Memorandum

Re: Draft Emerging Issues Paper
Unmanned Aircraft Systems (UAS)

I. Introduction

A. UAS Integration Review

The rise of Unmanned Aircraft Systems (UAS) integration into the National Airspace System (NAS) has become one of the most impactful events on the history of aviation. Just as the Grand Canyon crash in June 1956 led to the creation of the Federal Aviation Administration (FAA) for regulation and safety of air traffic operations nationwide, the emergence of UAS for routine commercial and civilian operations is forcing many stakeholders to reevaluate the entire aviation network. Both traditional aviation and non-aviation industry players are developing technologies, services, and product packages that offer new capabilities related to UAS operations in the NAS. Legislatures, regulation authorities, and standards organizations globally are evaluating strategies or implementing new structures and laws for managing the integration of UAS to protect the safety and integrity of civilian airspace, while also protecting the privacy rights of citizens. Education and certification requirements to meet evolving standards and regulations are as dynamic as the emerging UAS-based applications markets. There are many initiatives globally and nationally that are influencing the proliferation of UAS including standards development, research programs, advocacy efforts, and information programs.

1. Industry

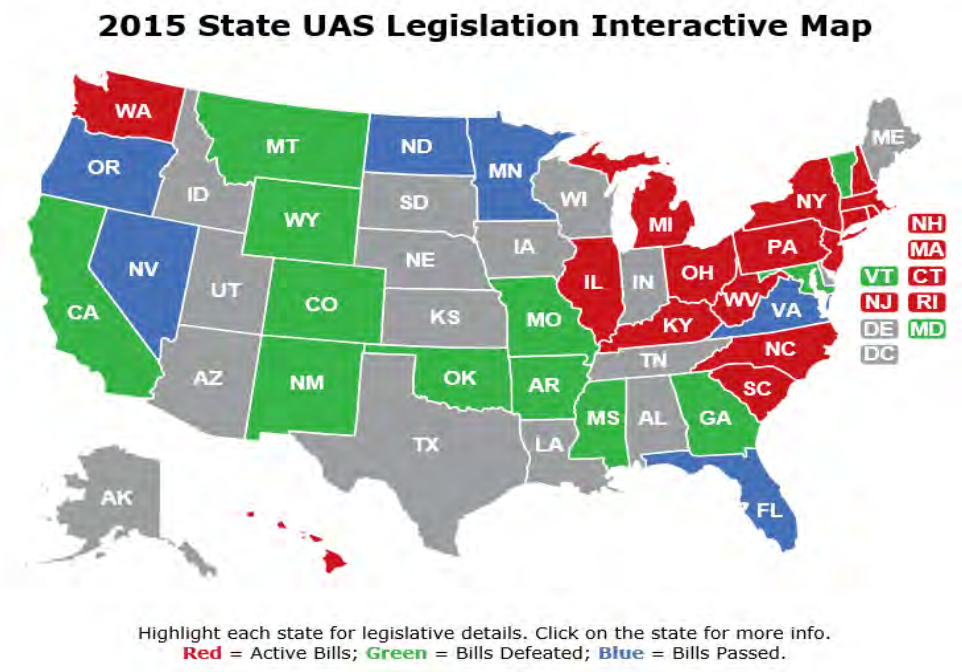
The UAS industry as a whole encompasses a wide range of demographics. Traditional aerospace contractors such as Boeing, Lockheed Martin, and Northrup Grumman are actively engaged in the UAS industry. They are developing technologies, acquiring smaller companies with UAS products, or integrating other solutions into their capability portfolios. Other large companies like Intel and Google that specialize in computing and information management, not aviation products, are also emerging as major players in the UAS community. Small businesses have created the most disruption in the UAS sector in recent years with the explosion of the consumer-grade UAS companies like DJI and 3D Robotics.

The UAS industry should not be strictly defined by the companies that are manufacturing the aircraft. Hardware components such as sensors, avionics, transponders, ground control stations, and batteries are evolving at least as fast as small airframe designs. Increased battery performance to extend endurance or power more sensors translates directly to increased system capability. Software development for advanced autonomy, vehicle operating systems, information management, image processing, and data analysis is another big area of growth. Companies like Airware, Sierra Nevada Corporation, and DJI are investing large amounts of money into developing or acquiring software to gain a competitive advantage in the UAS market.

