SOUTH DAKOTA BOARD OF REGENTS

Full Board

AGENDA ITEM: 12 – N

DATE: August 12, 2015

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SUBJECT: South Dakota State University Precision Agriculture Classroom and Laboratory Building – Preliminary Facility Statement

South Dakota State University requests approval of its Preliminary Facility Statement to begin planning for possible construction of a Precision Agriculture Classroom and Laboratory Building. Approval of this request will allow SDSU to hire an A/E firm to draw up schematic drawings. This will then allow SDSU to begin fund raising for the project and bring forward a future Facility Program Plan with more specific plan details, cost estimates and timelines.

The SDSU College of Agriculture and Biological Sciences (CABS) and the Jerome J. Lohr College of Engineering (JJLCOE) are partnering to strengthen university programming to meet an imperative societal need to feed more people using fewer resources in a manner that is socially acceptable and economically and environmentally sustainable. Precision agriculture is a suite of expert technologies, methods and applications utilized across the globe to help produce more food with less water, fertilizer and treatments.

The precision agriculture curriculum is being brought together through two parallel initiatives. The first is a $600,000 federally funded USDA Higher Education Challenge Grant led by SDSU. This team is comprised of members from SDSU, the University of Nebraska, Colorado State University, Washington State University, the University of Missouri, USDA Agricultural Research Service, Purdue University, Kansas State University and Oklahoma State University. The second initiative unfolds in parallel within the two SDSU colleges previously referenced to establish one of the nation's first multidisciplinary majors in precision agriculture, following on the previous year's introduction of two precision agriculture minors.

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RECOMMENDED ACTION OF THE EXECUTIVE DIRECTOR

Approve SDSU's Preliminary Facility Statement to plan for future construction of a Precision Agriculture Classroom and Laboratory Building. Approval of this project does not guarantee final project approval, but will allow SDSU to hire an A/E firm to begin development of schematic drawings. Approval will also allow SDSU to begin fundraising for this project. If approved, the Board President should appoint a building committee representative to oversee the planning of this project.

The project's site has not been determined. Possible locations include, but are not limited to, the existing Ag Engineering Building and site, Sexauer Field immediately south of the Plant Science Building, land east of the Alfred Dairy Science, and the parking area north of the Ag Engineering Building. Any of these sites would be suitable for the project as they can all be supported from the central steam distribution system and possibly the central chilled water distribution system.

Additional details of this proposed project can be found in SDSU's attached Preliminary Facility Statement document. If approved, the Board President should appoint a building committee representative to oversee the development of the project plan and cost estimates.

Funding for this project will come from earmarked donations to the SDSU Foundation along with other sources yet to be determined. The architectural programming and preliminary design services are estimated to cost $365,000. The South Dakota Corn Utilization Council's $600,000 donation to the SDSU Foundation will fund these costs.

PRELIMINARY FACILITY STATEMENT

FOR

PRECISION AGRICULTURE CLASSROOM AND LABORATORY BUILDING SOUTH DAKOTA STATE UNIVERSITY

SDSU requests approval of this Preliminary Facility Statement to plan a Precision Agriculture Classroom and Laboratory Building. University leaders request appointment of a building committee to select an architecture and engineering team to provide architectural programming and schematic design of this new building.

1. GENERAL PROGRAMMATIC NEEDS TO BE ADDRESSED:

The College of Agriculture and Biological Sciences (CABS) and the Jerome J. Lohr College of Engineering (JJLCOE) are partnering to strengthen university programming in order to meet an imperative societal need: feed more people using fewer resources in a manner that is socially acceptable and economically and environmentally sustainable. In FY2014, the colleges secured an internal strategic reinvestment to add 1.85 faculty full-time equivalencies (FTE), to install state-of-the-art precision agriculture classroom equipment and to conduct a comprehensive study of opportunities and obstacles for precision agriculture research and teaching. Building on that in FY2015, a strategic reinvestment of 4.55 faculty FTE was made by the university, and the two colleges internally reallocated another 8.15 FTE. These actions helped position CABS and JJLCOE to prepare the nation's first multidisciplinary major in precision agriculture in 2016 and to strengthen the precision agriculture research collaboration between JJLCOE and the South Dakota Agricultural Experiment Station (AES). The new academic program will help meet the increasing demand for the highly skilled workforce needed for 21st century agricultural production.

