Agenda Item No. C-29

**AGENDA ITEM BRIEFING**

**Submitted by:** M. Katherine Banks
Vice Chancellor and Dean of Engineering
Director, Texas A&M Engineering Experiment Station

**Subject:** Establishment of the Center for Autonomous Vehicles and Sensor Systems

**Proposed Board Action:**

Establish the Center for Autonomous Vehicles and Sensor Systems (CANVASS) as a unit within the Texas A&M Engineering Experiment Station (TEES).

**Background Information:**

Five disciplinary divisions of TEES are collaborating to establish the new CANVASS in response to the ubiquitous future of unmanned autonomous systems. CANVASS will seek to enable interdisciplinary research in five challenging areas of national and state significance:

- Networked Operations, Health Adaptive Mission Management, and On-Board Decision Making in Complex GPS Denied Outdoor Environments,
- Navigation in Global Navigation Satellite System Denied Environments,
- Space Environment Operations,
- Field-Based and Large-Scale Human-Machine Interaction, and
- Agricultural Cyber-Physical Systems.

The mission of CANVASS will be to unify research and development of autonomous vehicles and systems for the purpose of better serving our state and federal customers. The CANVASS vision is a center that will allow an orderly progression from basic research at Technology Readiness Level (TRL) 1 (basic technology research) up to TRL 7 (technology demonstration).

CANVASS will develop an outdoor test range at the Riverside Campus called the Riverside Range. The 900-acre Riverside Range will make TEES one of only a handful of major university systems worldwide with a large-scale instrumented outdoor laboratory located on campus. CANVASS complements the Lone Star Unmanned Aircraft Systems Center of Excellence and Innovation, a joint Texas A&M University-Corpus Christi and TEES center, by focusing basic research and testing for all types of unmanned systems (air, land and water).

**A&M System Funding or Other Financial Implications:**

CANVASS is supported with startup funds totaling $1.5 million over three years, at which time the center will be self-sustaining. Funds will be used for facilities, equipment and technician support to support the Riverside Range test facilities.

Agenda Item No. C-29

**TEXAS A&M ENGINEERING EXPERIMENT STATION**
Office of the Director
April 30, 2014

Members, Board of Regents
The Texas A&M University System

Subject: Establishment of the Center for Autonomous Vehicles and Sensor Systems

I recommend adoption of the following minute order:

> **"The Center for Autonomous Vehicles and Sensor Systems is hereby established as a multidisciplinary organizational unit within the Texas A&M Engineering Experiment Station."**

Respectfully submitted,

[ORIGINAL SIGNED BY]

M. Katherine Banks
Vice Chancellor and Dean of Engineering
Director, Texas A&M Engineering
Experiment Station

**Approval Recommended:**

[ORIGINAL SIGNED BY]

John Sharp
Chancellor

[ORIGINAL SIGNED BY]

Billy Hamilton
Executive Vice Chancellor and
Chief Financial Officer

[ORIGINAL SIGNED BY]

James Hallmark
Vice Chancellor for Academic Affairs

**Approved for Legal Sufficiency:**

[ORIGINAL SIGNED BY]

Ray Bonilla
General Counsel

**TEXAS A&M ENGINEERING EXPERIMENT STATION**
Center for Autonomous Vehicles and Sensor Systems

# EXECUTIVE SUMMARY

## 1. Rationale for establishing the Center for Autonomous Vehicles and Sensor Systems

Currently, the Texas A&M Engineering Experiment Station (TEES) is at the forefront of autonomous systems research in part due to the availability of the large outdoor facilities at the Riverside Campus and Disaster City®, plus laboratories such as the Unmanned Flight Laboratory (UFL), Vehicle Systems & Control Laboratory (VSCL), Land Air and Space Robotics Laboratory (LASR) and AggieSat Laboratory. The Aerospace Engineering, Civil Engineering, Computer Science and Engineering, Electrical and Computer Engineering and Mechanical Engineering divisions of TEES are collaborating to establish a new Center for Autonomous Vehicles and Sensor Systems (CANVASS). This multidisciplinary center is in response to the ubiquitous future of unmanned autonomous systems. Its member facilities and researchers are located throughout TEES. CANVASS will engage other divisions inside TEES, in addition to agencies outside TEES, as research capabilities and needs grow.