Not all of the companies in the UAS industry are developing technologies or manufacturing products. Hundreds of companies that did not exist even twelve months ago are now offering UAS services in the United States. While many of these are legally offering UAS aerial photography and surveying services under the FAA's Section 333 Exemption program, many other service providers are acting outside the current regulatory structure for a variety of reasons (informed defiance, unaware, etc.). Measure 32, Juniper Unmanned, Boeing's Insitu, and SkyPan International are some of the more recognized names offering UAS services. Many organizations have chosen to build UAS operations units inside existing corporate structures such as engineering firms, construction companies, and film making studios.

2. Legislation

Just as the profile for a UAS industry organization takes many shapes, the approaches to UAS legislation across the country also span a wide range of expectations. The FAA responsibility to protect the safety of the national air transportation system provides the agency with the prime authority nationwide. The FAA has three current methods for approving UAS operations in domestic airspace: (1) the Certificate of Authorization (COA) program for public agencies; (2) the Section 333 Exemption process for commercial UAS operations; and (3) the Special Airworthiness Certificate for UAS operations. Each of these programs is well-defined and discussed in various online resources including the FAA's website. In February of 2015 the FAA released the long-awaited Notice of Proposed Rule Making (NPRM) for small UAS operations. After the 60-day public comment period closed, the FAA had approximately 4,500 comments to process and integrate into the final rule. As of this report, the rule for small UAS operations in the NAS is expected no later than summer 2016. In addition, once FAA's rule is adopted, the Section 333 Exception process will be discontinued.



Many states are also evaluating proposed legislation or implementing approved legislation to immediately help manage the growing demand of UAS across the country. More than a dozen states have established a UAS Task Force or some kind of committee specifically to assess the need for UAS legislation in their respective state. More than half of the country has passed legislation that addresses UAS operations, data capture, equipage, or illegal activity

More details on this will be discussed later in the report. Just as when the FAA was established as a national regulator, the definitions of "airspace," "control authority," and regulatory enforcement responsibilities are being reviewed at all levels.

3. Education/training/certification

As the FAA continues progressing toward the final release of the rule that will define the requirements for small UAS commercial operations, government agencies, universities, and private companies are offering a variety of platforms to fill the UAS information needs. The FAA has multiple information websites covering UAS topics including details on the Section 333 Exemption program, Model Aircraft Do's and Don'ts and a UAS Roadmap for long term planning. State departments of transportation and aeronautics authorities are posting UAS information pages with fact sheets and local knowledge. Universities are offering UAS curricula for degrees and certificates in UAS operations. Aerospace engineering programs are still building small UAS as senior design or capstone projects, while higher level computer science classes are using UAS as platforms for demonstrating advanced artificial intelligence, dynamic networking, and human-machine collaboration knowledge comprehension. Remote sensing and Geospatial Information Systems (GIS) programs are integrating UAS data capture methods and samples into classes on modern surveying and image analysis skills techniques. Finally private companies are specializing in UAS operating training programs at the same time that traditional flight schools are also developing UAS-specific flight training programs building on existing Part 61 and Part 141 approvals. The challenge all of these organizations face today is the FAA has not defined the requirements for the UAS operator license that was proposed in the NPRM. So there is no such thing as an "FAA-approved UAS Flight School" or an "FAA-recognized degree program." Providing up to do date, accurate information that includes any pertinent and related local relevance is critical for state and local governments to keep their citizens informed. But as the regulatory and standards landscapes continue to evolve, the certification, permitting, registration, and education requirements for a professional UAS career will also continue evolve.

4. Applications

The demand for UAS in the national airspace is driven by the value that UAS capabilities are now providing users for a wide variety of applications. Although the benefits of UAS for aerial imagery were primarily isolated to the national defense community, the commercial sector and civilian services providers have begun adopting the technology and reaping the benefits. Although not an exhaustive list of applications, the following list presents a core set of missions that many state governmental agencies and commercial services companies are performing under FAA exemptions or waivers:

- Emergency Response
- Mapping / Surveying
- Aerial Photography
- Agriculture
- Mining
- Forestry
- Wildlife Resources
- Transportation
- Investigation
- Drug Enforcement
- Anti-terrorism
- Law Enforcement
- First Responder Support
- Weather Research
- Disaster Analysis
- Airport Planning
- Entertainment / Filming
- Insurance Assessments
- Real Estate Photography
- Construction Management

5. Initiatives

The continued acceleration and momentum of UAS growth provides several key initiatives that are ongoing:

