

**Academic Program Development in Unmanned Vehicular Systems**  
**Office of the Provost and Executive Vice President**  
**Mississippi State University**

*(Submitted: 10/16/2020 by Jamie Dyer)*

**I. Mission and Charge Statement**

Mississippi State University is a leading institution in research related to unmanned vehicular systems (aerial, marine, and terrestrial), and there currently exists a unique opportunity to leverage this research capacity into innovative transdisciplinary academic programs. At the direction of Vice Presidents David Shaw, Julie Jordan, and Reuben Moore, this task force was charged with exploring how MSU can best fulfill its land-grant mission of teaching, research, and service through the development and implementation of comprehensive transdisciplinary programs in the fields and applications of unmanned vehicular systems.

The original motivation for this initiative was based on an announcement from the Federal Aviation Administration (FAA), which as part of the FAA Reauthorization Act of 2018 (Sections 631 and 632), will allow colleges and universities to apply to become FAA-designated UAS Collegiate Training Initiative (CTI) schools. The program mission is for the FAA to collaborate with partner schools to deliver up-to-date training tools, resources, and guidelines for unmanned aerial systems (UAS) that will prepare students for careers in UAS and continue to maintain the safety of the National Airspace System. To be eligible to become a UAS-CTI school, the institution must offer a Bachelor's or Associate's degree in Unmanned Aircraft Systems, or a degree with a minor, concentration, or certificate in UAS. Based on this focus, the task force was comprised of the following individuals representing a cross section of expertise related to unmanned systems and academic programs at MSU, with a specific focus on aerial systems: Jamie Dyer (Chair); David Belk; Amelia Fox; Eric Hill; Tom Brooks; Eddie French; Joby Czarnecki; Carla Huston; Christine Ma; Peter Ryan.

The primary objective of the task force was to outline the requirements, potential structure(s), and known/expected obstacles associated with the development of programs focused on unmanned vehicular systems. Driven by the expertise of the task force, and under the guidance of the Office of the Provost, the general objectives and goals included the following:

- A description of potential academic programs focused on unmanned vehicular systems that aligns with the strengths of MSU faculty, resources, and research foci.
- Potential curriculum structure and content based on existing and potential MSU course offerings.
- An outline of potential program structures (e.g., certificate, degree, etc.) and their individual advantages/disadvantages.
- An overview of existing and anticipated challenges in the development and/or success of a program in terms of administrative, economic, political, or other factors.

Given MSU's existing research and academic expertise in unmanned vehicular systems, as well as available resources (e.g., Raspet Flight Research Laboratory (RFRL), Center for Advanced Vehicular Systems (CAVS), Northern Gulf Institute (NGI), Bagley College of Engineering), the University is in position to increase emphasis in unmanned system education by augmenting existing offerings to better provide students with a robust foundation in training, development, and applications of unmanned vehicular systems. Program development with a focus on these three tenets will lead to recruitment of students who will become increasingly sought after in a highly competitive and dynamic job market.

## II. Task Force Recommendations

Summaries of the task force recommendations are provided below in order of preference and/or time to implementation, as defined by the task force. Additionally, the specific justification for the recommendations is provided to further define the expected impact and potential structure of associated academic programs.

### 1. *Workforce assessment in unmanned vehicular systems*

This recommendation has become an action item due to its importance in defining the path forward for subsequent recommendations. With the support of the Office of the Provost, Jamie Dyer and Eric Hill are working with the MSU Center for Entrepreneurship & Outreach (eCenter) to develop a workforce assessment focused on outlining the markets and industries in unmanned systems, defining employers within those markets, and outlining skills and knowledge those employers deem critical for the future workforce. The assessment is being conducted during the Fall 2020 semester.

### 2. *Inventory existing MSU courses and programs associated with unmanned vehicular systems*

Given the broad range of skills and applications associated with unmanned aerial, marine, and terrestrial systems, it is important to define and outline existing resources at MSU that could be utilized for academic program development. Although not exhaustive, the following list outlines some of the major centers and academic units that are associated with unmanned systems and their applications:

- Raspet Flight Research Laboratory (RFRL)
- Center for Advanced Vehicular Systems (CAVS)
- Northern Gulf Institute (NGI)
- Geosystems Research Institute (GRI)
- Bagley College of Engineering
  - o Department of Aerospace Engineering
  - o Department of Agricultural and Biological Engineering
- College of Agriculture and Life Sciences
  - o Department of Plant and Soil Sciences
  - o Department of Agricultural and Biological Engineering
- College of Forest Resources
  - o Department of Forestry
  - o Department of Wildlife, Fisheries, and Aquaculture
- College of Arts & Sciences
  - o Department of Geosciences

The task force also identified types of courses that can/should be incorporated into any unmanned vehicle program. While exact programs of study for future program curricula would be developed with the input and advice from faculty and administrators having expertise in the respective fields, the following is a list of disciplines where classes could be included in programs:

- Laws and ethics associated with unmanned vehicles
- Unmanned vehicle design and technical systems
- Data analytics
- Remote sensing
- Geospatial techniques
- Unmanned vehicle operations

- Includes hand-on training as part of official certification (i.e., FAA Part 107 UAG certification)
  - Environmental awareness
    - Such as aviation meteorology for UAS applications, oceanography and/or hydrology for marine applications, etc.
  - Precision agriculture
  - Disaster management
3. *Addition of unmanned vehicular system concentration(s) to the Bachelor of Applied Science (BAS) program*

Given the technical basis of training and education in unmanned vehicular systems, the Bachelor of Applied Science (BAS) is a natural path forward for developing academic programs that lead to an undergraduate degree. Although the definition and outline of potential concentrations will depend on the workforce assessment and availability of courses at MSU (see Recommendations 1 and 2, respectively), the task force agreed that there are three areas that each concentration should include:

- a. Operations
  - Skills and training associated with safe operation of unmanned vehicles.
  - Knowledge of rules, regulations, and guidelines for operation in various conditions and environments.
- b. Technical/engineering
  - Knowledge of the electrical and mechanical systems associated with unmanned vehicles, including both on-board and ground station communications.
- c. Applications
  - Information on the use of unmanned systems, including both the vehicles and associated sensor packages, for research and operational applications.
  - Training on data collection and assessment for various applications, including information on relevant aspects of remote sensing, data processing, and data dissemination.
  - Recognizing and analyzing market opportunities for new and novel applications of unmanned vehicular systems.

