Maryland
DEPARTMENT OF COMMERCE

UAS AND MARYLAND: OPPORTUNITY AND ACCOUNTABILITY

A REPORT CONNECTED TO THE UNMANNED AIRCRAFT SYSTEMS RESEARCH, DEVELOPMENT, REGULATION AND PRIVACY ACT OF 2015.

AS REQUIRED BY:

MARYLAND GENERAL ASSEMBLY CH 164, Acts of 2015

Submitted by:
Maryland Department of Commerce

Contents

1. Introduction

The Unmanned Aircraft Systems Research, Development, Regulation and Privacy Act of 2015 was enacted by the Maryland General Assembly (CH 164, Acts of 2015) and signed into law by Governor Hogan. The Act requires the preparation of a report by the Department of Commerce to be submitted to the Maryland General Assembly by December 31, 2015. The report's focus is on unmanned aircraft systems (UAS).

Findings and recommendations are to include:

- The benefits of UAS activities in Maryland
- The identification of policies pertaining to safety and privacy
- The identification of policies for specific industries
- Qualification guidelines for companies to follow when applying to the Federal Aviation Administration (FAA) for commercial exemptions (Section 333).

The report and the ability of various constituencies to comment on the growth of the Unmanned Aircraft Systems industry will enable the State of Maryland to support, manage and guide this emerging technology.

High-level summary of report content:

a. The continuing development of Unmanned Aircraft Systems (UAS) is part of a much larger "smart machine" evolution across the globe, which will bring both enormous benefit and disruption to economies. Until recently, UAS applications were solidly in the military and federal government realm. Maryland can be a leading player in commercial UAS.

b. UAS presents a plethora of positive applications in the civil and commercial worlds, offering dramatic safety, accuracy and efficiency gains. While the market is currently relatively small, it is projected to significantly grow and mature within the next decade. UAS is also connected to more general "unmanned" advances in ground vehicle and maritime/underwater technologies.

c. UAS expansion is tempered by regulatory challenges. The Federal Aviation Administration (FAA) is working with industry and the public to create a new regulatory framework for small UAS, slated to be finalized in 2016. There are distinctions between recreational drone operators and commercial ones, which are reflected in pending work on creating a regulatory framework. Lessons can be learned from other countries that are further along, both in terms of commercial drone use and regulatory development.

d. Until regulations are finalized, commercial small UAS operations can seek FAA approval to operate under a special exemption process, known as Section 333. Since mid-2014, the FAA

has generated over 2500 approvals, with the pace of reviews accelerating in the past six months.

e. Maryland and the mid-Atlantic region have a significant opportunity to capture new employment and capital investment from UAS as the commercial market grows. Maryland has a concentration of commercial and federal assets that have UAS expertise, with a history of designing and manufacturing larger UAS for military markets.

f. The tri-state Mid-Atlantic Aviation Partnership (MAAP) represents one of six FAA-designated national test sites working with the FAA on developing commercial UAS regulations. Maryland, Virginia and New Jersey are cooperating through MAAP, though each state manages its own activity. As part of the partnership, the University of Maryland's test site activities are an important step forward in expanding the industry in Maryland, the broader region and the nation.

g. Privacy and safety risks must and will be addressed as UAS use spreads. Progress will be the result of a blend of technological advancements, an improved regulatory and legal framework, best practices embraced as there is more experience logged, and consistent compliance and enforcement of laws and regulations.

h. Maryland's State and local governments should focus on identifying and implementing best practices in any UAS use by public entities (emergency response, research, police), protecting manned flight activity near public-use airports, supporting enforcement of existing regulations and laws, and providing information to the FAA to assist in creating a clear and risk-adjusted regulatory system for UAS.

i. Maryland can also support the State's emerging and existing UAS companies through a variety of mechanisms, including the provision of the State R&D tax credit, an angel investment tax credit, accelerator and incubator support, and assistance with broad-based research and the current exemption process for FAA approvals through the use of the Mid-Atlantic Aviation Partnership (MAAP).

2. Drones, UAV and UAS: what are they?

The three terms each refer to unmanned aircraft. Unmanned Aerial Vehicles (UAV) references the aircraft itself, while the Unmanned Aircraft Systems (UAS) term includes all of the different components: aircraft, software, camera, controller, and scanners and sensors. Drones are generally used interchangeably with both UAS and UAV, though the term is often used to describe military drones, which cannot be flown without highly trained operators.

For purposes of this report, we will generally use the term unmanned aircraft systems, or UAS, though UAV and drones will also be used where more appropriate. The term "sUAS" refers to small

UAS (under 55 lbs). Small UAS can either be recreational or commercial. Larger UAS have commercial or military applications.

Unmanned aircraft systems are a type of "smart machine" or robot. Gartner, a global technology research and advisory firm, groups commercial UAS along with other technologies such as speech recognition, virtual and augmented reality, consumer smart appliances and virtual personal assistants. Each of these technologies will follow its own path and timing to reach maturity in the marketplace. Taken together, these emerging technologies will go well beyond automation, and will transform work processes and businesses.[1] Over time, UAS will develop more advanced levels of collaboration and autonomy, working in groups, for example, to complete tasks. Full acceptance and adaption to smart machines is a longer-term prospect, and will bring both enormous benefits and disruption. Smart machines are creating new opportunities and jobs and they will change the nature of some traditional occupations.