1. The FAA UAS Center of Excellence: This is a 5-year funded research program for a university-led team of research institutions, industry partners, and government agencies to tackle the challenges facing UAS integration today and in the future. Mississippi State University leads a 22-school team called ASSURE (www.assureuas.org) that was selected by the FAA for the UAS COE in May of 2015.
2. The FAA's 6 UAS Test Sites (FAA, UAS Test Site Program, n.d.): In December of 2013, six UAS test sites were selected to achieve cross-country geographic and climatic diversity and help the FAA meet its UAS research needs. The six sites are managed by the University of Alaska, State of Nevada, New York's Griffiss International Airport, North Dakota Department of Commerce, Texas A&M University-Corpus Christi, and Virginia Tech through the Mid-Atlantic Aviation Partnership.
3. Know Before You Fly and the B4U Fly App (FAA, B4U Fly App, n.d.):
   The "Know Before You Fly" campaign started in December of 2014, when the AUVSI, the Academy of Model Aeronautics (AMA), the Small UAV Coalition, and the FAA partnered to provide prospective UAS operators with the information and guidance needed to fly safely and responsibly. The campaign plans to team with manufacturers and distributors to provide consumers and businesses with the types of information needed before flying a UAS. The information is provided through a website, educational videos, point-of-sale materials, and digital and social media campaigns. The "Know Before You Fly" website (http://knowbeforeyoufly.org/) contains pages with information applicable to recreational users, public entities, and business users. It contains contact information, links to additional resources, and printable brochures aimed at enhancing UAS operations. Airport operators can steer stakeholders and members of their communities toward the campaign materials as a starting point for local UAS discussions.

B4UFLY is a smartphone app that helps unmanned aircraft operators determine whether there are any restrictions or requirements in effect at the location where they want to fly.

4. RTCA SC-228 Minimum Operational Performance Standards for Unmanned Aircraft Systems Committee: "Established May 20, 2013, this committee is working to develop the Minimum Operational Performance Standards (MOPS) for DAA equipment and a Command and Control (C2) Data Link MOPS establishing L-Band and C-Band solutions. The initial phase of standards development will focus on civil UAS equipped to operate into Class A airspace under IFR flight rules. The Operational Environment for the MOPS is the transitioning of a UAS to and from Class A or special use airspace, traversing Class D and E, and perhaps Class G airspace. A second phase of MOPS development is envisaged to specify DAA equipment to support extended UAS operations in Class D, E, and perhaps G, airspace." (RTCA, n.d.)
5. The Small UAV Coalition: "The Small UAV Coalition advocates for law and policy changes to permit the operation of small unmanned aerial vehicles (UAVs) beyond the line-of-sight, with varying degrees of autonomy, for commercial, consumer, recreational and philanthropic purposes." (Coalition, n.d.)
6. The Association for Unmanned Vehicle Systems International (AUVSI): "The Association for Unmanned Vehicle Systems International is the world's largest non-profit organization devoted exclusively to advancing the unmanned systems and robotics community. Serving more than 7,500 members from government organizations, industry and academia, AUVSI is committed to fostering, developing, and promoting unmanned systems and robotic technologies. AUVSI members support defense, civil and commercial sectors." (AUVSI, Association Overview, n.d.)
7. FAA UAS Registration Task Force (FAA, Unmanned Aircraft Systems (UAS) Registration Task Force (RTF) Recommendations Final Report, 2015): In October of 2015 a Registration Task Force was established to provide the FAA Aviation Rule Making Committee direct recommendations regarding UAS registration strategies and needs. The FAA charged the Task Force with the following three objectives:
    1- Develop and recommend minimum requirements for UAS that would need to be registered.
    2- Develop and recommend registration processes.
    3- Develop and recommend methods for proving registration and marking

    On November 21, 2015 the RTF submitted their report to the FAA for immediate consideration. The Task Force recommendations for the small UAS (less than 55 lbs. aircraft) registration process are summarized as follows:
    1- Fill out an electronic registration form through the web or through an application (app).
    2- Immediately receive an electronic certificate of registration and a personal universal registration number for use on all sUAS owned by that person.
    3- Mark the registration number (or registered serial number) on all applicable sUAS prior to their operation in the NAS.

4- An exclusion from the registration requirement for any small unmanned aircraft weighing a total of 250 grams (g) or less.
5- A free, owner-based registration system with a single registration number for each registrant.