Precision agriculture is the suite of expert technologies, methods and applications that is being employed globally to help produce more food with less water, fertilizer and treatments. The world is at a turning point in the development of agricultural machinery. Prior efforts have focused on the human and animal labor savings provided by mechanized agriculture. Agricultural machinery is advancing beyond basic mechanization to include continuous processing of agronomic data in the field and to enable real-time adjustments that will allow an acre of land to achieve food production levels that would not be possible with manual labor or simple machines.

Responding to this global trend is part of SDSU's land-grant university mission. The two colleges are driving innovation and education by conducting new research and developing new curricula to educate a workforce that will harness the continual flow of precision agriculture knowledge and technology. Impact 2018, the university's strategic plan, calls for leading-edge academic programming (Goal 1) and research (Goal 2) that champions the public good and fosters economic development. These goals also extend toward fulfillment of *Vision 2020: The South Dakota Science and Innovation Strategy* developed by the South Dakota EPSCoR REACH Committee. The plan emphasizes the growth of ideas and talent in agriculture, manufacturing and information technology.

Influential stakeholders in the South Dakota economy understand the need for SDSU to lead the way with academic programming and research. Raven Industries provided matching resources to the FY2014 strategic reinvestment in precision agriculture and has established an office in the Research Park at South Dakota State University to enhance student internships and collaborative research and development. The South Dakota Corn Utilization Council contributed $600,000 to the SDSU Foundation to be used for the architectural and engineering plan of the Precision Agriculture Building. It has signed a pledge agreement with SDSU Foundation for a lead gift of $3 million toward the facility and has committed to assist in further fundraising activities.

The precision agriculture research initiatives involve both CABS and JJLCOE scientists. The former are jointly appointed in two departments — Plant Science and Agriculture and Biosystems Engineering — and work in research spaces on campus and at AES field stations throughout the state. The latter are in three departments — Mechanical Engineering, Mathematics and Statistics, and Electrical Engineering and Computer Science. Collaborations are also active with scientists and engineers in the commercial sector and at other universities.

Notable among the external partnerships are enhanced data science education and research capabilities that will strengthen the data processing aspects of this growing precision agriculture research and curriculum. A partnership among the Department of Mathematics and Statistics, Dakota State University and Raven Industries has already been established for this purpose and its potential for growth is substantial.

The precision agriculture curriculum is being brought together through two parallel initiatives. The first is a $600,000 federally funded USDA Higher Education Challenge Grant led by SDSU. The scientific team — with members from SDSU, University of Nebraska, Colorado State University, Washington State University, University of Missouri, USDA Agricultural Research Service, Purdue University, Kansas State University and Oklahoma State University — is working to:

1) Identify student outcomes for a range of precision farming employment opportunities;
2) Beta test classroom and distance online educational curricula;
3) Create a precision farming educational video library and curricula;
4) Improve institutional and instructor capacity by networking industry and academic experts;
5) Graduate students with enhanced occupational training in science, technology, engineering and mathematics (STEM);
6) Enhance teachers' willingness to integrate experiential learning approaches into classroom activities; and
7) Build a pipeline of students that are technology literate, creative, innovative and fully trained in their disciplines with the skills needed to develop creative locally based solutions that increase sustainable food production.

The American Society of Agronomy, the International Society of Precision Agriculture, Monsanto, DuPont Pioneer, John Deere, Raven Industries and other corporate collaborators are providing specific guidance to content development. The second initiative unfolding in parallel in the two colleges is the previously referenced establishment of the nation's first multidisciplinary major in precision agriculture, following on the previous year's introduction of two precision agriculture minors.

