and Canada are all creating plant diagnostic networks based on the NPDN model.

Description
The reduced funding (40% cut) from USDA continues to weaken NPDN. NPDN is one of three programs funded through FADI. Administrative decisions at USDA will see the animal diagnostic network transition from a NIFA program to APHIS. We are hopeful that the funding for FADI remain the same and that support for NPDN and EDEN can then be restored to pre-cut levels and increase in future.

Drastically reduced training and education programs impair early detection of new and emerging pathogens and pests. Aging diagnostic technologies compromise the ability to employ the most sensitive and reliable detection and diagnostic protocols in NPDN laboratories. The USDA is investing tens of millions/year to enhance plant biosecurity infrastructure in other nations (our competitors), while funding for NPDN remains at less than $3 million annually. The volume of plants and plant product imports is so large that we only inspect 1-2%; border inspection and interception alone will not protect US agriculture. Without effective plant biosecurity infrastructure for early detection and accurate diagnostics to inform rapid and appropriate response, both agricultural production and exports are at risk.

There are over 40 million people on food assistance in the U.S. Increased food costs resulting from import/export disruptions will increase the number of people requiring food assistance in the U.S. This will lower the standard of living in the U.S. and impair our ability to address the global food security challenge.

Relevance
NPDN is listed as critical infrastructure by USDA and by the Department of Homeland Security. To protect U.S. agriculture from the threats of bioterrorism and from unintentional introductions, this infrastructure must be strengthened. International phytosanitary protocols, and ultimately policies, are transitioning to advanced molecular-based detection and diagnostic technologies. Protocols based on these more accurate and sensitive technologies will require that plant diagnostic labs that support trade are equipped with these technologies and staffed by trained diagnosticians. NPDN is an important partner with APHIS Plant Protection and Quarantine in safeguarding U.S. agriculture. Underfunding NPDN jeopardizes the effectiveness of that partnership.

The Plant Diagnostic Information System (PDIS), a lab management software system developed at KSU, is in use in 30 states. K-State provides leadership for the national exercise scenario program to facilitate preparedness of local, state, and federal personnel in outbreak management. Due to funding cuts, the national exercise preparedness program is at risk. All GPDN states have participated in K-State organized training workshops on advanced diagnostic techniques, first detector training, and secure communications. Those essential programs have been dramatically reduced.

K-State and GPDN continue to provide leadership in setting a vision for the network. That leadership is recognized as evidenced by many invitations to speak at national and international meetings, including Keynote presentations and Plenary Lectures at International Meetings. Although significant advances were made in enhanced diagnostic capability, we remain deficient in our national detection capability.

Agency Contact Information
USDA NIFA
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USDA-ARS Ogallala Aquifer Program

Background/ Description
Funding in the USDA-ARS budget for FY2016 is requested for the Ogallala Aquifer Program. This program is conducting research and outreach activities to protect the Ogallala Aquifer and retain the economic integrity of the Southern Great Plains region, including the Texas High Plains, and portions of Oklahoma, New Mexico, Kansas, and Colorado, all states that are dependent on the survival of the Ogallala Aquifer.

The Ogallala Aquifer in Western Kansas and the Texas High Plains is declining at an unacceptable rate with average depletion rates of 1 to 3 feet per year. Agricultural irrigation use accounts for nearly 90 percent of the groundwater withdrawals in the region. Water availability, cost, and policy, together with technology development and adoption rates, will shape the rural landscape in the coming decades. To ensure the sustainability of rural communities in this region, continued investments are needed in irrigation management and agronomic research concerning water use efficiency, improved hydrologic assessments of water availability and sustainability, socioeconomic considerations and wise public policy regarding water rights, and public outreach engaging all stakeholders.

The Ogallala Aquifer has provided water for the regional development of a highly significant agricultural economy. Ninety percent of groundwater withdrawals are used for irrigation. This region produces about 4 percent of the nation’s corn, 25 percent of the hard red winter wheat, 23 percent of the grain sorghum, 28 percent of the cotton and 42 percent of the fed beef. Local grain production is used primarily as feed grains for intensive beef, dairy, and swine production. The Ogallala Aquifer is a finite resource with aquifer recharge being much less than withdrawals. Research into the complex nature of water availability, uses, technological improvements, and pricing will drive the discussions and decisions relative to water policy.

Relevance National/Regional
This initiative will:
• Develop, evaluate, and disseminate information and technologies for water users that will result in balancing economic, environmental, and social concerns;
• Provide scientifically sound data and knowledge to planners and policymakers to enable them to develop effective water management policies that will result in balancing utilization and protection of the Ogallala Aquifer.