8. UAS Traffic Management (UTM) Program, NASA Ames Research Center
A UTM system would enable safe and efficient low-altitude airspace operations by providing services such as airspace design, corridors, dynamic geofencing, severe weather and wind avoidance, congestion management, terrain avoidance, route planning and re-routing, separation management, sequencing and spacing, and contingency management. UTM is essential to enable the accelerated development and use of civilian UAS applications.

One of the attributes of the UTM system is it will not require human operators to monitor every vehicle continuously. The system will provide to human managers the data to make strategic decisions related to initiation, continuation, and termination of flight operations. This approach would ensure that only authenticated UAS operate in the airspace. In its most mature form, the UTM system will be developed using autonomicity (also known as autonomous or self-directing) characteristics which will include self-configuration, self-optimization and self-protection. The self-configuration aspect will determine whether the operations should continue given the current and/or predicted wind/weather conditions. (NASA, n.d.)

B. Framing the Impact of UAS on the Air Transportation System

When the FAA's "NextGen" program to modernize the national air transportation system was launched in the early 2000s, UAS integration into the NAS was considered a minor demand falling near the bottom of priority lists. ADS-B maturation, implementation, funding, and

adoption was critical to provide the backbone for the modern, GPS-based digital airspace. System Wide Information Management, digital data-link communications between aircraft-to-aircraft, aircraft-to-controllers, and other airspace participants, and improved weather impact analysis were considered the top priorities for increasing capacity while maintaining or improving the air transportation safety performance. Based on analysts' predictions and industry trends today, UAS could outnumber traditional manned aircraft ten to one in the not-so-distant future. This exponential growth will require support for a wide range of unmanned aircraft operating in nearly all types of airspace including urban, rural, high density, low density, and various altitudes. UAS have the potential to epitomize the capabilities and benefits of NextGen, while also demanding the expedited, successful transition to the modern aviation system.

II. Industry Trends and Outlook

A. Platforms

1. Small UAS

Small UAS are the largest growth sector and the primary focus of the FAA for UAS integration in the near future. "Small UAS" is currently defined as 55 pounds or less in maximum takeoff weight of an aircraft (i.e. airframe+payload+fuel). There is a consideration for a "micro UAS" class of aircraft, but current exemptions and waivers apply to all commercial and civilian UAS of small UAS. Small UAS include traditional Department of Defense systems such as the Aerovironment Raven and Puma systems, but also the rapidly emerging public consumer type systems such as the DJI Phantom series and the SenseFly eBee. Most of these systems are hand-launched, launched from a small bungee powered catapult, or are vertical takeoff multi-copter designs. Flight time is anywhere from 15 minutes to 4 hours (for the extended range Puma) for aircraft less than 55 pounds, but the top of the small UAS weight range systems that are gas powered have complete 12+ hours missions. Except for a handful of research projects, small UAS are flown exclusively Line-of-Sight in the NAS today.

There are reports that the 2015 holiday season may see as many as 1 million small UAS sold at the general consumer level. These aircraft will be sold as "hobby" devices intended for recreational purposes. However, the commercial potential for these devices is not a far leap into real estate photography, roof inspections, and surveying. That is why the UAS Registration Task Force was assembled to quickly develop a registration strategy as a step toward the release of the small UAS Rule (Part 107).

The package delivery UAS concept that organizations such as Amazon and Google are researching and evaluating is based on a network of small UAS that can carry an approximate 5-pound payload. Fleets of aircraft delivering toothpaste, books, medical supplies, and other immediate-need orders is not a fictional marketing concept, but an evolving business plan within multiple companies across the globe. Developing technologies for equipping these small UAS for tracking, path deconfliction, all-weather operations, and high-rate utilization are active development programs in research labs.

Based on the more than 2,200 approved small UAS commercial exemptions today and with the release of Part 107 anticipated in the back half of 2016, routine UAS operations in the NAS could be witnessed daily before 2020.

2. Large UAS

UAS larger than 55 pounds are emerging at a much slower pace than small UAS. Outside of the DOD Predators, Global Hawks, and Shadows, aircraft such as the Yamaha RMAX helicopter for aerial spraying and the Arcturus T-16 and T-20 are rarely seen in the United States NAS. Although large UAS provide more capacity for carrying transponders and other communications capabilities, and they are more likely to show up on radar due to size and higher flight altitudes, their cost and support logistics are significantly more than small UAS. The FAA and standards committees are just beginning to address the demand for Beyond-Line-of-Sight (BLOS) UAS operations.

