

Virginia RoboTics and Unmanned Systems Education Summit (VIRTUES) Report

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James Madison University

Research | Curriculum | Industry | Policy & Ethics

Prepared by the summit facilitators from the Institute of Constructive Advocacy and Dialogue, JMU

With an estimated economic impact of \$82 billion (Association for Unmanned Vehicle Systems International (AUVSI) Report, 2013), growth in the unmanned aircraft systems (UAS) industry continues to spark interest and competition—particularly in states with significant aerospace and transportation research facilities, as well as those transitioning military industries.

According to the report, Virginia ranks 8th in terms of potential economic impact despite having significant research capacity and a high concentration of related military industries.

VIRTUES brought Virginia's unmanned aerial vehicles (UAV) community together to produce actionable objectives toward Governor McAuliffe and Senator Warner's vision for [The New Virginia Economy](#).

Keynote Speaker, David Hinton

The conference opened with a keynote by David Hinton, Senior Advisor for Unmanned Systems who highlighted that Virginia is fostering a pro-unmanned systems (UMS) regulatory environment. He also talked about exciting and innovative things going on in the commonwealth in the UMS realm:

- Robot fish
- Swarm technology
- First legal unmanned humanitarian package delivery in Wise, VA
- First responders using UAVs in Albemarle County
 - Creation of a UAV database of qualified UAV operators that emergency personnel can call on is underway
- Blackstone – Textron
- Utilities looking at how to use UAVs to assess infrastructure, miles of pipeline, particularly after storms
- Virginia Department of Transportation (VDOT) exploring drone use for roadwork
- Virginia has formed an unmanned systems commission and an online portal to facilitate sharing of information and resources.

Hinton noted some good regulatory news from the past legislative session:

- HB 454 – permits moving displays in front seat of unmanned car technology
- HB 412 – prevents local UAV regulations, avoiding a patchwork of regulations

- HB30 budget bill – supports UMS research, development and education with equipment to enhance the unmanned aircraft test range for Beyond Visual Line of Sight research
- SB30 – Creates an Unmanned Systems Center of Excellence and incubator

Hinton noted that the commonwealth hired a firm to develop a value proposition about UMS to tout that Virginia has the whole package: a unique combination of geography, policy, educational institutions, and existing research and industry in unmanned technologies.

One of the key central themes for the state is education and workforce development to meet needs for trained employees in this industry, so he was delighted this was the central purpose of the VIRTUES conference.

Overall, Hinton reflected, the area of unmanned systems is not just about technology, “It is an ecosystem.” He identified parts of that ecosystem and what is needed in each:

- Regulatory – Continuing to get laws out of the way of innovation
- Need to look at front end of R&D and the back end of evaluation and analytics
- Marketing – “We need a drum beat out there for Virginia”
- Education – Developing standards for curriculum

Industry in the commonwealth is organizing and establishing a trade association which will ensure that someone’s fulltime responsibility is to promote UMS. Hinton said this is an exciting time. “This industry is about to go exponential at a time when the FAA is opening the skies.”

2016-2017 Action Plans

The conference was organized into four working groups—Research, Curriculum, Industry, and Policy and Ethics—who met with facilitators during the day to discuss the success stories in each area, to map what was happening regarding UMS in each of the areas, and to identify gaps and opportunities for collaborative action that would move each of these areas forward and make each more responsive to rapidly changing and growing needs.

All of the information was gathered and reviewed and resulted in a list of actionable items for the coming year that will help support UMS growth through research, jobs creation, and policy that supports innovation.

Here are the collaboratively developed needs and themes identified by more than 50 participants. Some more specific action items in each area can be found in the working group notes.

Overall Needs

1. Coordination between industry and academia to set up workforce development programs and curricula
2. Education for high-level academic administration, industry leaders, students, and public—‘drones as a tool’
3. Interdisciplinary collaboration
4. More money accessible to big and small actors

5. Partnerships between academic researchers, industry, and government
6. Publicity
7. Standards and training to decrease overhead for new initiatives
8. To clarify campus regulations
9. To clarify policy – need for tort liability and patents regulation
10. To know how to keep up with pace of R&D innovation
11. To make Virginia a ‘drone state’ with an overarching organization or trade association
12. To map infrastructure—create a shared ‘asset inventory’
13. To outline differences in standards for operators based upon specific industry/position

Next Step – VIRTUES conference in February, 2017

There was support for meeting again in February for another summit. Here are the collective suggestions for the next summit:

