Opportunities and Challenges for Use of UAS at Airports

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A recognized advantage of Unmanned Vehicle Systems (UAS) is that many will be able to operate outside our limited and overburdened system of airports. There are, however, at least three categories of opportunities for use of UAS at airports.

Opportunities

First, airports and their subsidiaries and service providers can themselves use UAS at the airport and in its environs to improve the quality, efficiency, and economics of their own operations. Among those jobs that UAS can perform around the airport are surveillance for safety including fire and rescue, security and law enforcement, and facilitation of airport operations such as ground vehicle traffic management, collision avoidance, wildlife management, environmental monitoring, surveying (i.e. Obstacle and Terrain evaluation), and even small package delivery within the airport confines.

Second, there will be some UAS operators who will become customers of the airport. Although most small UAS operations probably will take place outside the airport environs, airports will eventually host some significant UAS operations. For example, it can be envisioned that small package delivery companies might operate large aircraft into airports, and then use UAS to pick-up and dispatch small packages from the airport directly to customers in the local environs. Direct dispatch from the airport would potentially save time and expenses associated with local warehouse, sorting, and road delivery infrastructure. And over time, it may well be that military and many large aircraft cargo carriers already residing at airports will convert to optionally-piloted and unmanned aircraft. There are numerous joint use military and civilian airports where, and from which the military may want to operate drones or expand current drone operations.

Third, it is likely that UAS or combined UAS and manned aircraft airports will be newly built exclusively to serve UAS customers. For example, a distributor or group of distributors might build distributions centers in an industrial park locations, around and from which they could deliver goods by UAS.

Challenges

There remain significant challenges however for use of UAS at airports, many of which are not, or are not adequately being addressed.

Some of these challenges are technical. Large UAS such as Global Hawk, properly fitted with avionics (e.g. voice communications, ADS-B, GPS) may operate and be handled by ATC indistinguishably from manned aircraft. Small UAS however may well operate largely outside the traditional ATC system, raising the following safety and operational issues:

- How will airborne surveillance of small UAS be assured, both for ATC and other operators when most will not be position reporting to ATC? Will all UAS in and around airports be required to have transponders? Will other operators be required to have some sort of primary surveillance and collision avoidance capability to avoid such small targets or will avoidance always be the responsibility of the UAS? Would large aircraft operators—and their passengers—accept the idea of UAS having sole responsibility for avoidance? What surveillance, if any, will be required for surface operations?
- Will small UAS operating in and around airports, including surface areas be subject to some sort of positive control for anti-collision or airport efficiency, and if so, who will perform this function and

how? What infrastructure will be required, such as information and communications systems and air traffic management tools? If there is some form of positive control, what will be the control procedures and prioritization paradigms in situations of high or excess demand, or when airspace, runways, landing areas or parking is limited or capacity is constrained. To what extent would segregation of airspace and surface operations suffice?

- What is the minimum performance capability required of UAS in particular terminal environments for specified operations, and can these standards vary depending on where and how the UAS will be used? Should these characteristics, and/or physical characteristics, be circumscribed such that UAS can receive uniform treatment?
- Will radio spectrum be sufficient and if not, how will this be addressed?
- What will be the certification and safety standards for UAS operating in and around airports, and who will perform certification and safety assurance functions? It is not a forgone conclusion that FAA can or will assume this role with respect to small UAS operating at low altitudes.
- What failure contingencies will be established to cover all potential UAS failures (e.g., lost ATC communications, navigation, or surveillance, inability to continue flight, or declared emergency)?
- How can risk to the public of UAS operations at airports be effectively analyzed and assessed?
- Will UAS operations pose environmental concerns, including noise?
- How can the airports and their customers assess the operational and financial impact of UAS operations on their current business, including liability?

Other issues will have policy, legal, and public acceptance implications, such as:

- What level of risk to the non-participating public from UAS operations is reasonable and acceptable, and by whom and how will this risk standard be set and enforced?
- How would the public be protected from residual risk? Should third-party insurance be required of operators, and if so how might appropriate coverage amounts and liability limits be established? By whom and how should compliance with insurance requirements be enforced?
- Do airport customers, suppliers, and employees, or neighbors of airports have any expectation of privacy that might be infringed by UAS operations, and if so what are the boundaries of these privacy rights, and how might invasions of privacy be avoided, mitigated, or compensated? To what extent could public outreach improve the chances of public acceptance?