B. Command and Control

1. ATC Integration

Air traffic control (ATC) integration for UAS is a multi-faceted challenge. Very small aircraft, flying below 500 feet altitude (very often less than 100 feet), that are only in the air for less than half an hour are not considered a major concern for most air traffic towers. However, for a crop duster operating at less than 500 feet that is actively scanning for new met-towers and power lines while making sure to only working specific fields, a small UAS with a camera that is capturing spectral imagery of a neighboring field is considered a serious air traffic threat.

All FAA approved UAS operations under the Certificate of Authorization program require the posting of a Notice to Airmen (NOTAM) two days before flying. The NOTAM does not restrict the airspace from other users; it is an awareness tool to be alert for UAS operations in a specified area.

Many companies and researchers are evaluating the UAS-to-ATC communication path as an opportunity for improvement and technology development. A growing number of UAS operations, increased use of UAS in complex airspace, and the potential emergence of single-operator-multiple-vehicle control architectures will drive the development of new ATC integration technologies and protocols. Deconfliction of airspace requires ATC awareness of aircraft operations, aircraft knowledge of position (via pilot or electronic device), and communication between the two for maintaining separation. Unmanned aircraft do not have the same level of autonomy as manned aircraft do today, but as command and control technologies improve and system-wide information management enables airspace participants to make more independent decisions that are shared throughout the system, UAS will integrate with ATC just as any other aircraft does.

2. Data links

Data links are the Achilles heel for UAS integration. Strong, powerful, secure data links enable UAS to perform more complicated tasks by sharing more information with the ground control station (GCS) and ATC regarding aircraft situational awareness. Higher performance data links also means that mission data captured on the aircraft can be shared safely and quickly during flight. Intermittent or unreliable data links require UAS communications architectures to focus on command and control to maintain safety of flight operations and protection of the airspace, which often means storing mission data onboard the aircraft and downloading after landing. Satellite based communications are expensive for small UAS. Cellular-network based UAS data links are being tested for both navigation data distribution and mission (imagery) data transport. Cellular networks have never been part of the FAA's certification programs, so there is concern about evaluating these resources to meet FAA standards and requirements.

C. Applications of UAS

1. Washington State UAS user profile

There are two types of UAS users in Washington to address: state and local government agencies, and commercial operators.

Government Agency Uses:

- Public safety / Law Enforcement- accident investigations, search, disaster response
- Surveying / mapping- flood plains, earthworks, DOT construction sites
- Infrastructure inspections- structural analysis of a building, bridges

- Agriculture- crops, forests, aquatic, herd management
- Utilities- power lines, treatment facility management
- Research- public universities, K-12 schools

Government Profiles:

- Frequent use teams
  - A UAS unit that would be active weekly
  - 2 or 3 dedicated flights crews. Each crew has one pilot, two observers, and data analyst.
  - Team owns equipment- aircraft, sensors, radios, mobile communications unit, transportation vehicle
- On-demand operations
  - Need for UAS capabilities just a couple times a year max.
  - Either maintains 1 flight crew that has other job responsibilities or maintains service agreements with commercial UAS service providers.
  - Internal team maintains a small UAS capability, leases equipment when needed, or contracts the services as needed.
- Scope
  - Aircraft are operated under the FAA Public Agency Certificate of Authorization (COA) Process
  - Aircraft are operated as “public aircraft”.
  - Crews are self-certified to meet a minimum credential, not necessarily an FAA issued private pilot’s license.
  - Aircraft are self-certified as “airworthy”.
  - Altitude limitations are based on the specific COA approval.

Commercial Operator Uses:

- Surveyors
- Engineering Firms
- Film companies
- Real Estate companies
- Aerial photographers

Commercial Profiles

- Range from small business (1 or 2 person shop) to large organization with a dedicated UAS operations team
- Scope
  - Commercial operations are approved today through the FAA Section 333 Exemption Process
  - Operator must have a minimum Sport Pilot’s License

- Aircraft is exempt from an airworthiness certificate, but must be inspected before every flight.
- Line of Sight operations only.
- Daylight operations only.
- Blanket operations are approved below 200', specific COAs are required for operations between 200' and 400' to define the perimeter.