The industry includes a wide range of players and suppliers: semi-conductor components, various software designers, big data analytics, cameras and specialized manufacturers of components such as LIDAR devices (light detection and ranging, which uses pulses of laser to map while in the air), cybersecurity features, manufacture of the hardware, and UAS services. This last element will likely see significant growth as commercial applications enter the mainstream. It will not make sense for every farmer, film crew and researcher to invest in and maintain their own drones. Service companies will increasingly step in to act as intermediaries and handle the regulatory demands, provide skilled pilots and manage data being collected.

3. Projected size and characteristics of UAS market

The UAS market of the recent past has been almost entirely driven by military demand, and accordingly one of the key drivers has been federal defense funding. Revenue for UAV manufacturing in 2015 is estimated at $3.3B, and three global manufacturers dominate: Northrup Grumman (NGC), General Atomics Aeronautical Systems, and Textron. [2] This competitor landscape is shifting as the regulatory framework for the non-military industry is being built and as the recreational market explodes. Market size projections for small UAS (which would include consumer and commercial applications) range from $80B by 2025 (AUVSI, the industry association) to lower estimates by various market analyst firms. [3] The forecast variation is understandable, given the nascent status of the industry. (By way of comparison, consensus estimates for the cybersecurity market are $75B in 2015, growing up to $170B in 2020).

Whether at the low or high end of forecasts, the industry's emergence will generate tangible economic opportunities. AUVSI's 2013 economic impact report projected that the integration of UAS into the national air space will total more than $13.6 billion in the first three years of integration, and create more than 34,000 manufacturing jobs and 70,000 new jobs. The jobs will pay well

[1] Kenneth F. Brant and Tom Austin, "Hype Cycle for Smart Machines", *Gartner.com*, July 24, 2015, page 2.
[2] Ibis World US, "Unmanned Aerial Vehicle (UAV) Manufacturing," *IbisWorld.com*, April 2015.
[3] http://droneanalyst.com/2015/06/04/diversity-and-hype-in-commercial-drone-market-forecasts/

($+40,000) and require technical degrees or training in manufacturing, maintenance and operations.[4]

Defense contractors, having invested heavily in military UAVs, are keenly interested in finding a place in the commercial market. Similarly, early stage companies are staking out their place as demand grows. Tech heavyweights like Amazon and Google are investing as well, regarding UAS as a necessary part of their overall competitive advantage.

Unmanned aircraft are part of a larger, growing "autonomous" industry, including vehicles (e.g., self-driving cars, trucks) and maritime, underwater vessels. The mid-Atlantic region brings technology, federal, port and transportation assets that can be tapped to capture a percentage of this larger market.

Selected UAV Manufacturers and Service Providers

Company	Description
DJI	Leading global small drone manufacturer, China; Phantom drone is best known; Tao (Frank) Wang founded in 2006[5]
3D Robotics	Designs and manufactures recreational and commercial drones; CA-based, leadership includes former DJI management[6]. New product: Solo.
Textron Systems/AAI	Makes aerospace and defense systems, including larger UAS; subsidiary of Textron Inc.; traditional client base has been US and foreign governments. Multiple locations including MD.
Parrot	French company Parrott designs and markets products for wireless devices, has developed series of drones, primarily for recreational operators.
Google Titan Aerospace	Designs, produces larger solar powered UAS ("atmospheric satellite") at R&D facility in New Mexico; early stage company acquired by Google in 2014.
EnrGies	Veteran-owned, Huntsville AL-based. Support and design UAS services (in addition to other, defense-related ones). Company is supplying content and instructors for UAS flight school at Auburn University.
AeroVironment	CA-based military contractor (manufacture and support) moving into agricultural market, aerial surveys, search and rescue.

[4] *AUVSI.org*, "The Economic Impact of Unmanned Aircraft Systems Integration in the United States", http://www.auvsi.org/auvsiresources/economicreport

[5] http://www.forbes.com/sites/ryanmac/2015/05/06/dji-drones-frank-wang-china-billionaire/

[6] http://www.forbes.com/sites/ryanmac/2015/05/06/dji-drones-frank-wang-china-billionaire/

Sentera	Designer of drones, software and sensors. Early stage firm based in Minnesota; recent release of data management system.
Measure	Early stage "drones as service" company for commercial clients, HQ in Washington DC.
Skycatch	San Francisco-based firm provides drone services to range of commercial users (mining, construction), processes and analyzes gathered data.

Sources: *Hoovers, Wall Street Journal, New York Times, company websites*

4. Economic impact, and benefits to public and private sectors

"This current stage in UAV evolution might be compared with the earliest emergence of mobile phones... UAVs are essentially aerial robots that will become increasingly autonomous and collaborative. They will enable field workers to safely accomplish more than ever before, and they will carry sophisticated sensor payloads. As such, they will expand the Internet of Things (IoT)."[7]

AUVSI's 2013 report projected that UAS primary markets, civil and commercial, would be public safety and agriculture. [8] These two remain significant, while other applications are emerging (e.g., utilities, construction) that may prove as compelling. UAS public and commercial applications grow by the day, and as the regulatory environment matures over time, will drive the growth of the industry. The applications will bring dramatic safety, efficiency and knowledge benefits to government and private business. Examples of existing and anticipated applications are shown in the box below.

