

**DRAFT Report on Areas of  
Research, Scholarly and Creative Activities, and Discovery (RSCAD) Strength**

**Date** May 2014

<b>A. Area of Strength:</b>	<b>Virtual Interactive Design Education</b>
<b>B. Scope and Context:</b>	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 Unified Learning Model (ULM), combined with virtual serious games will provide an integrated project-based pedagogy throughout the curriculum, increasing critical thinking and practice of students.
<b>C. Current or Emerging Strength:</b>	<input type="checkbox"/> <b>Current</b> <input checked="" type="checkbox"/> <b>Emerging</b> <input type="checkbox"/> <b>Both</b>
<b>D. Criteria of Strength (1, 3, 5, etc.):</b>	
<b>E. Narrative:</b>	<p>In addition to the successful synthesis model of learning with problem-oriented 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.</p> <p>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.</p> <p>Project-based learning is student-centric model where students acquire knowledge though activity and experiential learning. This approach has proven to be an effective pedagogical model in higher education to develop thinking and creativity. Research is</p>

	<p>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.</p> <p>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 diverse work force 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.</p> <p>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 call for an “overhaul our educational system to foster the interdisciplinary study that SBES requires.”</p>
<b>F. Keywords/Tag words:</b>	serious games, Unified Learning Model, active project-based learning, game-based learning

<b>A. Area of Strength:</b>	<b>Great Plains Center for Urban Watersheds (GPCUW): Joining sustainable water science, planning and management</b>
<b>B. Scope and Context:</b>	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.
<b>C. Current or Emerging Strength:</b>	<input type="checkbox"/> <b>Current</b> <input type="checkbox"/> <b>Emerging</b> <input checked="" type="checkbox"/> <b>Both</b>
<b>D. Criteria of Strength (1, 3, 5, etc.):</b>	
<b>E. Narrative:</b>	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 three percent of Kansas population (most of which is in eastern KS) relies on surface water for all or party 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 predications). 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

	<p>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.</p> <p>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.</p> <p>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 \$35 M. 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.</p>
<p><b>F. Keywords/Tag words:</b></p>	<p>water supply, sustainable green infrastructure, water conservation, Kansas, Midwest</p>

<p><b>A. Area of Strength:</b></p>	<p><b>Performance and Innovation in Building Envelopes</b></p>
<p><b>B. Scope and Context:</b></p>	<p>The project involves graduate architecture students engaging practices architects and consultants to explore a particular environmental issues (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.</p> <p>The project is currently in its pilot year (AY 2013-14), working specifically of 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</p>

	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 envelop systems.
<b>C. Current or Emerging Strength:</b>	<input type="checkbox"/> <b>Current</b> <input type="checkbox"/> <b>Emerging</b> <input checked="" type="checkbox"/> <b>Both</b>
<b>D. Criteria of Strength (1, 3, 5, etc.):</b>	
<b>E. Narrative:</b>	<p>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 build upon the broad applied knowledge of the architectural discipline and that is expanded by way of collaborative inquiry among engineers, scientists, and manufactures using the most advanced technologies for fabrication and testing.</p> <p>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 recognized 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.</p>
<b>F. Keywords/Tag words:</b>	building envelope, sustainable technology, energy transfer, interdisciplinary collaboration

<b>A. Area of Strength:</b>	<b>Breaking the Barriers: Aging in Place</b>
<b>B. Scope and Context:</b>	<p>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.</p> <p>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).</p>

	<p>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.</p>
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<p><b>D. Criteria of Strength (1, 3, 5, etc.):</b></p>	
<p><b>E. Narrative:</b></p>	<p>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.</p> <p>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.</p> <p>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.</p>
<p><b>F. Keywords/Tag words:</b></p>	<p>independence in aging, aging inhabitants, quality of life, patient specific spaces</p>

<b>A. Area of Strength:</b>	<b>Promoting Health through the Built Environment</b>
<b>B. Scope and Context:</b>	<p>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. Bonds (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 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.</p>
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<b>D. Criteria of Strength (1, 3, 5, etc.):</b>	
<b>E. Narrative:</b>	<p>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 of 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.</p> <p>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.</p> <p>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.</p> <p>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</p>

	<p>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.</p> <p>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.</p>
<b>F. Keywords/Tag words:</b>	wounded soldiers, wounded veterans, rehabilitation facilities

<b>A. Area of Strength:</b>	<b>Investigating Place Using Digital Toolset</b>
<b>B. Scope and Context:</b>	<p>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.</p> <p>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.</p> <p>This project develops a formative and evaluative toolset to address attributes and how proposed designs can help support these attributes.</p>
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<b>D. Criteria of Strength (1, 3, 5, etc.):</b>	
<b>E. Narrative:</b>	<p>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.</p> <p>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.</p>

	<p>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.</p> <p>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.</p> <p>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.</p>
<b>F. Keywords/Tag words:</b>	digital toolset, parametric modeling, mass-personalization, product design

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