Objectives
• Investigate and improve water management within existing cropping systems.
• Develop and evaluate integrated crop and livestock systems that reduce dependence on underground water resources.
• Investigate designs, performance, and management strategies for water conservation.
• Assess groundwater resources in the Ogallala Aquifer and their relationships with climate.
• Enhance the knowledge base of producers, water professionals, and policy makers.
• Develop and evaluate water-saving technologies for concentrated animal feeding operations and industries.
• Evaluate the implications of alternate water policy options.

Funding for FY2016 will allow the partners to continue developing innovative conservation measures for the Ogallala Aquifer resource through a multi-state university and federal program. The group will develop, evaluate, and transfer technologies that will allow efficient water utilization while conserving and protecting the Ogallala Water Aquifer. The consortium also will develop and establish the program as the resource for data and knowledge in the development of fair and effective water policy.

Partners
USDA-Agricultural Research Service (lead agency)
Texas AgriLife Research
Texas AgriLife Extension Service
Kansas State University Research and Extension
West Texas A&M University
Texas Tech University

Agency Contact Information
USDA NIFA
CPRL USDA Ag Research Service
David Brauer, 806-356-5769
NSF Long-Term Ecological Research Program at Konza Prairie

Contributing to the conservation and management of grasslands worldwide

Background and Description
The Long Term Ecological Research (LTER) program was created by the National Science Foundation (NSF) in 1980 to support a network of research sites to address critical ecological questions that cannot be answered with more typical short-term observations or experiments. Funding is provided by NSF in the form of renewable six-year grants, which are peer-reviewed and renewed based on the quality of science, research productivity and contributions to network and synthesis activities. NSF conducts rigorous reviews of LTER sites at the midpoint of each grant cycle, as well as a comprehensive review of the entire LTER Network every 10 years.

NSF funding for the Konza Prairie LTER site supports an interdisciplinary research LTER site with a long-term goal of building a comprehensive understanding of ecological processes in tallgrass prairie and other grasslands, while contributing to broad synthetic and conceptual advances in ecology. The Konza LTER program also provides education and training (K-12 to postgraduate), public outreach, and knowledge to inform grassland management and conservation. Our site-based research focuses on the tallgrass prairies of Kansas, but cross-site and comparative studies with other grasslands extend the relevance of this research globally.

Konza Prairie LTER research is organized around four major themes — land-use change, climatic variability, altered biogeochemical cycles and restoration ecology — and builds on a 30-year foundation of long-term experiments and measurements in terrestrial and aquatic grassland ecosystems.

Konza Prairie Biological Station has approximately 120 active registered research projects by Kansas State University scientists in five colleges and 14 departments as well as more than 60 visiting scientists and students from other research institutions across the U.S. and world. Research conducted at Konza Prairie has resulted in more than 1,450 publications and more than 220 student theses and dissertations.

Konza Prairie LTER funding also supports on-site K-12 activities, undergraduate and graduate education and training, community outreach and engagement with grassland managers and conservationists. Collectively, LTER research and associated cross-site and comparative studies are contributing to improved management, conservation and restoration of grasslands globally.

Agency Contact
National Science Foundation
Division of Environmental Biology (BIO/DEB)
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Relevance
K-State’s Konza Prairie Biological Station is the core research site for the Konza Prairie LTER (KNZ) program. Konza Prairie, an 8,600 acre native tallgrass prairie research station, is jointly owned by Kansas State University and The Nature Conservancy and managed by K-State’s Division of Biology. Konza Prairie was one of the initial LTER sites funded in 1980, and LTER funding for the site was renewed in 2014 for the next six years at a level of $6.76 million, bringing total LTER funding for the program to more than $29 million.
National Animal Health Laboratory Network

Description
The National Animal Health Laboratory Network [NAHLN] provides an automated high throughput diagnostic protocol to facilitate rapid and accurate examination of samples from diseases of importance to food animal security. A major paradigm for the success of a great nation is its ability to provide food and water resources to its citizens. An essential element in this process is the health and wellbeing of our food animals, with NAHLN at the forefront of diagnosing and preventing the spread of important limitations to our food supply and our ability to export food supplies to our global partners.

Kansas State University (KSU) has participated with NAHLN in significant ways, including both the Kansas State Veterinary Diagnostic Laboratory [KSVDL] and the National Agricultural Biosecurity Center [NABC]. These include the development, enhancement and delivery of targeted technical training support programs, with: (1) exercises and reviews of best practices from NAHLN labs; (2) expanded animal health diagnostic screening capabilities regionally; (3) increased testing capacity of the KSVDL by conducting research on new methodologies; and (4) development of training strategy framework for NAHLN laboratories by assessing lessons-learned.