Selected Commercial and Civil UAS applications

Sector	Application	Benefit/Status
Law Enforcement	Search and rescue, crowd control, port security	Greater coverage with less risk to people; commonly used through FAA approval process for government entities (COA).

[7] Randy Rhodes, "Drones launch new opportunities for energy, utility, and oil and gas, *Gartner.com*, July 27, 2015, page 1.
[8] AUVSI, The Economic Impact of Unmanned Aircraft Systems Integration in the United States.

Disaster Recovery	Surveying earthquake and storm damage, first responders	Faster access to affected areas and people; FAA approvals largely given to government entities and not-for-profits; relevant for insurers.
Insurance	Pick up and deliver claims documentation post-natural disaster	Faster, safer reviews and delivery of claims. Not currently in use by insurance industry; will require FAA approval as commercial user.
Utilities	Inspection of electric transmission, nuclear, communications, wind and solar infrastructure	Safer, less expensive, more accurate. Utilities are among the industries expected to embrace UAS most quickly. Requires FAA exemption.
News and entertainment	Overhead filming; news gathering	Safer, less expensive, faster; popular application for current commercial FAA exemptions.
Agriculture	Crop monitoring; pest control and management	Component of precision agriculture, which uses technology to better manage crops; more accurate data tracking. Used extensively overseas; growing commercial application.
Oil and Gas	Land surveys, delivery of parts and tools to remote sites	Safer and faster than traditional labor-intensive exploration; oil and gas industry anticipated to be early UAS user.
Construction	Conduct field dimensions; automate construction process[9]	UAS collects and analyzes data more accurately and easily than conventional methods; early experimentation underway

[9] Komatsu, the construction equipment manufacturer, has partnered with San Francisco-based Skycatch Inc, an early stage drone data company. Komatsu is planning to use drones to gather and process data required to build foundations; the data is then used by unmanned bulldozers and other equipment on the ground. Jack Nicas, "Drones next job: Construction Work", *Wall Street Journal*, Jan 20, 2015; http://www.wsj.com/articles/drones-next-job-construction-work-1421769564.

Wildlife Preservation	Monitor and identify risks to endangered animals, plants	Access to remote areas better with UAS; less invasive and more accurate data gathering; in use by researchers.
Internet access	Google proposal; UAS would provide wireless internet access in remote areas	Pending review by FAA; Google testing through its Titan Aerospace acquisition (see company chart).

Sources: *AUVSI, FAA, Gartner, Wall Street Journal, Forbes*

The potential gains offered by the growing number of UAS applications are constrained by the complexity of the regulatory and legal environment (covered in sections 6 and 7). Maturation of the industry may take up to a decade.[10] States and regions that provide support and clear guidance will capture most of the UAS growth, in terms of jobs and capital investment.

5. Maryland landscape

Maryland is a member in the Mid-Atlantic Aviation Partnership (MAAP) with New Jersey and Virginia. The tri-state partnership represents one of six Federal Aviation Administration (FAA) UAS test sites in the nation. The sites work jointly with the FAA to advance research and testing, establish standards to integrate UAS into the national airspace, and provide industry airspace and services for product development and testing. AUVSI, which represents the UAV industry, maintains that the establishment of test sites is one of the key factors supporting conditions for the UAV industry to grow. The University of Maryland (UMD) is the lead Maryland institution in the effort. UMD, in turn, collaborates with the Naval Air Systems Command (NAVAIR), Maryland industries and the broader UAS environment. The State is also represented by the Department of Commerce on the MAAP board of directors.

Maryland is home to two of the nation's leading UAS locations: Webster Field Navy Annex and the Patuxent River Naval Air Station (NAS). Both provide testing and evaluation capabilities and access to available airspace for UAV. Patuxent and proximate facilities in southern Maryland are the center of the UMD UAS test site work described above. An 11,000 square foot hangar space, designated for UAS testing, is under construction at the St. Mary's County Regional Airport in southern Maryland.

The State's resources also include the Crisfield Airport on the lower Eastern Shore, and the Wallops Flight Facility, located on Virginia's Eastern Shore, just five miles from the Maryland border. Wallops has recently completed an UAV launch ramp. NASA predicts that UAV traffic could "increase up to ten-fold" once the airstrip is active. NASA's presence at Goddard Space Center and Wallops adds to the R&D and testing strengths in the state.

[10] Kenneth Brant and Tom Austin, "Hype Cycle for Smart Machines, 2015", *Gartner.com*.