CANVASS seeks to enable interdisciplinary research in five challenging areas of national and state significance:

- Networked Operations, Health Adaptive Mission Management, and On-Board Decision Making in Complex GPS Denied Outdoor Environments,
- Navigation in Global Navigation Satellite System Denied Environments,
- Space Environment Operations,
- Field-Based and Large-Scale Human-Machine Interaction, and
- Agricultural Cyber-Physical Systems.

CANVASS will initially be composed of researchers from 18 laboratories throughout TEES aligned within three technology areas – integrated, autonomous systems; sensors, information and controls; and test and evaluation. CANVASS will connect the relevant research talents from these labs to develop multidisciplinary teams that pursue large, integrative research projects. Additionally, it will provide a physical space for these researchers to conduct advanced research. Other laboratories will be included as CANVASS expands.

CANVASS will develop an outdoor test range at the Riverside Campus called the Riverside Range as a focal point for tackling difficult research issues and problems which require a realistic, outdoor laboratory environment. The 900-acre Riverside Range will make TEES one of only a handful of major university systems worldwide with a large-scale instrumented outdoor laboratory located on campus. The Riverside Range is currently one of the 12 test ranges of the recently awarded Lone Star Unmanned Aircraft Systems Center of Excellence and Innovation (LSUASC) a joint Texas A&M University-Corpus Christi (A&M-Corpus Christi)

and TEES center. LSUASC is one of only six FAA-designated test sites in the United States. CANVASS complements LSUASC since it encompasses all types of unmanned systems with a primary mission of research and will also support industrial customers. CANVASS and LSUASC are synergistic centers with complementary facilities. A new autonomous systems laboratory facility is being built as part of the Riverside Range and is estimated to open by early 2015. Both industry (Camber Corporation) and the initial divisions listed above are supporting this effort with cost-sharing to help build and instrument the Riverside Range and provide technician support.

CANVASS will consist of several facilities investments that will serve the overall goal of establishing a state-of-the-art autonomous systems research center. Each facility investment is summarized below:

- Construction of a new air-conditioned 6,000 sq. ft. metal building that will serve as CANVASS's primary research facility and will be the focal point for multidisciplinary research activities. It will also serve as the primary conduit for collaboration with commercial partners. The building will be located next to the current UFL hangar. It is designed for expansion as CANVASS research grows to accommodate new technologies.
- The UFL hangar will be upgraded to serve as a secure storage facility for larger university-owned unmanned vehicles as well as vehicles brought by industry partners.
- An anechoic chamber will also be added to the UFL hangar which can be used for vehicle Electromagnetics (EM)-signature characterization, signals collection research and other EM research activities.
- Runway site improvements needed to provide safety, security, power, water, data and electrical grounding.
- Furnishings and state-of-the-art instrumentation to allow its immediate use as a laboratory facility.

**Mission, Goals, Objectives and Milestones**

The mission of CANVASS will be to unify research and development of autonomous vehicles throughout the Texas A&M University Engineering program for the purpose of better serving our state and federal customers. CANVASS will provide these customers and partners access to unique researchers, capabilities and facilities for the purpose of incubating and maturing autonomous technologies onsite at the College Station campus. The CANVASS vision is a center that will allow an orderly progression from basic research at Technology Readiness Level (TRL) 1 (basic technology research) in the indoor, on-campus labs, to initial testing of mature systems and concepts at TRL 7 (prototype near or at planned operational system, requiring demonstration in an operational environment [e.g., in an aircraft, vehicle or in space]).

CANVASS will feature an instrumented outdoor laboratory and multiple affiliated laboratories in TEES's divisions that will make TEES extremely attractive to government and industry program managers and proposal reviewers since it can provide a credible, outdoor test site with state-of-the-art instrumentation and a network of affiliated laboratories and researchers. The research activities will develop innovative, synergistic strategies for the design, analysis, control, validation and verification of complex autonomous vehicle systems and sensor systems

operating in challenging environments. These problems and activities are specifically targeted to be of great interest to federal, state and industrial sponsors over the next 10-20 years. CANVASS will be a common core of facilities used by many research groups, enabling faculty and student researchers to share expertise across TEES. Furthermore, CANVASS complements the statewide LSUASC, led by A&M-Corpus Christi, which was approved by the Board of Regents in October 2013, by providing a basic research and testing facility located near world-class faculty researchers in a wide range of disciplines. CANVASS expands upon the mission of LSUASC by focusing on all types of unmanned systems (air, land and water).