Background
Homeland Security Presidential Directive – 9 (HSPD-9), Defense of United States Agriculture and Food, states that America’s agricultural and food sector is vital to our economy and is one of the key underpinnings of national security and thus it must be protected from disruption by natural, accidental, or deliberate events. HSPD-9 also directed a number of federal agencies to work together to provide a unified strategy to protect our agriculture sector and to improve coordination with and among the states. More specifically, the directive states that these agencies should “…develop nationwide laboratory networks for food, veterinary, plant health, and water quality that integrate existing Federal and State laboratory resources, are interconnected, and utilize standardized diagnostic protocols and procedures.” Historically, the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) has served as the vanguard to protect America’s pre-harvest resources. The NAHLN represents a cooperative effort between two USDA agencies: APHIS and the National Institute of Food and Agriculture (NIFA), and the American Association of Veterinary Laboratory Diagnosticians (AAVLD). The NAHLN is a multifaceted network comprised of sets of laboratories that focus on different high-consequence diseases (primarily foreign animal diseases), using common testing methods and software platforms to process diagnostic requests and share information.

The NABC at KSU was established to help protect the U.S. agricultural infrastructure and economy from endemic and emerging biological threats. Beginning in 2006, NABC entered into a strategic relationship with the NAHLN for the development of training exercises and operations software that provided a common and secure frame of reference for NAHLN Laboratories in disease outbreak response.

Relevance
At the Federal level, USDA’s National Veterinary Services Laboratories (NVSL) serves as the national veterinary diagnostic reference and confirmatory laboratory.

The State/University laboratories, such as KSVDL in the NAHLN perform routine diagnostic testing for endemic animal diseases as well as targeted surveillance and response testing for foreign animal diseases and other high-consequence diseases. State/University laboratories also participate in the development of new assay methodologies and are on the frontline of detecting emerging diseases important in animal and/or human health (zoonoses).

Networking these resources provides an extensive infrastructure of facilities, equipment, and personnel that are geographically accessible no matter where disease strikes. The laboratories have the capability to conduct nationwide surveillance testing for the early detection of an animal disease outbreak. The ability to test large numbers of samples rapidly during an outbreak and then to demonstrate freedom from disease after eradication is critical and requires enhanced capacity nation wide.

Agency Contact
USDA-APHIS-VS-NVSL-NAHLN
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Background/Description
The National Canola Research Program is a competitive research program, funded through the USDA-NIFA Supplemental and Alternative Crops Grants Program. Producers in the Great Plains need profitable and reliable winter broadleaf crops that can be grown in rotation. Canola is an alternative crop that can be used to enhance winter wheat quality and yield. Kansas State University research has shown increases between 18% and 51% in wheat yield the first year following winter canola. Additionally, growing canola in rotation reduces or eliminates the need for tillage, decreases soil erosion, improves water infiltration, and enhances sustainability.

A high-value market exists for the heart-healthy oil and high-protein meal derived from canola seed. The USA imports over 80% of the canola oil consumed domestically. Production in the major spring canola growing areas has nearly peaked because of competition with other crops. Therefore, more winter canola must be grown to meet U.S. demand. As a result, winter canola planted acres have increased substantially in the Great Plains. Total planted acres in the region have exceeded 250,000 in the past three cropping seasons. Federal crop insurance is available and regional seed crushing facilities provide end markets. More adapted cultivars are needed to increase production to meet demand.

The long-term goal of this multi-state, multidisciplinary project is to facilitate the adoption of winter canola as a viable rotation crop in the southern Great Plains. To promote acreage and production increases in the region, the project will focus on the high priority areas of development and testing of superior cultivars, improved methods of production, and transfer of new knowledge to producers. The objectives of the project are: 1) Develop and evaluate high-yielding, regionally adapted winter canola cultivars. Priority traits include: winter survival, tolerance to sulfonylurea herbicide carryover, tolerance to post-emergence applications of glyphosate herbicide, yield potential, quality of the grain and extracted oil, blackleg disease and pest resistance, and forage quality. 2) Improve canola cropping systems by addressing agronomic management issues. Production studies will address: crop establishment, simulated grazing of forage, crop rotation, nutrient balance and management, harvest management, on-farm testing, and crop modeling. 3) Extend production and marketing technologies through extension and outreach programs. Methods of delivery may include field days, field tours, risk management schools, extension and journal publications, professional society meetings, radio and television, and social media.

Relevance
Early demonstrations and production management studies with canola in the 1980s often failed because the winter cultivars used were not well adapted. As a result, Kansas State University began a canola breeding and research program focused on developing cultivars adapted specifically to the southern Great Plains. It is the only public canola breeding program in the region.

Many wheat producers view rotation with winter canola as a sustainable and effective method for managing hard-to-control, grassy annual weed species. Thus, breeding cultivars resistant to glyphosate herbicide will expand rotation and non-selective weed control options. Harvested wheat fields are one of the few areas open for planting winter canola in the fall. However, 50% of winter wheat acres in the region are treated with sulfonylurea herbicides. Many of these herbicides have a residual life of nearly two years and canola is extremely sensitive to the carryover. Thus, Kansas State is breeding cultivars tolerant to carryover from sulfonylurea herbicides. Growing these cultivars will increase the number of fields where canola can be produced.