Impact 2018's goals to secure essential human and fiscal resources (Goal 4) and to extend the university's reach (Goal 3) with innovative partnerships are also engaged by these initiatives. The precision agriculture partnership with Raven Industries demonstrates the latter. Since the partnership was formalized in 2014, Raven Industries provided matching support to the FY2014 precision agriculture strategic reinvestment and has hosted 13 SDSU student interns at its 1,100-square-foot suite in the Research Park at South Dakota State University. The present flow of six student interns is expected to grow to seven to eight by 2017. Work conducted both through interns and faculty collaborations has led to two new precision agriculture technologies coming to market in South Dakota and nationally. Additional students pursue internships at Raven's Sioux Falls location. Raven's position as a core enterprise in the precision agriculture space is leading to research and education partnerships with other players in the data processing segment of precision agriculture, such as SST Software Inc. These relationships have helped identify the market's needs both for precision agriculture research and for a more specifically educated workforce, ultimately driving the decision to develop the new multidisciplinary major in precision agriculture. The precision agriculture major will be the first of its kind in the United States and is expected to increase total enrollment by broadening SDSU's student recruitment reach.

Modern and sufficient classroom, laboratory and engineering space will provide the specialized experiential learning and research environment that is needed for university faculty to lead research and development of a workforce of agronomists and engineers who can apply the complex data analytics that are central to precision agriculture. Updated classroom space is limiting; the need to modernize on-campus AES research space was clearly called out in South Dakota Ag 2020 (South Dakota Ag 2020: Creating a Comparative Advantage Through Investments in Agriculture Research, [2012]). There are three primary objectives of this building initiative:

1) Strengthen SDSU's ability to deliver a workforce more highly trained in decision management and application, geospatial imaging, plant and soil sensing, agricultural big data analysis, and field use of novel technology that supports changing food production industry needs;
2) Strengthen SDSU's collaborative research programs in three domains of precision agricultural — data acquisition, data processing and analysis, and decision-making; and
3) Expand experiential learning opportunities for engineering students so they graduate prepared to design the next generation of agricultural machinery that will increase world food production, and for statistics and data science students so they graduate prepared to address the big data challenges presented by precision agriculture.

Meeting the growing demand for a highly skilled workforce in precision technology development and use in South Dakota will require the convergence of teaching, research and outreach efforts of plant, soil and agronomic scientists, agriculture engineers, statisticians and data scientists, economists and climatologists into a more collaborative environment. The new curriculum in precision agriculture will merge traditional agronomic fields of study with engineering technology and data sciences to provide state-of-the-art multidisciplinary courses emphasizing advances in precision agriculture technology. This will improve and increase SDSU's ability to collaborate and interact with industry and producer partners resulting in increased access of researchers and students to state-of-the-art fabrication and manufacturing methods. This innovative curriculum will require

modern physical space for the following:

- Space to support and encourage design, construction and installation of data acquisition and control sensors on large agriculture equipment;
- Space to support laboratory and studio-style learning with high-speed computers, software and technology unique to precision agriculture;
- Specialized laboratories to support cross disciplinary collaborative research in soil chemistry, soil physics, crop production, ag engineering, aerial imaging, water management and sensor development; and
- Space for rapid prototyping and state-of-the-art fabrication and manufacturing methods.

The project provides the infrastructure that leverages research, strengthens curriculum delivery and ultimately fosters economic development. It will help to fulfill goals at the convergence of Impact 2018, South Dakota's 2020 Vision strategy and the AES Ag 2020 strategy.

2. ANALYSIS OF THE STUDENT BODY OR CONSTITUENTS TO BE SERVED:

The Departments of Agricultural and Biosystems Engineering and Plant Science both offer four-year baccalaureate degrees highly desired by state and regional employers. These employers seek graduates who have hands-on experience with current agricultural technology and equipment. They also express preferences to collaborate with SDSU and to provide experiential learning opportunities to engage students in developing the next generation of technology.