Regional UAS Facilities

Wallops Flight Facility	Crisfield Municipal Airport	St. Mary's County Municipal Airport
High SME population	Centrally located to Restricted Airspace (R-4006)	Centrally located to Restricted Airspace (R-4007)
Successful record managing highly technical projects	50% of airport traffic area is located over water.	Located 8 miles from NHK Patuxent Naval Air Station.
Access to vast Special User Airspace	Ideal proximity to support NASA WFF and Navy Patuxent River.	Ideal proximity to support NASA WFF (with corridor) and Navy Patuxent River.
Extensive infrastructure and network	Minimal encroachment	Large number of UAS experts locally
Tier I, II and III UAS range experience	Runways are suitable for multi-level	Close working relationship with PAX

Maryland has an impressive base of aerospace and UAS companies, ranking fourth nationally in number of firms, following California, Florida and Virginia.[11] The broader Maryland/Virginia region combined represents an even stronger concentration. Many firms have been active in the defense UAS market since its inception, and are investing in developing commercial capabilities. Among the larger players are Lockheed and Northrup Grumman, which house complementary UAS functions in the State. Maryland also has a robust start-up environment in modeling, simulation and big data analytics, an integral piece of the unmanned systems world.

Finally, the presence of a very sizeable cybersecurity industry in the State is particularly complementary to the development of the region's UAS industry, as cybersecurity features must be embedded in the hardware and software.

[11] Gary Evans and Robert Rea, "Maryland Aerospace Program, Q4 Report", Axcel Innovation LLC, July 12, 2015, page 16.


Baltimore
Ohio
Canal
A. JAMES CLARK
SCHOOL OF ENGINEERING
Annapolis
DC
Delaware Bay
DELAWARE
Easton
Cambridge
Salisbury
Ocean City
St. Mary's
Airport
NAS Patuxent River
Potomac River
NAS Patuxent River
Webster Field Annex
Chesapeake Bay
Crisfield Airport
Pocomoke City
UAS
TEST SITE
Wallops Flight Facility
VIRGINIA
ATLANTIC OCEAN


St. Mary's
a UAS Technology
County

Selected Maryland UAS-related Companies

Company	Description
AAI	Textron division located in Hunt Valley; aerospace and defense systems, including UAS for military markets; commercial UAS development being pursued.
UAV Solutions	Privately held company; design, testing and manufacture of UAS for commercial and government clients.
Ausley Associates	Southern Maryland-based, Naval contractor providing UAS and fighter aircraft engineering management services, Ausley is developing commercial client capabilities.
UAS Safelight Inc.	Early stage company at UMBC research park, product development includes patent-pending high volume data management system to support long-range UAS operations.
Offshore Aviation Group	North American distributor for two UK firms, manufactures two FAA-approved UAVs for commercial use. Has developed FAA-approved curriculum for UAV pilots.
Proxy Technologies (formerly Proxy Aviation Services)	VA company with significant facilities in Gaithersburg, Maryland. Software and systems integrator, works with the U.S. government and commercial sector in advanced autonomous capabilities.
ASEC	Veteran-owned small business in Lexington, MD; specializes in development, test, acquisition, and delivery support for military and civilian aviation communities.
Neany	Headquartered in southern Maryland with locations in VA, AZ and FL. Supports government and private industry in areas including unmanned aerial systems, ground-based sensor integration, prototype fabrication, and UAS pilot training.
NAVMAR Applied Sciences Corporation	Headquartered in PA, significant facility at NAS Patuxent River. Provider of engineering and technical services to US Dept. of Defense. Expanded operations to include Unmanned Aircraft System (UAS) testing in Yuma, AZ, and UAS production facility in PA.
AVIAN LLC	Service-disabled, Veteran-owned small business in Lexington Park, MD providing Government Flight Representative (GFR) approved test pilots, air vehicle operators, mission payload operators, and engineering and maintenance support for the U.S. Navy's UAS Test Directorate. AVIAN is consulting for commercial companies and State Agencies.

6. Competitive landscape: Other countries and states

Japan, Australia, Canada and Europe are advancing more quickly than the US in the use of commercial UAS. Japan has long used drones to manage agricultural crops. As of early 2015, the European Union (EU) had 2495 approved UAS operators (UAVs up to 330 lbs). For comparison, there were 2342 in the rest of the world, with Japan claiming about 2000.[12] The EU, Canada and Japan have a more settled – or flexible – regulatory framework (including insurance requirements), which is supporting the industry. US airspace is more complex, has a large stakeholder community, and the regulatory environment is more fragmented.

AUVSI recently reported on the first 500 commercial exemptions granted by the FAA (more detail in next section). California had the most approved operators (70), followed by Texas (46) and Florida (40). Maryland had 9, and Virginia, 12 among the 500. California companies also manufactured the most UAV platforms among US producers.[13] (DJI, which is manufactured in China, leads the industry overall.) This places Maryland and Virginia in the top ten states for commercial UAS exemptions.

Among states with FAA test sites, North Dakota has significant activity. Northrup Grumman has opened an unmanned facility there (named Grand Sky), and it includes R&D, training and maintenance capabilities. The North Dakota Department of Commerce has also landed a NASA contract to assist in gathering responses to a pilot UAS traffic management system. The FAA has granted North Dakota a blanket certificate of authorization for test site operations, which covers more than half of the (admittedly sparsely populated) State. While the North Dakota site has been operational for over 7 years, Maryland and the MAAP partnership have garnered over 40% of flights and flight hours among the six test sites.

Maryland's neighbor Virginia released a report on the broader unmanned sector (aerial, self-driving vehicles, maritime) this year, and has launched an unmanned systems commission to advance the industry in Virginia. In addition to its FAA test site designation (along with MD and NJ, through Virginia Tech), the State has organized a cyber-unmanned systems consortium to make connections between the two industries. Virginia has also created an "automated corridors" program, which offers a streamlined process to use Virginia roads and test facilities for automated vehicle testing.