Seven adapted cultivars have been released by the breeding program since 2010. ‘Riley’ possesses a total oil content that is 40%. It is estimated that increasing oil content of U.S. cultivars by just 1% would be worth an additional $5 million per year. ‘Griffin’ is the first cultivar that will be marketed as dual-purpose for forage and grain production. The program released four glyphosate tolerant cultivars in 2013 and 2014.

Most states do not have statewide canola cultivar testing programs and few researchers focus on winter canola. Thus, regional variety testing and agronomic trials are an important component of this project. The National Winter Canola Variety Trial (NWCVT) is also coordinated by Kansas State and this trial is planted at 51 locations in 19 states. NWCVT data facilitates the release of new cultivars in areas where they can be profitably marketed. Coordination of the NWCVT demonstrates a strong ability to manage a collaborative program with national impact.

Partners - Through the National Canola Research Program, Kansas State cooperates with four universities in the Great Plains region and 20 others nationally. Many commercial and experimental cultivars are evaluated for domestic and international enterprises.

Agency Contact Information
USDA NIFA – Ann Marie Thro, 202-401-6702
USDA-ARS Center for Grain and Animal Health Research (CGAHR)

Protecting swine from foreign diseases

Description:
The Arthropod-Borne Animal Disease Research Unit (ABADRU), in the Center for Grain and Animal Health Research, is conducting research on animal diseases including Rift Valley Fever, Vesicular Stomatitis, and Blue Tongue that threaten US livestock. Collaborative research including Kansas State University (KSU) scientists in the Colleges of Agriculture and Veterinary Medicine has recently been initiated on several swine diseases including African Swine Fever, Japanese encephalitis and Classical Swine Fever that pose a serious risk to producers and the entire industry because of the trade impacts that outbreaks could cause if these diseases are introduced into the US. This initiative will strengthen on-going research to develop diagnostic and control measures for these diseases. In addition, several critical research gaps will be addressed including determining the potential North American arthropod vectors and the host-vector-parasite relationships involved in arbovirus transmission to swine, and the understanding the epidemiology and progression of both diseases. There is critical need to strengthen the vector biology component of this research.

The requested funds ($2 mill. permanent increase to base funds) will be used to hire two scientists in ABADRU along with support staff to conduct this research.

Relevance:

The US produces 31 million tons of pork annually, valued at more than $14 billion. Exotic diseases of swine threaten domestic production as well as an important export market. These funds are needed to increase research efforts on African Swine Fever and other exotic swine diseases.

With these funds ABADRU and its KSU partners will:
- Evaluate the competence of potential native arthropod vectors to transmit disease to domestic and feral swine, and determine their possible role should the disease be introduced to the US.
- Determine the important geographic, climatological, and ecological factors that could influence the establishment and spread of this disease.
- Develop and evaluate disease diagnostic, surveillance and control measures to protect US swine from this disease.

Agency Contact: USDA-ARS Center for Grain and Animal Health Research (CGAHR)
Arthropod-Borne Animal Disease Research Unit, Manhattan, KS

Agency Director:
Dr. Tom Herald
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Wheat Quality and Competitiveness

Description:
The Hard Winter Wheat Quality Laboratory (HWWQL), part of the Grain Quality and Structure Research Unit, serves the largest growing region of the four USDA-ARS Wheat Quality Laboratories and provides leadership, expertise and service to the U.S. industry for improving quality and marketability of hard winter wheat (HWW).

The Engineering component within the Stored Product Insect and Engineering Research Unit (SPIERU) has responsibility to develop new technology for measuring, selecting and predicting wheat quality. These programs have suffered from long-term decline in funding, staffing, and antiquated equipment.

Immediate action must be taken to provide adequate funding and resources, or research critical to the economic health of the US wheat industry will be curtailed.

The requested funds will be used to increase program funds to both HWWQL and Engineering component of SPIERU ($650,000 permanent increase to base funds for each program).

Relevance:
- The Hard Winter Wheat Quality Laboratory was established by Congress in 1937 to determine the end-use quality of experimental wheat lines. The HWWQL evaluates 100% of the hard winter wheat commercially released in the US that is used in a $70 billion bakery and snack food industries. A similar volume of HWW is exported.
- The HWWQL and Engineering need program funds to support the development of:
  - Rapid assessment of wheat quality to more accurately predicts protein, starch, processing and end-product quality.
  - Rapid, accurate and non-destructive evaluation on a single kernel basis, of color, hardness, protein and starch quality.
  - Novel end-use qualities and trait combinations using molecular and conventional biochemical approaches.