Large instructional laboratories are needed to handle the size and scale of modern agricultural equipment. Students must be able to use the actual hardware to fully understand the complexity of today's integrated machinery systems. Modern agricultural biosciences laboratories are needed to more effectively assist farmers and the industry through the development of new or improved crops and crop production systems.

Students need space to work on projects and access to modern electronic tools such as video conferencing, 3-D visualization and 3-D prototyping to collaborate with industry professionals in multiple locations.

Three departments — Agricultural and Biosystems Engineering, Plant Science and Mathematics and Statistics — have well-established master's and Ph.D. programs. Most students in these programs are on campus and work daily with faculty to address many different research questions. Quality graduate students seek to work in the best-equipped research space. Highly collaborative research labs in the Precision Agriculture Building will allow university faculty to recruit the best and brightest graduate students to assist them in solving food production challenges. This collaborative environment will allow university faculty to host visiting scientists to discover and to share knowledge and to expand SDSU's reach in global research. The proximity of engineers, statisticians and data scientists, and biological scientists with diverse expertise will enable SDSU to meet the imperative societal need of increasing food production for generations to come. Students in the M.S. in data science program (a collaborative effort with Dakota State University), the M.S. in statistics, and the doctorate in computational science and statistics will develop new methodologies to address the enormous data analysis challenges that are presented by precision agriculture. In the first year of the program's existence, the M.S. in data science program partnered with Raven Industries, which

sponsored a full graduate fellowship for a student pursuing that degree. The potential for additional collaboration of this sort with Raven and other precision agriculture constituents is substantial.

Constituents who will make extensive use of the new facility include undergraduate students majoring in precision agriculture, agronomy, agricultural science, agricultural and biosystems engineering, and agricultural systems technology. Students pursuing minors in precision agriculture or in engineering for precision agriculture will have several laboratory classes in the building. Graduate students pursuing master's degrees in agricultural and biosystems engineering and plant science, as well as doctoral students in plant science, biological sciences, and agricultural, biosystems and mechanical engineering, will make extensive use of the research laboratories in the new facility.

Scientists and engineers from both Plant Science and Agricultural and Biosystems Engineering would be in proximity for collaborative research and Extension efforts. The spaces and facilities with state-of-the-art communications systems will engage audiences from various age groups and geographic locations so university professionals can demonstrate techniques and provide education on topics such as profitable crop production, increasing the resiliency and sustainability of cropping systems, bioprocessing, grain handling, biofuels, ventilation, water quality, agricultural sensors and control systems, machinery management and machinery safety. The ultimate benefactor of these efforts will be a society that has access to a safer and more abundant food supply.

3. ADDITIONAL SERVICES TO BE OFFERED:

The project's primary objectives are to provide modern facilities that will support the new curriculum planned for precision agriculture and upgraded laboratories for plant science and agricultural and biosystems engineering discovery and adaptive research. The existing facilities are unable to provide proper support.

4. COMPLIANCE WITH CAMPUS MASTER PLAN:

This project and potential sites are consistent with the planning goals of the 2025 Campus Master Plan Update. More specifically, the project modernizes laboratory and core facilities for discovery and adaptive research in the priority areas of applied plant biotechnology, soil and environmental sciences, and plant-based value chain products and systems. The three priority areas are brought together through the precision agriculture application platform. This modernization effort stems directly from the South Dakota Agricultural Experiment Station's long-range plan, "South Dakota Ag 2020: Creating a Comparative Advantage Through Investments in Agricultural Research" (2012).