In 2015 the FAA awarded the UAS Center of Excellence (COE) to a Mississippi State-led team made up of twenty-two of the world's leading research institutions and more than a hundred leading industry/government partners, named the ASSURE team (Alliance for System Safety of UAS through Research Excellence). The COE program is how the FAA accomplishes and focuses research. As such, the UAS COE will be the conduit through which the majority of FAA-funded and guided research will be awarded. The UMD UAS Test Site, as a member of the MAAP, is one of the six test site partners for the UAS COE.

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[12] Greg McNeal, "European drone regulations are about to get smarter and more permissive", *Forbes.com*, http://www.forbes.com/sites/gregorymcneal/2015/03/23/european-drone-regulations-are-about-to-get-smarter-and-more-permissive/

[13] AUVSI, "Snapshot of the First 500 Commercial UAS Exemptions", 2015, http://auvsilink.org/advocacy/Section333.html.

7. FAA and Regulatory Environment

This section and the next will explore aspects of an evolving and complex regulatory environment.

The FAA is working on developing the regulatory framework for integrating small (defined by FAA as less than 55 lbs) and large UAS into the National Airspace System (NAS). The FAA was supposed to have finalized small UAS (sUAS) rules by the fall of 2015; that deadline has been extended until June 2016. It is expected that when these rules are complete, the sUAS commercial component of the industry will rapidly grow. The sUAS rule will provide limited commercial access but will not permit flight over people or Beyond Visual Line of Sight (BVLOS).

In the interim, the FAA has established rules and processes for different classes of UAS users. *Public* entities are authorized to operate UAVs under a Certificate of Authorization or Waiver, generally referred to as a COA. *Commercial* UAS applications are currently only allowed with an exemption from the FAA under Section 333 of the 2012 FAA Modernization and Reform Act. The commercial entity receives a COA and must possess an airworthiness certificate. The exemption is granted if the UAS is not deemed to pose a threat to the National Airspace system (NAS) or national and public security.

The *commercial 333 exemption* carries these requirements:

- Must operate outside controlled airspace
- Fly below 400 feet
- Within Visual Line of Sight (VLOS)
- UAS must be less than 55 lbs (unless authorized)
- Accompanied by crew of at least two (spotter and operator)
- Not to be flown over people.

Drone hobbyists follow separate FAA rules for Model Aircraft, which include:

- No allowance for commercial use; recreational only
- UAV must be less than 55 lbs (unless authorized)
- Cannot interfere with any other aircraft
- Operator must give notification if within 5 miles of an airport
- Within Visual Line of Sight (VLOS)
- Must be registered (as of December 21, 2015).

The FAA initially approved few 333 exemptions, which frustrated commercial applicants. In recent months the FAA streamlined its reviews and increased the pace of overall approvals. As of early October 2015, the FAA had approved over 1700 individual commercial UAS flights. This summer the FAA was approving about 50 new operations per week.[14] Real estate and general aerial photography were the dominant applications, followed by agriculture, construction and utility inspection. [15]

[14] AUVSI.org, "Snapshot of the first 500 Commercial UAS Exemptions, page 2.
[15] AUVSI.org, "Snapshot of the first 500 Commercial UAS Exemptions, page 4.

While the commercial exemptions to date have not posed threats to safety, hobbyist drone activity has grabbed more than its fair share of the UAS spotlight. Stories of encroachments on stadiums, power lines, firefighters and near misses at airports have populated the headlines. The FAA estimates that up to a million drones will be sold for the 2015 holiday season, compounding the need for training and compliance among recreational drone operators.

Legislative and regulatory initiatives are rapidly being developed, triggered by the rapid expansion of recreational drone flight. In October the federal Department of Transportation (DOT) announced the creation of an online national drone registry, and a few days later, added that it will require new drone owners to have visible identification on the UAV, analogous to the tail numbers on a conventional plane. The first phase of the registration system kicked off in late December (2015).[16] The short timeframe to launch a national effort is ambitious, and full and effective implementation may take time to mature. Registration for larger UAS (over 55 lbs.) and civil/commercial UAS continue to register via a more detailed paper submission to the FAA.[17]

US Senators Feinstein (CA) and Schumer (NY) have proposed a bill (named the Consumer Drone Safety Act) which, in addition to identification, would require UAS manufacturers to integrate "geofencing software" into recreational UAV production, which would automatically manage entry into restricted areas.[18]

There remain significant research and regulatory challenges before full UAS integration is achieved for both small and larger UAS. The FAA has named two committees to work on the standards for safe UAS integration. These committees are stakeholder-based, and must develop consensus standards for the industry. (Some of these are covered in the next section). The stakeholders include industry, government, airline pilots, general aviation pilots, aviation groups, and airline carriers. Once the standards are developed they are given to the FAA to inform the agency's rulemaking.