D. Legislation/policy

1. Review of other states' activities

The National Conference of State Legislatures maintains a comprehensive list of state UAS-related legislation. (NCSL, n.d.) As of the writing of this report, 20 states have passed legislation related to UAS operations. Most of this legislation is related to protecting citizens' privacy through data management, establishing a UAS Task Force or Commission to develop a state strategy, or to prohibiting operations at state facilities such as around the state Capitol, correctional institutions, or recreational parks.

Cities are also developing UAS specific legislation to manage safety and impacts of the expanding operations. Tourist destinations are limiting operations by requiring city council/management approval before any operations are allowed by a specific operator. Other cities are banning operations in parks and other public areas. Some municipalities are temporarily restricting operations during large events.

2. Projected needs for Washington

Several states have formed UAS Working Groups; some, like NC, have a legislative statute to make that happen. Washington State should consider this to be in a position to address UAS issues.

At this point, following the FAA's lead with the eminent release of Part 107 will give the state time to how other states are performing under approved legislation, how industry is reacting to FAA and other states, and evaluate what is needed based on current activities by Section 333 Exemption approved operators in the state. As of the production of this report, there are approximately 50 Exemption 333 holders in the state of Washington (SUASnews, n.d.).

- A process for monitoring FAA approved operations in the state (333 holders and Part 107 certified operators).
- Tools for supporting airspace integration- local airport communications and agreements, positions of routine launch and recovery locations, preferred testing/training locations for new operators.

3. Public Perception and Engagement

Public perception and engagement is absolutely critical to successfully establishing a UAS program in a government organization.

The Seattle Police Department UAS Program failure to launch in 2012 means that Washington has a steep climb to gaining public trust and confidence. (Times, n.d.) (Times, Seattle grounds police drone program, n.d.)

Include Communications Best Practices…

Airports looking to introduce UAS into their operations will be well served by actively reaching out to their local communities. The purpose of the outreach should be to educate the public on the aircraft to be flown, the types of activities the UAS will perform, and the risk mitigations implemented to ensure public safety.

Topics for Public Outreach Building and maintaining community support for UAS operations is a continuous process that goes beyond simply giving the public notice of upcoming operations. The community needs to be informed about the organizations that will be conducting the operations, how the flight activities could impact them, and then given the opportunity to ask questions and express any concerns. Using the DOI's approach as an example, a list of topics the airport and UAS operator might present to the public is as follows:

• Define a UAS

— Explain the history of UAS flying

— Describe the different types of UAS

• Who is doing the flying

— Overview and history of the organization

— Safety record and risk management processes

— Examples of past missions and their results

• The aircraft and the missions

— Types of UAS

— Sensors on board

— Purpose of the flights

— Flight routes and restrictions

• Benefits to the community

— Economic benefits

— Safety benefits

— Environmental benefits

• Status of regulation

— Current regulations

— Proposed regulations

• The future of UAS

— Companies involved in the UAS industry

— Future applications of UAS

The topics are best presented by the UAS operator or by persons experienced in the type of UAS operations to be conducted in order to provide the public with the most accurate information and to completely answer any questions the audience might pose.

E. Future Implications

1. Unmanned Air Cargo

It's coming. 3 principles that will shape UAS Cargo:

1- Autonomous operations are fundamental for routine BLOS operations
2- Definition of a warehouse will determine cost benefit.
3- Ownership follows cellphone adoption curve as individual ability to retrieve and transport cargo becomes feasible. Whether that is launching a personal aircraft to pick up medicine at a pharmacy or sending it home from the field to retrieve forgotten sports gear, when the infrastructure is in place and the technology is mature enough, the benefits of ownership will create the market.

2. Unmanned Commercial Air Service

The general consensus within the UAS community is that commercial passenger transportation will not transition to a pilotless cockpit any time soon. The pilot may become the co-pilot to the autopilot, fulfilling the role of system manager, but a human will remain in the cockpit for a multiple reasons.

Commercial cargo services, however, have received significant research and business case analysis for assessing the potential value of unmanned operations. Especially long-haul flights across the Atlantic and Pacific Oceans, autonomous commercial cargo operations are considered economically practical.

Both of these concepts are natural extensions of current capabilities in commercial airlines and large DOD unmanned aircraft programs. Autonomous takeoff, navigation, and landing has been performed thousands of times with large aircraft. Integration into commercial airport terminal operations and contingency management are the primary areas for research into technology and procedure development.