The National Wheat Improvement Committee, National Association of Wheat Growers, North American Millers’ Association, and US Wheat Associates strongly recommend additional funding for a multidisciplinary initiative to improve wheat quality and competitiveness, and security in our domestic and export markets. To successfully compete in the world wheat market, U.S. wheat must have superior end-use qualities and offer exceptional value to millers and bakers. This initiative would support the HWWQL and its national mandate to conduct research and provide support for the entire wheat industry, including breeders, growers, millers, bakers, and exporters.

Agency contact: USDA-ARS Center for Grain and Animal Health Research (CGAHR)
Grain Quality and Structure Research Unit and Stored Product Insect and Engineering Research Unit, Manhattan, KS

Agency Director:
Dr. Tom Herald
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Development of Heat and Drought Resilient Wheat

Description:
In Kansas and neighboring states, heat stress cuts average wheat yields in half and significantly reduces grain quality. Heat stress also dramatically reduces water use efficiency, especially in irrigated wheat. In rainfed systems, drought stress is typically the most important yield constraint. If predictions of climate change and aquifer depletion are realized, the challenges from heat and drought will become even greater in the future. Unfortunately, breeding for tolerance to heat and drought stress is difficult. New research investment is urgently needed to accelerate efforts to improve wheat resilience to heat and drought stress.

An aggressive, comprehensive program is required that uses both conventional and biotechnological approaches for germplasm enhancement and fundamental studies on stress tolerance. The program will leverage existing USDA-ARS and KSU personnel who have expertise in wheat genetics, high throughput genotyping, whole plant stress physiology, and field plot-level physiology. This expertise must be complemented by additional personnel with expertise in the cellular-level physiology, biochemistry, and molecular biology of stress tolerance.

Research objectives include: 1) develop improved laboratory and field screening techniques for heat and drought tolerance; 2) identify wheat lines or wheat wild relatives with stress tolerance and introgress into elite germplasm lines; 3) map and characterize genes involved in conventional tolerance to heat and drought; 4) characterize biochemical mechanisms and regulatory pathways that control heat and drought stress susceptibility or tolerance; 5) identify novel molecular targets and innovative strategies for enhancing stress tolerance, and 6) develop transgenic wheat plants to test new hypotheses and strategies for increasing abiotic stress tolerance.

To achieve these objectives, the following new USDA-ARS positions are needed:
1) Category 1 Research Plant Physiologist/Biochemist
2) Category 1 Research Plant Molecular Biologist
3) Category 3 Support Scientist

The requested addition to permanent base funds for salaries, materials, supplies, and equipment, as well as overhead, is $1,100,000.

Justification:
- Tolerance to heat stress is the single most important genetic improvement that is needed for wheat worldwide.
- Tolerance to drought stress is the second most potentially useful trait in the Great Plains.
- Expected outputs include: 1) high throughput stress tolerance screening methods; 2) biomarkers or reporter genes for measuring stress responses; 3) new elite germplasm lines with enhanced conventional stress tolerance; 4) locations, effects, and DNA markers for genes that are involved in conventional stress tolerance; 5) identification of physiological or biochemical constraints and yield-limiting factors under heat or drought stress; 6) understanding of the composition and dynamics of stress-responsive gene regulatory networks; 7) new models, strategies, and testable hypotheses for abiotic stress tolerance; and 8) invention of novel stress-resilient transgenic wheat lines.

KSU contacts: Dr. Gary Pierzynski, Head, Department of Agronomy; Dr. J. Ernest (Ernie) Minton, Associate Director of Research, College of Agriculture

USDA contact: Dr. Robert Bowden, Research Leader, Hard Winter Wheat Genetics Research Unit, USDA-ARS Center for Grain and Animal Health Research (CGAHR)
Hessian Fly Research

Description:
The Hard Winter Wheat Genetics Research Unit, in the Center for Grain and Animal Health Research, in close cooperation with Kansas State University (KSU), conducts research to control the Hessian Fly. This pest attacks wheat across the US and is especially prevalent in the Southern Great Plains. It is typically found in 70% of wheat fields in Kansas, Oklahoma and north Texas. Most older, resistant varieties have been defeated by new biotypes of the Hessian fly.

New genetic sources of resistance and rapid, effective screening methods are needed to achieve more durable resistance. Also needed is a greater understanding of the mechanistic basis of insect virulence and host resistance. New sources of resistance and knowledge of this pest are critical to protecting US wheat producers.

The requested funds ($250,000 permanent increase to base funds) will be used to expedite research on this high priority constraint.

Justification:
○ Hessian fly is becoming a more important problem. The resurgence of the Hessian fly can be attributed to increasing adoption of reduced tillage management practices, increased insect virulence, and warmer fall and winter weather. In the Southern Great Plains only 2 of 22 resistance genes are continuing to provide resistance to the Hessian fly. New resistance genes are urgently needed.
○ The Hessian fly project at Manhattan currently provides resistant germplasm sources and screening for resistance services to all public and private wheat breeding programs in the hard winter wheat region.
  ● Increased capacity to screen germplasm and develop resistant wheat varieties are needed to support regional breeding efforts.
  ● The search for more durable resistance requires investment in basic research to determine molecular mechanisms for insect virulence and host plant resistance.
○ The Hessian fly project is under-funded in relation to the mission that it fulfills.