It is expected that many courses will be relevant to all unmanned vehicular systems, while specific systems (i.e., aerial, marine, and terrestrial) will require courses explicitly applicable to their respective operations and applications. Additionally, due to the relatively young and rapidly changing unmanned vehicle industry, it may be advantageous to position business as an option for students interested in adding leadership and management skills on top of technical training. Based on this, the task force agreed that development of a concentration in unmanned systems should include a set number of required hours in the areas of operations, technical, and applications, while including a number of elective hours based on a pre-defined and vetted list of courses to allow students the flexibility to pursue whatever area of expertise they choose within the realm of unmanned systems.

As Recommendation 2 (see above) would provide an overview of what courses are currently available at MSU related to unmanned systems, development of an unmanned systems concentration in the BAS would require input from a task force focused on curriculum development. Such a task force would need members with expertise in all forms of unmanned systems (aerial, marine, and terrestrial), as well as

expertise in potential focus areas such as engineering, data analysis, remote sensing, and entrepreneurship.

#### 4. *Certificate programs in unmanned vehicular systems*

To provide students an opportunity to gain experience and/or expertise in unmanned vehicular systems at MSU while still allowing for fulfillment of an existing degree program, the task force recommended the development of certificate programs. Under the broader umbrella of unmanned vehicular systems, a certificate would include coursework with minimum required hours focused on operations, technical, and applications, similar to the concentrations under the BAS recommendation (see Section II.3). To define the total number of hours required for a certificate, as well as the number of hours needed for each of the three focus areas, additional discussion with relevant faculty and administrators is needed.

#### 5. *Application to become a UAS-CTI institution*

Although specific to unmanned aerial systems (UAS), as part of the original charge of the unmanned vehicular system task force, once a concentration and/or undergraduate program associated with UAS is in place the task force recommends moving forward with applying to become a designated FAA UAS-CTI institution. Given MSU's existing expertise and reputation in UAS research and operations, this is a critical step in furthering the visibility and recruitment potential of the University in UAS education.

### **III. Potential Challenges**

The task force identified a common set of challenges associated with developing academic programs in unmanned vehicular systems. These include:

- Defining credit/ownership.
  - o Where will the program be housed? Who will oversee administrative tasks associated with the program (i.e., application and approval processes)?
- Funding and resource allocation.
  - o What will be the funding stream for the programs, and how will funds be collected/allocated among academic units?
  - o Who will provide the initial resources for program development?
  - o If required for equipment storage or training, who will provide the physical space to house the program?
- Faculty recruitment and recognition.
  - o How will faculty involvement in potential transdisciplinary programs be recognized for promotion and/or tenure?
  - o How will faculty be recruited into potential programs, either as new hires or as associates from existing academic units across campus?
  - o Faculty implications associated with teaching responsibility in future programs may be an issue, especially if there are limitations to class size and teaching resources.
- Defining niche program focus areas based on MSU expertise.
  - o What existing courses could be used to develop academic programs in unmanned aerial, marine, and terrestrial systems? What courses could be developed with existing faculty expertise and availability?
  - o As programs in unmanned vehicular systems are already in place at other peer and peer-plus institutions, the task force recognized that competition with other universities could

be a challenge; however, this is also an opportunity to develop programs unique to the current expertise and mission of MSU.

- Identifying and developing external partnerships.
  - o How can industry, government, and academic partners be recruited and utilized in unmanned vehicular system program development?
  - o How can current and future graduates be connected with external partners for internships, capstone projects, and job placement?

#### **IV. Paths Forward**

Based on the recommendations provided by the task force, as well as the requirements and scope of the associated tasks, the path forward has four primary steps. These steps, along with the estimated time to completion, are as follows (short-term is < 1 year; medium-term is 1-2 years; long-term is > 2 years).

1. Work force assessment (short-term)
  - a. Currently underway; anticipated completion by end of Fall 2020.
2. Inventory of MSU resources (short-term)
  - a. Identification of MSU faculty associated with operations, technical aspects, and applications of unmanned vehicular systems.
  - b. Inventory of existing MSU courses and programs associated with operations, technical aspects, and applications of unmanned vehicular systems.
  - c. Inventory of current faculty and staff with expertise in disciplines associated with unmanned vehicular systems.
3. Development of concentrations in the BAS program (medium-term)
  - a. Using existing MSU courses and faculty expertise, define concentrations that could be housed under the BAS.
  - b. Work with faculty, students, and potential external partners to outline programs of study associated with defined concentrations.
  - c. Work with faculty and administrators to determine the logistics and cost structure associated with the development and implementation of BAS concentrations in unmanned vehicular systems.
4. FAA UAS-CTI certification (medium-term)
5. Develop certificate programs in unmanned vehicular systems (long-term).
  - a. Building on academic programs developed as concentrations under the BAS, design and implement certificate programs with the same (or similar) foci.