3. Unmanned Local Passenger Transport (Aerial commuting)

As autopilots and vehicle management systems continue to advance and the NextGen system matures, the line between manned and unmanned aircraft will begin to blur. Personal Aircraft Systems that are highly efficient, semi-autonomous air taxi services will operate as large UAS carrying commuters as cargo with pilots that are more "system managers" than aviators. An FAA Aviation Rulemaking Committee committed to developing recommendations for large UAS integration is established and preparing a report for the FAA. The expected release date for that report is not yet determined.

III. Anticipated Impacts on Washington Air Transportation System

A. Impacts on Airports

As reflected in ACRP Report 144: Unmanned Aircraft Systems (UAS) at Airports, there are two overarching considerations that stakeholders would be well served by addressing when developing the airport UAS vision. First, airports should consider the types of UAS that can be expected and the number of operations anticipated. Second, airports should determine the facilities necessary and currently available for UAS activities, including a communications infrastructure. A vision for UAS operations could be integrated into the master plan, or an airport strategic plan or financial plan if those are more applicable vehicles, and take into consideration tasks needed for UAS development and provide a roadmap for this change in airport operations.

The most likely airport situation is that UAS will co-exist with manned aircraft on the airport, on runways and taxiways, and in the airspace to the extent the FAA determines an acceptable level of safety is provided.

1. Operations

Airports may benefit by making sure the rates for services and facilities paid by UAS operators are comparable to those paid by the manned aircraft community in order to avoid conflicts and ensure operational cooperation.

It is commonly accepted that UAS operations require more support than manned aircraft from the ground, and perhaps in the air, because of the necessary communications and control protocols

Understanding and communicating any restrictions placed on manned aircraft operations to the tenants based at the airport, and to known transient users, will be important for airport operators. This will allow airport tenants and known transient aircraft pilots to adjust schedules and flight plans accordingly.

2. Infrastructure

As the airport makes preparations for bringing in UAS, taking inventory of available facilities that potentially meet UAS operator needs is an important early step. The goal

of the inventory is to help ensure an airport does not turn UAS operations into a negative revenue situation.

The considerations for infrastructure requirements should start with some basic questions from the airport to the UAS operator:

• Does the UAS need a runway for takeoff, landing, or both? If so, what runway length and width is required?

• Can the UAS taxi to/from the runway and follow ATC commands and other voice commands?

• Does the UAS need hangar space when not flying?

• Does the UAS need ramp space prior to or after flight?

• What sort of control station is required (truck, trailer, office space, etc.)?

• Does the UAS need launch and recovery space (in lieu of a runway)? If so, how close to the airport does this space need to be?

• What sort of communications infrastructure is needed? Does the UAS operator need special towers of antennas in order to ensure communications are established and maintained with the UAS?

• Will the communication frequencies needed create conflicts? Will they interfere with existing frequencies used by airport staff, the FAA, tenants, airlines, fixed base operators, or others?

• Will the UAS need special emergency standby equipment? Is it available at the airport or does it need to be brought in from an outside source? As an example, a large general aviation airport might need to bring in a local fire department truck to standby for UAS operations as a matter of protocol.

Long-range planning for land use and UAS is a slightly different matter. Airport operators are encouraged to take a master planning approach in creating a vision for future UAS operations. Land-use planning is an important aspect of this approach. Long-range planning about where permanent ground based control stations might be located, as well as where to place storage and maintenance facilities that may require airfield access might be prudent approaches for those airports looking to attract UAS operators.

For those airports that receive FAA grant funds, it will be important for the airport management to ensure there are no land-use issues that violate the grant assurances. Airport operators are encouraged to have a discussion with their FAA Airports ADO prior to executing agreements with UAS operators for airport facilities or property. The property itself might be encumbered in such a way that UAS use might not be permitted. This is highly unlikely, however, given that the FAA and the NTSB have

determined that UAS are aircraft. Moreover, local zoning laws and local restrictions might prohibit such activity. It will be up to the airport management to investigate and ensure UAS operations do not violate any restrictions. Land-use issues are listed on the UAS checklist in Appendix C for reference.

IV. Public Policy

A. Washington State government integration

1. Licensing/permitting

UAS licensing and permitting are carried out differently in different states; MN and NC's approach are summarized below.

Minnesota's approach: Under Minnesota state law, Unmanned Aerial Systems (UAS) or drones, are required to be registered with MnDOT Office of Aeronautics. Registration is not required for unmanned aircraft operated solely for recreational use. Commercial operators are required to obtain a licensed from MnDOT before they advertise, represent, or hold themselves out as giving or offering to provide UAS services. (MNDOT, n.d.)