The first committee (ASTM Committee F38 – Unmanned Aircraft Systems) has been working on sUAS standards since 2003. It will refine its standards to meet the new sUAS rule 107 when released, and will also continue working on BVLOS, over people, night operations, and other areas not included in the rule. A second committee (RTCA Special Committee 203 Unmanned Aircraft Systems, replaced in 2013 by SC228) was established in 2006 to develop standards for full integration of UAS into the National Airspace System (NAS). Its successor SC228 is working on Detect and Avoid (DAA) and Command and Communications (C2) for transitioning of a UAS to and from Class A or special use airspace, traversing Class D, E and G airspace for larger UAS. One of the sub-committees includes representation by the MAAP Executive Director.

On the training and data front, the FAA has made available online a smartphone app (B4UFLY) that provides airspace and regulatory information to hobbyists, based on the location and route. [19]

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[16] Cyrus Farivar, http://arstechnica.com/tech-policy/2015/10/feds-suggest-drones-will-soon-need-identification-and-marking/ October 21, 2015

[17] "FAA UAS Registration", https://www.faa.gov/uas/registration

[18] *Dronelife.com*, http://dronelife.com/2015/10/14/schumer-urges-manufacturer-solutions-in-drone-safety-act/

[19] "B4ufly Smartphone App", *FAA*, https://www.faa.gov/uas/b4ufly/

States, to some degree, may also assess risks – and how to mitigate them – connected to manned flight operations and public safety. This subject is broached in the next two sections.

While measures such as these will significantly improve the management of safety risks, particularly in the hobbyist realm, commercial development of the UAS industry will be marked by advances in a number of areas. These are discussed in the next section.

8. Beyond a basic regulatory framework: managing safety and privacy risk

The anticipated FAA sUAS regulations (due by mid-2016) will pave the way for significant growth in the UAS industry. Technology companies, retailers, insurance companies and manufacturers are working with the FAA to help develop the drone registry (which will help manage hobbyist use) and establish policy and standards. There is a general consensus that UAS offers huge benefits – and poses risks. Managing the risks proactively, with the UAS industry, will go a long way in assuaging public concerns about its widespread use.

AUVSI maintains that the UAS industry needs a "risk-based regulatory framework" (what is being done where) rather than one based on what kind of platform is used (the focus of current guidelines). Certainly strategies should continue to distinguish between recreational use of drones and commercial development of the industry. Regulations will need to allow for beyond line-of-sight operations and use at night by commercial users. Pending new European regulations are designed along these lines, driven by risk levels and type of use. [20]

Safety and privacy concerns have multiple dimensions. Safety seems obvious: people can be injured or property damaged by an errant drone. That can happen on an individual or collective basis. Safety can also mean protection from data collected by UAS being accessed or misused.

FAA does not have statutory authority to regulate privacy matters. At the Federal level, privacy questions are being addressed by the National Telecommunications and Information Administration (NTIA), an advisory agency to the President. NTIA is working on the national question of privacy as it relates to UAS activity as well as other developing technological advancements that also raise privacy issues. NTIA is tasked with establishing protocols and legal standards of care in this legal and ethical area.

The NTIA has a weighty task. US privacy laws are fragmented and sometimes inconsistent, and at the same time, are enforced more strictly than peer nations. [21] The concept of privacy in US law has not been re-interpreted to account for major technological advances in the past decade. UAS use brings these broader legal issues (e.g., what constitutes trespassing?) into high relief, and are compelling courts, regulators and the public to better define privacy. [22] Gartner has presented the notion of an emerging "digital ethics" that will accompany the growth of new technologies, UAS

[20] "Civil Drones", *European Aviation Safety Agency*, https://easa.europa.eu/easa-and-you/civil-drones-rpas
[21] Carsten Casper, "Gartner Hype Cycle for Privacy", *Gartner.com*, July 24, 2015, page 26.
[22] M. Ryan Calo, "Drone as Policy Catalyst, Stanford Law Review, http://www.stanfordlawreview.org/online/drone-privacy-catalyst, 12/12/2011.

among them. These ethics must be "explicit, repeatable, and scalable".[23] Development of such ethical standards will need to be embedded in the practices of companies, individuals and the regulatory and legal framework.

The complete integration of UAS into national airspace, and the broader advance of "smart growth" technologies in many spheres of the economy, will need to have several elements working together:

- Operating experience garnered during this initial exemption period, and subsequent experience as commercial activity grows;
- Regulations that provide safety and allow for innovation at a cost that is not prohibitive;
- Evolution of law around privacy and trespassing, compliance and enforcement;
- Continuing technological innovations that improve safety and reliability;
- Education of the public on the benefits of UAS (beyond recreational use);
- Development of industry standards and insurance requirements relating to hardware, software and operator training.

Some of the specific areas in which there is continuing evolution and improvement are summarized below.

a. Airspace information and avoidance capabilities are a significant focus of innovation, R&D and regulation.

- Improving "sense and avoid" technologies that prevent collisions, now under development by both early stage and established companies.
- Investment in and development of new companies and products that offer accurate and reliable situational awareness (e.g., airspace/airport proximity, rapid change in weather, temporary flight restrictions).
- The FCC (and other Federal agencies) will sort out and better manage the growing demand for radio frequency bands that are required for the commercial UAS industry.

b. There is a consensus that industry standards in manufacturing, data collection and data storage need to be developed.