The set-up of CANVASS research operations in the new research facility will be conducted in three phases over a period of 20 months:

- Phase I – Site Preparation (July 1, 2013 - July 1, 2014)
- Phase II – Equipment Procurement and Building Construction (July 1, 2014 – January 31, 2015)
- Phase III – Set-up of Research Operations in New Research Facility (February 1, 2015 – March 1, 2015).

Figure 1 shows an aerial photo of how the new CANVASS facility will be arranged at Riverside Campus. Figure 2 is an architect-prepared plan for the initial configuration of the CANVASS building. The Phase I building plan contains secure storage and testing areas for autonomous ground and air vehicles, a technician shop, a proposal development area, offices for visiting industry and academic researchers, and TEES research faculty and students.

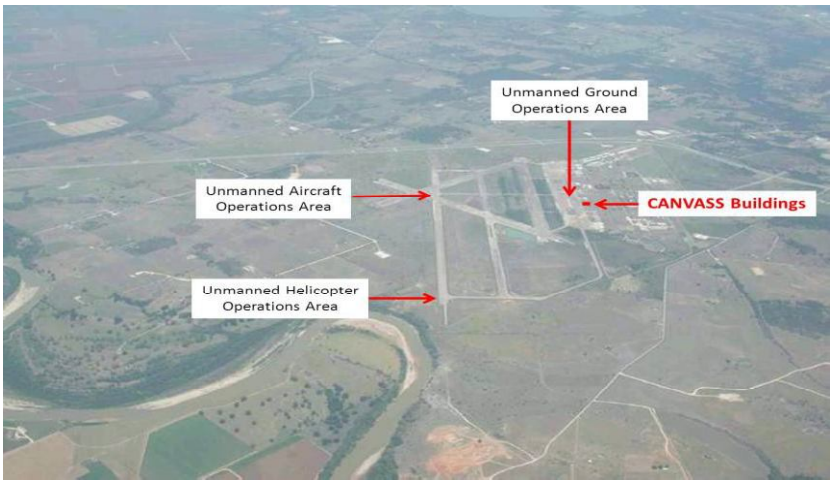


**Figure 1. Riverside Campus showing proposed Riverside Range (unmanned air and ground vehicle test areas) and CANVASS buildings**

As a vibrant component facility in the LSUASC, a variety of federal and state government agencies, along with large, medium and small industries, will routinely station and rotate researchers in and out of the Riverside Range facilities along with facilities available at other TEES research centers. The existence of secure temporary office and equipment space in the new CANVASS building (Figure 2) will help facilitate these working relationships and activities.


**Figure 2. Floor Plan of the Initial Phase of CANVASS Building**

## 2. Impact on Education and Training of Students

CANVASS facilitates engineering education and will be a part of the LSUASC conduit for enhancing the autonomous systems engineering workforce in the state of Texas with a particular focus on UAS. As unmanned systems advance, the need for a skilled workforce will be in high demand from government and industry. The center will serve as a laboratory and proving ground for students, faculty, staff and practitioners to apply knowledge learned in the classroom, in practice and through research, to test hypotheses and evaluate innovative solutions/designs that will advance the autonomous systems knowledge base, technology development and operations.

At the start of research operations (Phase III), CANVASS anticipates having five graduate research assistants (GRAs) and 10 undergraduate research assistants (URAs) participating in research activities. Within three years, the number of students involved should increase to seven GRAs and 15 URAs. After five years, CANVASS anticipates having at least 10 GRAs and 20 URAs supporting research operations. The sponsored research activities with government agencies and industries should generate at least 10 undergraduate research internships annually.

As a key part of the LSUASC, the CANVASS Riverside Range will serve as a laboratory and testing ground for thesis and dissertation research in current graduate programs in aerospace engineering, civil engineering, electrical engineering, mechanical engineering, oceanography and computer science. It will also enhance geospatial surveying engineering, the proposed Ph.D. program in geospatial computing sciences and future graduate programs in engineering. An undergraduate autonomous systems track and graduate thesis/dissertation research will provide opportunities for faculty to mentor and train students to pursue careers in autonomous system-related industries and to contribute to workforce development of this significant emerging industrial sector.