The National Wheat Improvement Committee, National Association of Wheat Growers, and US Wheat Associates strongly recommend additional funding for this initiative to improve Hessian Fly resistance in wheat.

Agency contact: USDA-ARS Center for Grain and Animal Health Research (CGAHR)
Hard Winter Wheat Genetics Research Unit, Manhattan, KS

KSU contacts: Dr. Gary Pierzynski, Head, Department of Agronomy; Dr. J. Ernest (Ernie) Minton, Associate Director of Research, College of Agriculture

USDA contact: Dr. Robert Bowden, Research Leader, Hard Winter Wheat Genetics Research Unit, USDA-ARS Center for Grain and Animal Health Research (CGAHR)
NSF National Ecological Observatory Network

Background and Description
The National Ecological Observatory Network (NEON) is a continental-scale ecological observation facility sponsored by the National Science Foundation to gather and synthesize data on the nation’s natural resources and biodiversity. When completed, it will consist of state-of-the-art environmental sensors and standardized research equipment and sampling protocols at sites across the U.S. (including Alaska, Hawaii and Puerto Rico) strategically selected to represent different ecosystem types, land-uses, and climates.

NEON will combine site-based measurements with airborne remote sensing and other continental-scale data sets (e.g., satellite data) to document the health of the nation’s ecosystems and to assess changes in those ecosystems through time. Sensor networks, instrumentation, experimental infrastructure, natural history archives, and remote sensing will be coupled linked with computational, analytical, and modeling capabilities to create an integrated NEON infrastructure. In this way, NEON will transform biological research by enabling studies on major environmental challenges at regional to continental scales.

Relevance
NEON sites are distributed across 20 large regions (eco-climatic domains), with each region having a “core” terrestrial and aquatic site and two additional sites that represent contrasting environmental conditions or different land-uses. For the Prairie Peninsula region, the core terrestrial and aquatic sites are located at K-State’s Konza Prairie Biological Station, and an additional relocatable site is located at the University of Kansas field station. The two Kansas sites are the only NEON sites in the multistate Prairie Peninsula region.

NEON moved through the concept, approval and design stage from 2006 through 2012. NEON funding has been approved by congress, and NEON sites are currently being developed and instrumented. At the Kansas sites, construction of instrument towers and sensor arrays began in 2014. NSF expects that all NEON sites will be fully operational by 2017, and that the core sites will collect data for at least 30 years.

Continued funding for NEON will bring new state-of-the art equipment to biological field stations in Kansas and provide unique research capabilities for researchers and students at K-State and elsewhere. The co-location of NEON infrastructure and the Konza LTER program also will provide unique research and training opportunities for students and scientists at institutions throughout Kansas and beyond. We expect that this will facilitate additional research funding built around NEON and LTER capabilities and data availability, and this will help in attracting the nation’s top ecological scientists and students to Kansas.

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Overview of FY 2016 Request

America’s land-grant universities and related institutions provide much of the research, education, and public outreach that sustains U.S. food, fiber, and renewable fuel production while addressing many urgent and important local, regional, national, and global problems.

Financial support for this world-renowned enterprise comes from both public and private sources, but the most significant funding source is the federal-state partnership managed by the National Institute of Food and Agriculture (NIFA)—USDA’s extramural science agency—and funded by NIFA and state and local governments.

As shown in Table 1, the Association of Public and Land-grant Universities supports AFRI funding at $450 million. We also support funding for the six capacity priorities that support research, education, and extension efforts at America’s land-grant universities and related institutions at the levels contained in Table 1.

The Agriculture and Food Research Initiative is the flagship competitive grant program within NIFA. We have - and continue to - aggressively endorse additional funding for this program. As shown in Table 1, we request fiscal year 2016 funding for this program at $450 million. Meanwhile, the Smith-Lever, Hatch, McIntire-Stennis, Evans-Allen and 1890’s Extension programs are the foundation on which America’s Land-grants meet the critical challenges of today and tomorrow. This predictable source of funding is vital to deliver extension education and sustain the basic and translational research at land-grant institutions. As such, we oppose the FY 2016 budget proposal to change the law and make a portion of several of these funds competitive.

We urge Congress to continue to make overall NIFA funding a high priority and specifically request funding for the six capacity programs that support research, education, and extension efforts at America’s land-grant universities and related institutions at the levels also outlined in Table 1.