- Design and acceptance of common industry standards for hardware and software specifications in manufacture, including ability to land UAS in event of program errors or low battery status.[24]
- Development and acceptance of standards for collecting and storing data, including formatting, uploading and location of files – within an enterprise and across users.[25]

c. Cybersecurity features are being integrated into UAS, and need to be included in evolving industry standards.

- Protecting transmission of data; securing access only to authorized users

[23] Carsten Casper, "Gartner Hype Cycle for Privacy", page 5.
[24] Randall Ishikawa, "How drones are going to transform the insurance industry", *PropertyCasualty360.com*, April 8, 2015, http://www.propertycasualty360.com/2015/04/08/heres-how-drones-are-going-to-transform-the-insura
[25] Randall Ishikawa, "How drones are going to transform the insurance industry".

- Preventing flight path from being diverted; providing secure remote "kill switch" ability.[26]

d. Training of individuals operating commercial UAS, and accessible training and guidance for hobbyists.

- Designing and widely offering training for operators
- Providing testing (potentially certification) and update requirements for operators.[27]

e. Maintenance standards for commercial UAS will be identified and accepted in the industry.

- Technical and mechanical standards to observe during the service life of a drone, particularly those that are safety related.
- Processes for documenting and sharing maintenance information for accident or malfunction investigations.

f. Liability and insurance products are being introduced into the marketplace and will continue to improve as there is more experience in the industry.

- Development of UAS insurance products that provide coverage for liability, personal injury, invasion of privacy, and property and workers' compensation. These are likely to exceed FAA requirements and drive the need for more formalized certification and training. [28] Canada and the European Union are introducing coverage requirements for certain uses and sizes.[29]

g. Compliance and enforcement at the Federal, State and local levels will be better coordinated and clarified.

- The FAA retains the final authority to enforce civil penalties on UAS operators flying recklessly. Federal preemption grants authority of enforcement of UAS activity in the NAS to the agency. Nonetheless, cooperation with local authorities is increasing. The FAA has issued guidance to local law enforcement authorities as a first step toward coordinated enforcement. 0[30] There will necessarily be greater clarity around the legal definitions of privacy and trespassing, improving the prospects for effective compliance. (The UK recently completed its first conviction for illegal UAS operation; the individual was fined and cannot operate or own a drone for two years.[31])
- Significant fines or criminal charges explicitly designed and enforced for hacking in to a drone or its systems.

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[26] Dr. Christopher Pierson, J.D. and James Shreve, J.D., "Drones: All Abuzz with Privacy and Security Issues" (presentation at annual RSA conference, San Francisco, CA, April 20-24, 2015).
[27] Randall Ishikawa, "How drones are going to transform the insurance industry".
[28] Vikki Stone, "Rise of the drones", *Risk and Insurance.com*, March 2014, http://www.riskandinsurance.com/rise-drones/.
[29] Clay Dillow, "Here's why drone insurance may be the industry's downfall", *Fortune.com*, http://fortune.com/2015/09/17/drone-insurance/.
[30] https://www.faa.gov/uas/regulations_policies/media/FAA_UAS-PO_LEA_Guidance.pdf
[31] Arstechnica.com, Sebastian Anthony, "UK hands down first ever conviction for illegal drone flying", 9/16/2015.

9. State policies regarding UAS use

Direct public sector use of UAS in the State is focused on local government, police and search and rescue, agriculture, and education and research. The authorization for public sector UAS activity is done through the FAA Certificate of Authority (COA). *State and local governments can advance the UAS industry by establishing "best practices" standards within their own organizations.* Many of these are generally identified in the previous section, though State and local entities may not be able to control or influence each factor affecting UAS risks – at least not on a national level. There is growing guidance, however, in the government "best practice" realm.

The National Association of State Chief Information Officers (NASCIO) recently released a report on UAS and how State governments should handle their use. The report recommendations[32] include:

- Standardizing how data is collected and stored (e.g., video, photography) across different State and local agencies. The report proposes reaching out to other States and collaborating on shared protocols relating to data storage. Much of the data collected will be considered in the public domain.

- States should establish policy as to how to identify UAS activity that may collect evidence of criminal activity, and obtain warrants under specific conditions. The International Association of Chiefs of Police (IACP) proposes that UAS be painted a visible color, so as to minimize the potential for public interpretation as eavesdropping or invasion of privacy.

- Requiring training for operators of UAS used by and for public sector UAS.

- The IACP recommends discouraging or prohibiting the inclusion of any weapons on public sector UAS.

- State and local entities should be on the front lines of securing UAS from cybersecurity risk, integrating features that protect data and flight control frequencies.

  The NASCIO report *also urges that States create some form of governance structure to guide UAS activity in the public sector sphere*[33]. This could be a working group that provides coordination between state agencies (and ideally between States or local/State), and provide comments on potential legislation affecting UAS. In Maryland, this could include the Department of Information Technology (DoIT), the University of Maryland, the Maryland Aviation Administration (MAA, under the Maryland Department of Transportation), the Attorney General, and the Maryland Emergency Management Agency (MEMA). Focused

[32] Amy Hill Glasscock, NASCIO, "Unmanned Aerial Systems, Governance and State CIOs: On the Radar", http://www.nascio.org/Publications/ArtMID/485/ArticleID/78/Unmanned-Aerial-Systems-Governance-and-State-CIOs-On-the-Radar.