1. Focus on regulatory challenges – Continue to get laws out of the way of innovation
2. Invite government funders as participants
3. The number of participants (58) and the duration of the summit (1 full day/8 hours) were effective aspects of the summit
4. Have even more focused goals for next meeting—perhaps development of a 3-way research needs statement
5. Ideas for potential working group **goals** in February:
 - a. Create a virtual network that can help match industry needs and requirements to student capacities/students completing programs
 - b. Determine career development/minimum requirements for entry-level drone operators for drones between 0.55 lbs. and 55 lbs.
 - c. Develop a “research partnerships” needs statement
 - d. Form a legislative task force
 - e. Review and align goals and plans with the government task force report, which will be released in December.
6. Ideas for potential working group **topics** in February:
 - a. Diversity in UMS arena (jobs)
 - b. Insurance and legal updates
 - c. Privacy/ethics/public safety

Working Group Notes

1. Research Group

Successes	Who/Where	What enabled success?
Logistics/systems 2 yr. funded naval research Location science – studying how to get stuff where it needs to be	George Mason University faculty Public/private partnership with Group W Students	Federal \$ Partnership
Commission that helped determine where Virginia should apply efforts	Unmanned Systems Commission and trade association/Hub of Contact (by Labor Day)	Close proximity to federal government Legislative support Defense research location Focused energies Promoted communication
National Science Foundation (NSF) projects on atmospheric science to track hazardous agents	Virginia Tech Virginia Center for Autonomous Systems (VaCAS) Kentland Experimental Aerial Systems (KEAS) Laboratory	Infrastructure investment which drove project evolution (If you build it they will come approach) Built early trust and buy-in from leadership Took baby steps in getting infrastructure and each step brought in new projects
Online course training UAV operators	Liberty University	Responding to an exigency
VIRTUES conference		Sharing information, talking across the groups involved Showcases a commitment to collaborate

Challenges

1. Industry/University Partnerships, Status Quo and Bureaucracy
 - a. The word “contractor” has a negative connotation and there is a suspicion about for-profit conflicts of interest
 - b. Ownership/benefits of partnerships patents/licenses—when these are established at outset, working with imperfect information
 - c. Universities are inflexible, differing timelines than industry or funders
 - d. Provisional patents are only good for a year (There’s not enough time in the university environment with competing priorities)
2. Contacts/Network
 - a. We don’t always know who is doing this or specifically who to contact (Not just VT, but which people)

3. Funding
 - a. UAVs are seen as applied research which often eliminates proposals in NSF review
 - b. Infrastructure needs

Vision

1. Development of innovation zones for UMS
2. Educate vice presidents and deans of research on UMS research needs/challenges/support needed
 - a. Attendees from each university can take this VIRTUES report to talk with VPs of research and OSPs to start educating them
3. Disrupt the way public/private partnerships are created and maintained
4. Create a list of top 10 research questions, or research areas such as platforms, logistics, etc.
5. Look at military branches' strategic questions to see what they have committed to pursuing
6. Address non-disclosure, non-compete agreements as a way to promote sharing and collaboration while also protecting interests
7. Adapt to a fast ecosystem and make the pipeline efficient

Gaps

1. Industry-based needs statement
2. Develop a 3-way needs statement to support research partnerships, translated in a way that each party understands the others' needs
 - a. Perhaps hold a smaller, focused workshop with this as the deliverable goal
3. Collaboratively developed by universities, industries, government & funders
4. Invite university research vice presidents (VPs) and offices of sponsored program (OSPs) to a meeting about this
5. Need funders (NSF, DOD, etc.) to meet with us
6. NASA Langley seems as if it may have untapped potential in this area
7. Need to understand how the regulations on UMS (particularly UAVs) address or constrain the needs of university-based researchers.

Goals

1. Build partnerships that capitalize on expertise and resources
2. Streamline partnership development
3. Focus collaborative energy on important/needed research areas and increase funded UMS research
4. Be more agile in response in all ways—funding, partnership development, meeting needs of industry, etc.

Actions

1. Do a needs study to see how the challenges are stifling innovation
2. Take an inventory of research assets and infrastructure at universities and companies to promote partnerships or more broadly of general capabilities

- a. Have this information centralized and maintained (A ListServ, Database, Clearhouse – virginiarobotics.org, or other tool)
 - b. Assign someone in the research office at each university to update this information
 - c. Have a designated site contributor at each university or someone (from 4-VA?) who conducts site visits and posts photos and info
 - d. Tag things by “Topics” or research areas for searchability
3. Collect data about who is involved in grant-funded research to help identify funded areas & gaps
 4. Collaboratively generate a list of emergent/needed research areas with funders
 5. Capitalize on NSF call to integrate UAS in basic research
 6. Improve public/private partnerships by streamlining their creations