CANVASS will host at least one high-profile, cutting-edge technology event or technology policy workshop or conference each year for participants from industry and government agencies.

## 3. Sources and Future Expectations of Financial Support

TEES is contributing $750,000, five of the disciplinary divisions within TEES are contributing $500,000 total over three years, and Camber Corporation is contributing $250,000 for a total

initial investment of $1.5 million. This will be used for facilities, equipment and technician support over three years to support the Riverside Range test facilities. User fees from the Riverside Range and the CANVASS building will provide additional income, as will membership fees from industry partners that are members of the Industry Advisory Board. It is anticipated that CANVASS will be fully self-sustaining within three years from inception (August 2017). Sustainment of CANVASS will primarily be obtained through the performance of sponsored research for government agencies, large corporations and small to medium size businesses. The success of its performance will be primarily measured by the following metrics: sponsored research projects (dollars), collaborative initiatives (number of divisions, companies) and licensed technologies (number of licenses).

## 4. **Governance and Advisory Structure**

The CANVASS organizational structure is shown in Figure 3. A director will lead CANVASS and will report to the TEES deputy director or designee. The initial CANVASS director will be Dr. John Valasek. The director will initially be supported by an administrative assistant and a part-time (50%) equipment technician.

The director will establish an Oversight Committee and an Industrial Advisory Board. The Oversight Committee will be comprised of the participating TEES division heads and a member from A&M-Corpus Christi and will provide general oversight and assist with the engagement of and networking with faculty members and students to ensure that CANVASS has full support at the TEES divisions' level. The Industrial Advisory Board will be comprised of six members from relevant industries and agencies and will meet bi-annually to assess the health and progress of the center while also identifying potential research and testing opportunities with industry.

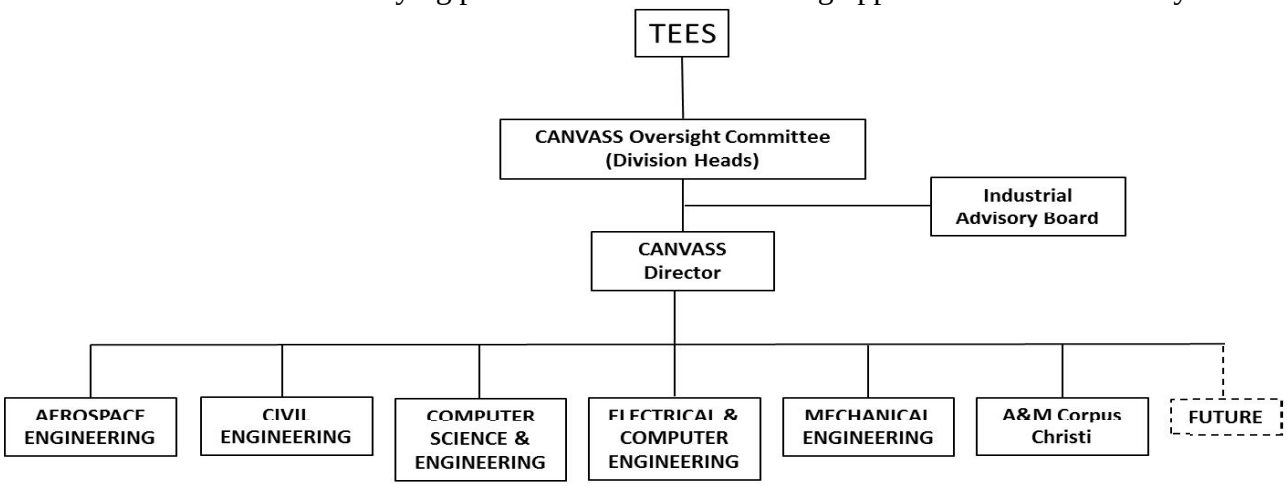


**Figure 3. CANVASS Organizational Chart**

## 5. **Mechanisms for Periodic Review**

The center will be reviewed in accordance with the policies established for TEES institutes and centers which includes a periodic review every five years to The Texas A&M University System. There will be bi-annual reviews with the Industrial Advisory Board and an annual review with the Oversight Committee. In addition, associated institutes, centers, divisions and specific funded programs routinely undergo formal periodic reviews by funding and accrediting agencies.