For more information and updated documents, visit: http://land-grant.org/appropriations_docs.html

<table>
<thead>
<tr>
<th>TABLE 1. CORE NIFA PRIORITIES</th>
<th>FY 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and Food Research Initiative</td>
<td>$450.000 M+</td>
</tr>
<tr>
<td>Smith-Lever 3(b)-(c)</td>
<td>304.000 M+</td>
</tr>
<tr>
<td>Hatch Act</td>
<td>256.201 M+</td>
</tr>
<tr>
<td>Evans-Allen</td>
<td>60.500 M+</td>
</tr>
<tr>
<td>1890 Institutions Extension</td>
<td>49.350 M+</td>
</tr>
<tr>
<td>McIntire-Stennis Cooperative Forestry</td>
<td>35.500 M+</td>
</tr>
<tr>
<td>1994 Institutions Research and Extension</td>
<td>9.247 M+</td>
</tr>
</tbody>
</table>

For additional information, please email Hunt Shipman (hshipman@cgagroup.com) or Jim Richards (jrichards@cgagroup.com). Phone: 202.448.9500
Feeding 9.6 Billion by 2050

The U.S. Census Bureau maintains digital clocks which display net population growth both domestically and worldwide. Those clocks show a net gain of one person in the United States every 15 seconds and another person worldwide about every half second.

To put this in perspective, if the world population clock were an automobile odometer, the car would be hurtling along at a velocity of ≈7,200 miles per hour or roughly Mach 9.4!

At present rates, the global population will reach 9.6 billion by 2050 and experts believe that agricultural productivity must double from current levels to feed a global population of that magnitude. One private-sector group that has been out front on this issue is Global Harvest Initiative (GHI).

Each year GHI publishes a Global Agricultural Productivity (GAP) Report® “to mark the progress made toward sustainably doubling agricultural output to meet the 2050 demand for food, fiber, fuel, and other industrial products derived from agriculture.” This annual report also “highlights key policies required to encourage more investment and innovation, and to build efficient, sustainable agricultural value chains.”

We believe that GHI’s 2014 GAP Report® could help inform the congressional debate over funding for the National Institute of Food and Agriculture and is worth reading in its entirety. We would highlight the following key policy recommendation:

Investment in agricultural research and development (R&D) is a principal driver of agricultural productivity growth… The private sector is a growing source of R&D funding, but greater public-sector investment is critical for innovation, basic research and making research findings and technologies widely available. Integrative research brings together multi-disciplinary teams of scientists from the government, academia, and the private sector to create synergies, accelerate progress, and improve cost effectiveness. New technologies must then be adapted to meet local needs and conditions so the benefits of these innovations are extended to farmers and producers across the value chain. The extension and commercialization of these new technologies should be pursued through collaborative public-private partnerships. Investments in agricultural R&D make significant contributions to sustained growth in agricultural productivity, alleviating poverty and improving food security. [Emphasis added.]

QUICK LINKS:
- www.globalharvestinitiative.com

Reprinted from GHI’s 2014 GAP Report,® these two charts demonstrate the profound difference that total factor productivity (TFP) has made in the developed world over the past 50 years. “Total factor productivity is the ratio of agricultural outputs (gross crop and livestock output) to inputs (land, labor, fertilizer, machinery and livestock). When TFP rises, more output can be produced from a fixed amount of inputs. TFP growth can result from increased effectiveness of inputs, more precise use of inputs, or the adoption of improved production practices.”
Background
Veterinary medicine is an integral and indispensable component of our public health system as well as our agriculture and agricultural biosecurity systems. In addition to their obvious role in maintaining animal health, veterinarians also protect human health by preventing and controlling infectious diseases, ensuring the safety and security of our food supply, promoting healthy environments, and providing health care for animals. Because of the threat that infectious diseases pose to both human and animal health, there is an immediate and urgent need to build national capacity in training of veterinarians with expertise in food animal medicine, public health and agricultural biosecurity. Rural veterinarians, engaged in food animal practice, are our nation’s first line of defense in recognizing a foreign animal disease. It has become increasingly important for schools and colleges of veterinary medicine to provide high quality training programs in agricultural biosecurity, within the instructional program for veterinary medical students, and at a higher level, for graduate veterinarians who seek advanced training in agricultural biosecurity. Such additional instructional programs are difficult to implement within the severe constraints of veterinary medical schools and colleges, placing a premium on programs that can assist the educational institutions in meeting a greatly expanded national need.

There are only 30 veterinary medical colleges in the country, and they do not have enough capacity to meet all of these needs. All of these schools are at the maximum number of students they can accept due to space limitations for teaching, diagnostics, and research. Laboratories, teaching hospitals, veterinary research facilities, and animal diagnostic areas are built specifically for use with animals including laboratory animals, livestock species, and wildlife. This is space built with unique safety, restraint, and handling requirements that are not commonly found on American campuses.