2. Industry Group

Successes

1. Educating Youth through Employment (EYE) Program
 - a. Fairfax County, QKE Corp., and George Mason University are coordinating with student interns who earn credit with professional experience.
 - b. Marketing and communication, professional networks, and mutual gain are all enabling factors.
2. The ability to build a quality product (large aerial vehicles)
3. Industry/Higher Ed/Economic development agency collaboration in southwest Virginia
 - a. Virginia Tech is a key partner
 - b. The group works through the western Virginia chapter of AUVI(?)
4. Drone tourism – racing events
 - a. Allegheny County, city/county, Homestead, Greenbrier, community college
 - b. Underground mine for flying drones
 - c. Young, passionate pilots
5. Generating friendly state laws and policy and allowing flexibility for industry and users
 - a. The state commission is a partner and enabling factor
 - b. Industry/legislator relationships are key
6. There has been success inserting industry needs into higher education curriculum, especially the need to educate students about business skills, i.e. human resources management, business planning, etc.
 - a. The example given takes place in Kansas and Ohio at both 2-year and 4-year universities
 - b. High levels of focus and specificity in academic programs are enabling factors . . . industry knows which university specializes in which aspect of remote technologies

Challenges

1. Potential customers not realizing that they are potential customers, i.e. emergency management personnel, farmers, etc. (received a lot of acclamation)
2. Restrictions on large UAVs in airspace
3. Insufficient workforce
4. Attracting partners to southwest Virginia

5. Venture capital
6. Linking young, independent pilots to private sector/industries
7. Insufficient industry voice in regulation development
8. Lack of state-level incentives and programs
9. Insufficient state budget allocation
10. Training engineers and makers in business management (note that this is also a success)
11. The current Virginia focus is too broad and trying to capture *all* forms of unmanned systems
12. A lack of market clarity for small business entrepreneurs
13. Bureaucracy and politics slowing and halting government support
14. Industry not fully leveraging state dollars to access other capital sources
15. Drone use not seen as 'visual data' in certain situations, putting drone data outside existing rules and regulations allowing/requiring visual data
16. Lack of general acceptance of UAVs from the general public due to privacy, morality opposition
17. Entrepreneurs do not know what resources are available
18. There are limited state resources and other state government constraints
19. 'I am government and I am here to help' is not a good partnership model because it suggests that government knows what is needed
20. Tension regarding government loans vs. grants – private sector wants grants, not loans but governments can't/won't create grants due to political pressures to not give away tax dollars
21. Supply chain education lacks . . . industry and entrepreneurs need to better understand insurance, legal/liability issues
 - a. Legal and liability must be seen from a multi-stakeholder perspective, i.e. industry vs. user vs. citizen, etc.
22. Insufficient leveraging of drone technology to address what is already happening

Vision

1. Higher education/industry integration
 - a. University by university focus on specific aspects of UAV → specialists, not generalists
 - b. Geospatial hub (in Wise County) that marries geospatial and UAV work
 - i. A four-week track for current employees
 - ii. A 12-week track for current college students
 - c. Co-op programming
 - d. Better integration of higher education/industry along three paths
 - i. Traditional electrical engineering program at four-year schools
 - ii. Two-year degree path
 - iii. Employ high school students who then go to school
2. Marketing/education
 - a. UAV/UAS public acceptance/educational programming
 - b. State-level marketing plan
3. Statewide 'voice' and resource hub
 - a. A larger, common 'voice' for UAV industry in the state
 - b. Take advantage of GOVA programming

- c. A statewide association to establish an information hub for entrepreneurship resources
 - i. Perhaps use the existing Maker Shed program?
- d. Local/regional collaborations for incubation and development
- e. Advocacy on behalf of industry to education the public, the government, etc.
- 4. Money
 - a. Funding opportunities for start-ups
- 5. Other
 - a. Virginia becoming a large-drone gateway site for the National Airspace System (NAS)

Gaps

1. Bridging college graduates to industry employment
2. Efficient-to-access sources of funding
3. Linking public and private loans together
4. Bridging producers and users of cheap, light UAS and big industrial UAS with something that is in the middle . . . consumers need products that are not too cheap or too large/complex

Actions

1. Sponsor workshops on legal issues from multi-stakeholder perspectives that include providers, users, citizens/public
2. Form working groups to establish acceptable UAV **use** in Virginia
3. Collaborate with broad stakeholders at public events
4. Market acceptance to 12 to 20-somethings to build markets, build acceptance
5. Form working groups to establish acceptable UAV use guidelines for Virginia
6. Collaborate in Wise County – **Jeff Harlam and Tim Tingler will take lead**
7. Leverage Virginia's resources with NASA/Langley to create NAS gateway
8. Collect, communicate stateside highlights to state and public stakeholders
9. Continue commission's website
10. Funding information sheet/webinar/workshop for start-ups, small, and expanding businesses