5. ANALYSIS OF NEEDS ASSESSMENT BASED ON THE FACILITIES UTILIZATION REPORT:

The Departments of Plant Science and Agricultural and Biosystems Engineering utilized space in the Agricultural Engineering Building (48,696 gross square feet, constructed 1959), the Plant Science Building (12,396 gross square feet, constructed 1955) and the second floor of Berg Agricultural Hall (19,332 gross square feet, constructed 1953). These facilities are fully utilized but have not been substantially renovated since original construction.

Retrofits and small renovation projects have taken place in specific spaces for some individual programs or research lab equipment installation. Examples include the flume lab in the Ag

Engineering Building, general classroom improvements in the Ag Engineering Building, and a current project to renovate a space for installation of a transmission electron microscope. Maintenance and repair projects to better serve basic utilities have been completed (e.g., electrical upgrades to the Ag Engineering Building). However, major renovations have not taken place. The basement and third floor of Berg Agriculture Hall were fully renovated in 2008, but the first and second floors were not, as funding for this science facility initiative would not allow a full renovation.

Demonstrations of modern technologies and farm equipment cannot be accomplished inside the existing facilities as the overhead doors and space available for modern equipment is not large enough to bring the equipment inside the Ag Engineering Building. The existing facilities also cannot readily support the higher technologies that need to be demonstrated by the upgraded curriculum.

6. LOCATION:

The project's site has not yet been determined. Possible locations include, but are not limited to, the existing Ag Engineering Building and site, Sexauer Field immediately south of the Plant Science Building, land east of Alfred Dairy Science, and the parking area north of the Ag Engineering Building. Any of these sites would be suitable for this project as they all can be supported from the central steam distribution system and possibly from the central chilled water distribution system.

SDSU would utilize an agricultural and engineering consultant's planning expertise to evaluate alternative sites and the advantages and disadvantages of each location. Sites that include or are close to the Ag Engineering Building offer the possibility of reuse of all or a portion of the existing building following renovation. Suitability of the class laboratory and research laboratory needs to a renovated building will be evaluated as an activity of site selection and architectural programming. Sites near the Plant Science Building and adjacent greenhouses offer possible links to other research facilities, plant scientists, and collaborative partners. A selection of a project site would be made upon proper consideration of the various alternative locations.

7. REALLOCATION OF OLD SPACE, IF ANY:

The proposed facility, when complete, will provide a common location for programs, faculty and staff currently occupying the Agricultural Engineering Building, the Plant Science Building and the second floor of Berg Agricultural Hall. All space currently utilized by the Department of Agricultural and Biosystems Engineering within the Ag Engineering Building will be affected. All space currently utilized by the Department of Plant Science in the Plant Science Building and a portion of the second floor of Berg Agricultural Hall will be affected.

The use or reuse of existing facilities will not be fully determined until architectural programming and space-planning services are complete and a site selected. Various site scenarios outlined in section 6 (Site Selection) of this report may allow for reuse of existing buildings or require new construction that will allow existing facilities to be repurposed or demolished. The Agricultural Engineering Building could be reused for project program space or repurposed into other classroom, class/lab and office space, depending upon the site selected. The second floor of Berg Agriculture Hall will be reassigned for use by CABS as food science laboratories and support space. The Plant Science Building could be reused, demolished or repurposed by CABS, depending upon the site

selected. Reuse possibilities could include generic laboratory or headhouse support space for the adjacent greenhouses.

8. PROPOSED FUNDING SOURCE/SOURCES:

This project will be funded from donations and other sources yet to be identified.

9. BUDGET FOR DEVELOPMENT OF A FACILITY PROGRAM PLAN:

The architectural programming and preliminary design services will cost approximately $365,000. The South Dakota Corn Utilization Council's $600,000 donation to the SDSU Foundation will fund these costs. These services include site analysis and selection from alternative acceptable sites. A professional consulting design team will provide design services. This will provide adequate information to determine the site and scope of the project, to develop a preliminary design for the building, and to estimate the project costs. A goal would be to have adequate information for continued fundraising and for submittal of the project to a future legislative session.