In addition to the projected need based on current assumptions about veterinary medicine, even more veterinarians will be needed due to other factors such as greater encroachment on animal habitat, resulting in increased human interaction with wild and exotic animals; changing climates and ecosystems, deforestation, dam building and irrigation, leading to greater numbers of arthropod vectors of disease and greater contact between these vectors and humans; more and faster global travel and displaced human and animal populations, leading to rapid and wide dispersal of infectious diseases; and changing human behavior, such as consuming exotic foods and keeping exotic pets, which increases the risk of exposure to newly emerging infectious diseases.

To be successful, programs that seek to recruit and retain veterinarians in careers in food animal practice, public health and agricultural biosecurity must compete effectively with programs recruiting veterinarians to many other career options. A new graduate from an accredited U.S. veterinary medical school or college typically enters the profession with over $160,000 of educational debt load. Consequently, graduates very logically examine the salary expectations, both at entry and over the long term, of a potential career choice, recognizing their need to repay their student loans even as they seek to establish a family and maintain a reasonable life style. With such financial pressures and analyses, a career in food animal practice and agricultural biosecurity often pales in comparison to the salary potential of other, more lucrative career options. Consequently, measures to relieve a significant portion of debt load, contingent upon entering and remaining in a career in food animal practice and agricultural biosecurity, are very important for the recruitment and retention of veterinarians to this area of national need.

The support of effective strategies to recruit and retain an adequate number of veterinarians in food animal practice, and to facilitate their training in agricultural biosecurity, are key elements in maintaining the security of our food supply and of our agricultural economy.

Measures to facilitate the recruitment and retention of veterinarians in food animal practice, while simultaneously expanding the training of veterinarians in agricultural biosecurity are keys to maintaining the security of animal agriculture, our agricultural economy, and our food supply.

Description
The Agriculture Act of 2014 (PL 113-79) contained provisions important to veterinary medicine. Section 7104 established a competitive veterinary services grant program to develop, implement, and sustain veterinary services. Authorized at $10 million annually, this section would amend the National
Agricultural Research, Extension and Teaching Policy Act of 1977 to direct the Secretary of Agriculture (USDA) to carry out a program with qualified entities to develop, implement and sustain veterinary services in the states. This grant would allow recipients to: a) establish or expand veterinary practices or establish mobile veterinary facilities, b) recruit veterinarians, technicians, and students, c) attend training programs in food safety or food animal medicine, d) establish or expand accredited education, internship, residency and fellowship programs, e) assess veterinarian shortage situations, and f) support continuing education and extension, including tele-veterinary medicine and other distance-based education.

The Veterinary Medicine Loan Repayment Program (VMLRP) Enhancement Act would amend the Internal Revenue Code to make VMLRP awards exempt from gross income and employment taxes. Awards are currently taxed at 39% although those taxes are paid by USDA directly to the treasury on behalf of the award recipient. Tax exemption for VMLRP awards would result in one additional veterinarian for every three based on current appropriations.

Support is requested for: 1) Provisions of the Agriculture Act of 2014 (PL 113-79) important to the veterinary profession, namely the Animal Health and Disease Research/1433 Formula Funds; Centers of Excellence, Food Animal Residue Avoidance Databank (FARAD), and the Competitive, Special and Facilities Research Grant Act, as well as the new authority for a the Veterinary Services Grant Program (VSGP) to develop, implement, and sustain veterinary services 2) tax exemption for awards made under the Veterinary Medicine Loan Repayment Program (VMLRP), and 3) passage of appropriations legislation that maintains or increases funding for the VMLRP, Animal Health and Disease Research/1433 Formula Funds, Agriculture and Food Research Initiative, FARAD, the VSGP, the National Animal Health Laboratory Network (NAHLN) as well as for the National Institutes of Health (NIH).

Aspirations for the appropriations for Fiscal Year 2016 should be to maintain current funding levels for such critical programs as the Animal Health and Disease Research/1433 Formula Funds, Veterinary Medicine Loan Repayment Program, Agriculture and Food Research Initiative, the Agriculture Research Service (ARS), and the National Institutes of Health.

Relevance
Agriculture, and specifically animal agriculture, is vital to the Kansas economy. Training, recruiting, and retaining enough veterinarians to meet the needs of agriculture and of agricultural biosecurity are important concerns of agriculture and related organizations. They are also natural issues of concern to the College of Veterinary Medicine at Kansas State University, one of only 30 such schools in the United States. As one of only 27 states with a College of Veterinary Medicine, Kansas would clearly benefit by increased federal investment in the training of veterinarians in agricultural biosecurity and food animal practice, as well as in their subsequent recruitment and retention.

The proposed federal investment would augment, not replace or diminish the importance of funding from the state of Kansas. It will, however, multiply the impact of state funds and enhance the ability of Kansas State University and the College of Veterinary Medicine to meet the needs of the state and nation. Leaders from the Kansas Congressional delegation have lent their support to these important legislative efforts.

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