North Carolina's approach:

Knowledge Test: To fly in North Carolina, an operator must pass the NCDOT's UAS Knowledge Test to ensure safety and the safety of those around in the area. (NC GS § 63-95)

Permit: With the passing of the Knowledge Test as a prerequisite, commercial and government operators may request an NC UAS permit from the NCDOT Aviation Division. (NC GS § 63-96)

Washington State considerations

- UAS service companies are not necessarily excited about having to be licensed/permitted everywhere. Lawyers, construction firms, mortgage brokers have to be- welcome to a regulated industry.
- Infrastructure to establish a licensing/permitting program is not trivial. Tying it to the evolving FAA program is complicated as cross referencing to a COA or 333-database is not easy.
- What is the intent of a permitting program? There is debate on the value of state level legislation versus implementation of an extensive education campaign. Responsible companies and government agencies are not the threat to safety and data misuse. The rogue, uninformed, over-confident operators are the threat to the system and there is not clear data that additional regulation reduces those activities.
- Corporate programs versus operator-based programs will arise. Warehouses offering routine package distribution via UAS will increase noise, airspace

congestion, and potentially use other modern infrastructure (cellular networks for instance). These kinds operations, in addition to small, discreet operations that are becoming more frequent today, present opportunities for creative revenue streams for governments committed to protecting citizens and capitalizing on local resources.

2. Enforcement

Given the growing interest in UAS and still widely held civic safety and privacy concerns, one opinion is that the public will become the enforcers of the regulations. As more and more UAS fly, and the flying increases in frequency in populated areas, it is possible that people may become concerned with the activity and call police or the local airport to report the UAS operations they see.

Airport managers and operators can be a positive force in ensuring safety UAS operations by staying abreast of the rulemaking process and UAS related stories. The FAA regularly posts news releases relating to the status of UAS regulation on the FAA website, and news on advancing UAS technologies can be found on the Internet. Airport operators should be ready to respond to questions and concerns from the public about unmanned aircraft

3. Application

State agencies will benefit from the access to UAS capabilities just as commercial organizations do. Low cost, on demand, frequent capture of aerial imagery is valuable for making many decisions. Public agencies need policies to manage their operations.

Safety is a high concern around many locations. The Pier 57 Great Wheel tourist venue was recently visited by a small UAS that lost control and crashed into the empty outdoor patio on November 11, 2015 (Times, Drone hits Seattle's huge Ferris wheel; SPD investigating, n.d.).

V. Summary for Washington Airport System

A. Future Expectations

UAS are coming fast, it's the evolution of aviation technology, and they are not the discovery of something new. Embrace the dynamic nature of the industry with minimal laws that protect citizen rights and safety without restricting innovation in the state or it will go somewhere else.

All of aviation is changing over the next 10-15 years as the airspace environment becomes a digitized 3-D world. UAS will be a piece of the Intelligent Transportation System that connects and reports participants, non-participants, infrastructure, and system status.

B. Recommendations from WSDOT UAS Working Group

As part of the WASP, WSDOT Aviation convened working groups to discuss aviation issues. A working group was established to discuss NextGen. This group recommended the following actions be considered:

Recommendation: Larger UAS should operate with the same requirements as manned aircraft.

Recommendation: As related to off-airport UAS activity (such as amazon prime air or Domino's pizza) government should know where commercial launch and recovery (VTOL) pads are located.

Recommendation: Government should establish policy for zones where UAS activity should be prohibited or regulated. Factors such as safety, noise, privacy, and inappropriate use (e.g. commercial activities) should be considered, and areas such as schools, public events, hospitals and assisted living facilities, certain residential zones, etc., should be considered and addressed.

Recommendation: Until technology enables co-use of airspace, UAS should be prohibited from operating in Hub airport airspace.

Recommendation: Unmanned activity at non-towered airports should require an operator to communicate with manned aircraft on the CTAF/UNICOM.

Recommendation: WSDOT should facilitate a process for establishing GeoFencing, and support the development/implementation of a universal standard.

Recommendation: WSDOT should assist in the development of documentation to address new infrastructure requirements to support UAS (e.g. power, hazardous materials disposal [batteries], etc.)

Recommendation: WSDOT should support and facilitate the development/clarification/promulgation of procedures for close-proximity manned (crop duster) and unmanned aviation agriculture operations.

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