[33] Clay Dillow, "Here's why drone insurance may be the industry's downfall".

analyses of specific commercial UAS applications, such as agricultural, would involve additional agencies and organizations (e.g., MD Department of Agriculture).

The federal government has regulatory authority (FAA), and States do not have the authority to enforce laws that conflict with FAA standards. Establishing additional regulations that do not conflict are possible, such as rules for UAS near public property, or prohibition of launching or landing drones in specific jurisdictions. Such overlays of local or State prohibitions, however, add to the inconsistent and fragmented system now in place, and increase the complexity (and paradoxically, the risk) of UAS commercial operations. The current lack of legal consensus around how to define trespass below 400 feet complicates compliance with and ultimate enforcement of the more stringent local laws. [34] For these reasons, local ordinances restricting or prohibiting UAS should be discouraged.

If a State UAS governance structure is put in place, its scope could be expanded to include tracking of and input into federal work such as the national drone registry and the expected FAA UAS regulations. This collaboration is already in place through the University of Maryland partnership (MAAP), and could be expanded to include a broader Maryland constituency. Assisting the FAA in compliance and enforcement of recreational drone use violations (by providing data and information to the FAA) is another possible area of engagement at the State level, as well as following developments in insurance coverage of UAS.

10. How Maryland can support the emerging UAS industry

Education and training

- Provide clear legal and regulatory guidance regarding *recreational* UAS use in the State, helping to disseminate FAA rules to hobbyist drone operators. Managing recreational use will help public opinion develop interest and knowledge in aviation, and support the commercial efforts underway. This is a rapidly changing area (given evolving case law, compliance and regulatory efforts at all levels of government in the US), and will require consistent tracking and analysis. The most suitable State entity (or entities) to manage this role would need to be determined.
- Provide relevant guidance to *commercial* UAS operators, adjusted according to the specific applications (construction, agriculture, utilities). This may include collection of data on early commercial use and identification of potential risks and ways to manage them. Relevant State players (e.g., MAAP, Department of Commerce, MD Emergency Management Agency) should monitor ongoing regulatory efforts in other states and at the Federal level, as well as the European Union, via EASA, the EU's aviation regulatory body. EASA's risk-based approach bears watching.
- Develop broad educational efforts engaging the general public regarding Federal regulatory requirements and operator training opportunities. These should be linked to existing tools developed by the FAA and industry, and make explicit the distinction between recreational and commercial use regulations.

[34] Gregory S. McNeal, JD/PhD, http://gsmcneal.com/californias-drone-trespass-bill-goes-too-far/#more-1911

- Educate the public on successful Maryland pilot projects in agriculture or other key industries using UAS and continue to show public benefit uses of UAS. The MAAP, University of Maryland and the Department of Commerce are logical sources of information in these early days of commercial UAS activity.

Testing and R&D

- Expand avenues for providing information and data to Federal regulatory entities, specifically FAA, NASA and FCC, specifically through the MAAP, the University of Maryland, and key State agencies involved in managing or directly using UAS. Experience and recommended strategies to manage UAS use in specific applications (e.g., search and rescue, agriculture) should be one focus on the data gathering and communication.
- Create a coordinating body at the State level to encourage, pursue and coordinate "best practices" in UAS operations within the State, and propose legislation or regulations pertaining to UAS as they become necessary (see previous section).
- Market the MAAP and University of Maryland test site capabilities to a national audience.

Expand the commercial UAS business footprint in Maryland

The growth opportunity for Maryland companies – and the State – is significant. There is already a cluster of UAS-related firms in the State, many with experience in large UAS and DOD markets now eyeing commercial opportunities. Start-ups are also part of this environment. Some of these companies are working with MAAP and the University of Maryland test site staff to meet their missions and expand their UAS capabilities.

Companies in Maryland – early stage and more established - face the same headwinds that many UAS companies elsewhere in the US do[35]:

- Competition from abroad, where non-military drone use is more common and commercial revenue is easier to generate;
- Risk of not receiving an FAA section 333 exemption, while competitors may have;
- Competing against huge investments being made by the "giants" in the space, which include Google and Amazon.

The MAAP, Department of Commerce, TEDCO, University of Maryland and other economic development-oriented organizations can encourage the industry's growth by:

- Underwriting some of the cost of testing for smaller firms, and continuing to provide assistance in securing exemptions (Section 333) for commercial firms through MAAP and the Maryland test site.
- Expanding support for trade show representation by organizations and companies at UAS related conferences
- Support promising UAS firms by matching with venture capital investors and providing access to capital opportunities.

[35] Kenneth Brant, "Cool Vendors in Smart Machines, 2015", *Gartner.com,* April 10, 2105.

- Offering export assistance to Maryland firms selling overseas, and initiating a focused foreign direct investment effort to attract European, Asian or Australian UAS firms to the US.
- Attracting promising and more established UAS firms from other regions in the country to Maryland, and continually scouting for and vetting early stage companies with technology complementary to the UAS industry.
- Organizing a UAS/cybersecurity forum, given the presence of these two sectors in Maryland.
- Intensifying efforts to successfully introduce UAS technologies now residing in Maryland-based Federal labs and agencies into the commercial marketplace.