3. Curriculum Group

Successes

1. JMU-Nova Labs collaborative drone class
 - a. Generating enthusiasm about unmanned systems
 - b. Infrastructure that allows faculty collaboration
 - c. Collaboration includes students across seven different departments: biology, education, engineering, industrial design, information technology, physics, writing
 - d. Enabling factors – 4-VA, telepresence, JMU X-Labs space, directorship, equipment, mentors, and the ability to fail
2. Piedmont Virginia Community College (PVCC) UAS class
 - a. Identifying efficiencies
 - b. Collaboration includes UAS Public Safety, Search and Rescue, the sheriff's department, King Family Vineyards, Virginia Department of Emergency Management (VDEM)
 - c. Enabling factors – Class formed according to needs, space to fly (vineyard), real world scenarios provided, drone fleet
3. Geographic information systems (GIS) online course
 - a. Service learning
 - b. First automated flight in NASA airspace
 - c. Collaboration includes Thomas Nelson, NASA, NSF
 - d. Enabling factors – NASA airspace, funding, NSF grant, faculty engagement, real customer, public/private partnership
4. Changing perception of drones
 - a. Social media promotion
 - b. Public presentation
 - c. Collaboration includes 4-VA, JMU and Nova Labs
 - d. Enabling factors – social media platforms
5. Students engaging real customers/clients
 - a. Collaboration includes 4-VA, Nova Labs, EPA, industry partners
 - b. Enabling factors – open-ended structure, letting students fail
6. JMU interdisciplinary robotics minor
 - a. Collaboration includes multiple JMU departments
 - b. Enabling factors – faculty interest, open-ended structure, admin support, minor allows broad approach
7. JMU X-Labs
 - a. Collaboration includes 4-VA and JMU
 - b. Enabling factors – flexible space, ability to fail, funding
8. Workshop with high school teachers
 - a. Collaboration includes participating high schools
 - b. Enabling factors – affordable drones, interest among youth

Challenges

1. Resources for universities
2. Faculty rewards
3. Faculty buy-in, convincing faculty this is truly the next big thing
4. Perception/image re: drones
5. Incentives for industry
6. No existing model for curriculum, developing material from scratch
7. Demand for jobs not matching curriculum
8. Legal concerns, public safety
9. Location, flying on campus
10. Funding
11. Lack of knowledge among the public re: existing drone regulations
12. Training/educating the public
13. Public perception
14. Competing agendas
15. Silo-ed excellence
16. Giving students truly marketable skills...this means they need UAS experience, but they also need to be trained in another field, because UASs are rarely used for their own sake. Also, students need to be trained in best practices like pre-flight checklists, so they are prepared to take on real-world tasks with real-world consequences.
17. UAS taught as tools for other fields vs. UAS studied for their own sake. Need to distinguish between these two approaches, and find appropriate place for each

Vision

1. Diverse UAS community
2. Jobs available to students upon graduation
3. R&D in drone utilization beyond visual line of sight

Gaps

1. Workforce Development
 - a. Need to evaluate whether a 4-year degree, a 2-year associates degree, or vocational training is the best fit for UAS workforce needs
2. Better Communication and Awareness to Prevent Missed Opportunities
 - a. Need a central information repository that is easy to access...maybe a Slack channel?
 - b. Needs to be something accessible to both academics and practitioners (maybe a reason not to use Slack)
 - c. Needs to accommodate people communicating in real-time as well as those who want to check in periodically for a summary or update
3. Funding
 - a. 4-VA is great for funding for those who are a part of it. What about those who don't have access to this kind of program?
4. Lack of Diversity
 - a. Clarify how UAS education leads to careers
 - b. Need a commitment from the community to diversify and intentional strategies to do so

- c. Start small – Identify and interview people in UAS field who are in a minority group, to find out what drew them to the field and how we can reach out to more people in their community
 - d. Develop marketing that is targeted to specific groups
- 5. Job Creation / Identifying workforce opportunities / Matching curriculum to industry needs
 - a. Think about retraining incumbent workforce and creating multiple pathways to UAS careers
 - b. This might be more of a communication/coordination issue than a lack of jobs. You hear from employers that they can't find people to hire, but you also hear from students that they can't find jobs. This could be a problem of training people in the right skills, or it could imply the need for some kind of portal to connect potential hires to employers. Or both?
 - c. Need to demonstrate the usefulness of UAS tech for business
 - d. Need to develop the infrastructure to connect education with industry
- 6. Curriculum Building
 - a. How do we inform curricula? How do we predict workforce needs?
 - b. Developing a Curriculum (DACUM)?
 - c. Need to produce students with real-world applicable UAS skills. Can't be learning in a vacuum.
 - d. Integrate UMS education into other fields/majors/departments
 - e. Focus on specific UAS applications and projects
 - f. Create classes where students can come together from different fields to apply UMS technology to diverse and specific real-world problems
 - g. Integrate UAS into general education? Should it be a certification? A minor?
- 7. Connecting Diverse Resources via Technology
 - a. Create a larger pool of resources for UAS educators to draw from
 - b. Programs like 4-VA are a great solution for this
 - c. Could create an asset inventory, as mentioned in the lunch brainstorm
- 8. Dedicated Places to Fly
 - a. See Virginia Tech as a model
 - b. Regional airports?
 - c. Private partners (e.g. PVCC partnered with vineyard)?
 - d. Necessary infrastructure includes: power, cover, A/C, etc. Some people have used trailers as command bases

Goals

1. Try to better understand short-term workforce demands, e.g., via a statewide survey.
2. Create a communication channel to continue this work. Could be via Slack or maybe an industry council? Needs to be organized to serve diverse interests/needs, e.g. education vs. industry, and regular participants vs. people who check in intermittently
3. Create avenues for students to plug into UAS outside of/after class, e.g., an inter-university competition

4. Policy and Ethics Group

Success	Who/Where	Enabling Factors
Sent in 333 exemption	JMU	
Multidisciplinary course	JMU	
Developing industry guidelines	International Association of Chiefs of Police (IACP)	
333 Exemption/Part 107/Directive for student use	Federal government	Respectfulness
Voluntary guidelines	Federal government, Academy of Model Aeronautics (AMA)	Data driven discussions
Pace at which 333 is moving	AMA, FAA	Incentives Collaboration with industry
Before you fly application	FAA	Application of tech to effect pace
Online registration processes	FAA, industry participation	
UAV testing range in Virginia	Mid-Atlantic Aviation Partnership (MAAP)	Government recognition, Commercial funding
Companies with defined UAV needs	Various companies	Enabled by FAA policies

Challenges

1. Integration of civilian UAS into national airspace
 - a. Pilot interaction with remotely piloted and fully autonomous systems
2. Negative public perception and public use
3. A low barrier to entry (How can you enforce regulation when anyone can go out and buy/fly?)
4. The pace technology is changing (How can policy keep up with the changes?)
5. Public education
6. Hesitancy of the public to accept regulations and a lack of respect
7. Lack of technical standards
8. Fame culture (the desire of younger people to use UAS to fly in places and ways that they shouldn't in order to create viral videos) and adversarial culture (older pilots unwilling to accept the new technology sharing the airspace with them)
9. Fear of autonomous systems
10. Discussion of state and municipal regulations is lacking
11. Defining the next integration steps in industry
12. Privacy and personal responsibility
 - a. Responsibilities of an operator who views illegal activity
 - b. Professional advisory regulations
 - c. Interplay between privacy vs. "spying" in regards to privacy rights
 - a. Navigating privacy preferences
13. Educating the public on UAVs
14. Differentiating between UAV technology and robotics

- a. Making the clear distinction between the two where appropriate
- 15. UAV legislation and privacy and personal responsibility
- 16. Guidance for good Samaritan laws in UAV use
- 17. Gray area in inter-regulatory regulations
- 18. UAV public education

Vision

- 1. Discussion of state vs. local government regulations (as opposed to federal)
- 2. State government providing an avenue for input into policy
- 3. *Local* input
- 4. Consistent method of enforcement (by the police)
- 5. Industry help in enforcement of regulation
- 6. Virginia looking at limitation of tort liability
- 7. Establish a business-friendly reputation in Virginia

Gaps

- 1. Continued discussion between regulators and operators
- 2. Defining UAV ethics
 - a. In particular at the state and university levels
 - b. Whoever provides UAV training should include information on ethics as well
- 3. Town hall meetings with localized recommendations
 - a. Particularly important for high density areas
 - b. Local areas can create informative websites
- 4. Industry and academia assisting in developing UAV resources and regulations
 - a. Feds are stretched thin in regards to UAV resources and developing these resources, industry and academia can help by developing some of these, advancing the field themselves
- 5. Legislative agenda formation and sponsors recruitment
 - a. A formal legislative agenda on UAV needs to be made, and sponsors recruited
- 6. Leverage local resources
- 7. "Legislature Education Day"
 - a. Dedicated efforts to engage and educate lawmakers