The most significant immediate challenge however for airports and their customers will be to secure FAA safety approval for the most useful applications of UAS. At this point, the boundaries of authorized UAS use are very narrow. FAA has attempted to accommodate the most pressing UAS operator demands through exemption processes (so called "Section 333 Exemptions"), and now through new FAR Part 107 (14 CFR Part 107). But both the exemption process and Part 107 prohibit commercial UAS operations within 5 miles of an airport, require the UAS to fly under 400 feet, only within the human UAS pilot's un-aided line of sight (LOS), and only over people participating in the operation. Neither avenue of approval allows the operator to fly UAS near an airport, over the public, beyond the human capability to see the vehicle (beyond line of sight or BLOS), or using "autonomous" systems such as pre-programmed flight routings. Absent the 5-miles restriction, such limiting operating parameters might suffice for some on-airport uses of UAS (e.g. surveying or wildlife monitoring), but ultimately more sophisticated capabilities will be integral to most practical business and commercial applications.

FAA has invited prospective UAS operators to apply for "waivers" of the requirements of Part 107, or to use its general exemption processes to apply for certifications/approvals of UAS operations beyond those already permitted. To earn a waiver or exemption, the application would have to seek approval of an alternate method of compliance (AMOC), having demonstrated that the proposed UAS operation achieves

an equivalent level of safety (ELS) with the analogous manned operation. FAA has provided little guidance on how to make such a showing, and an applicant attempting to do so faces the challenge of baselining and measuring the safety of current operations in the absence of good historical and current data. As of the date of this writing, FAA has granted very few waivers from the over-the-public prohibition, and none with wide ranging practical, much less commercial, application.

Addressing the Challenges

The authors believe that a comprehensive program leading to full UAS integration in the NAS is necessary to address all of these challenges, including those inherent in UAS operations at airports. The scope and elements of such a program were presented in a paper and presentation to AUVSI's 2015 annual meeting in Atlanta. The full paper "An Achievable Path to UAS Integration in the NAS" can be read and downloaded at http://www.safeaccess4uas.com/paper-uas-integration-nas.html. Although the paper describes the requirements for full integration of UAS into the NAS, *the same technical and policy elements would be necessary to safely and acceptably integrate UAS operations into the microcosm of an individual airport:*

- Real time position determination, reporting, and information sharing for all vehicles (not just UAS (where we all are)
- Intent information (where everyone is going)
- Some form of positive control over everyone (collision avoidance), even if only by exception, and an airspace management paradigm and mechanism to prioritize operations if necessary
- Adequate spectrum, which will be a combination of government allocation (and preservation of the aviation bands) and technical advances to divide and better use what spectrum there is
- A performance-based safety certification, approval, and assurance regime, including articulated standards (acceptable risk to the public) and measurable outcomes, whereby the performance of diverse UAS in various operating environments can be demonstrated, measured, and adjudged objectively
- Methodologies and tools for assessing residual risk to the public from UAS operations, and requirements for compensating the public for injury and damage from mishaps (e.g. insurance coverage or adequate financial wherewithal for self-insurance)
- Analysis and prevention and/or mitigation of any unacceptable invasions of privacy or civil rights inherent in specific UAS uses at the airport or to airport neighbors.

Needed most of all however, is active acknowledgement and acceptance by the entire aviation community of the fact that UAS will be full participants in the NAS, and for some entity—be it government or aviation community initiated and driven—to lead, drive, and manage the technical and policy activities toward that objective. At this point, FAA has not accepted this role and no other organization—public or private--has come forward to fill the gap.

Impacts of UAS Operations at Airports

It is possible that some airspace, surface, and terminal building areas at the airport could be sufficiently segregated and sanitized so as to allow some small UAS to operate without disrupting routine airport operations. But to the extent that UAS attempt to integrate into routine airport operations, they will impact virtually everyone there.

On the positive side, airports and their service contractors can realize operational improvements (e.g. speed and comprehensiveness) and economies by using UAS for what are now labor intensive activities such as observation and surveillance of airport operating areas and wildlife, and environmental or other

potential hazards, and airport surface management. Within the terminal structures, UAS have the potential to improve security observation and surveillance, and might even perform rapid document and small package delivery. On the negative side, airport customers including passengers may object to the sense of being constantly observed (although observation cameras and recordings are pretty much ubiquitous these days, performing pretty much the same function.)

Some current aircraft operators, such as large cargo and small package delivery companies, may contemplate significant business opportunities in UAS operations at airports, including the possibility of UAS pickup and delivery of packages and small cargo beyond the airport. And there may be a rush on building new airport facilities, new UAS airports, or hybrid UAS/manned airports to serve these needs.

On the other hand, other aircraft operators at the airport—commercial and general aviation--may be negatively impacted. Most will not have on board primary surveillance equipment or the maneuverability needed to detect and avoid small UAS, which will be perceived as a safety hazard even if the UAS themselves are capable of detecting and avoiding the manned aircraft. And to the extent UAS are capable and desirous of using the airport under ATC management and control, they will add demand to airports already experiencing congestion and/or demand management.

All of these stakeholder groups are represented by trade organizations, such as AUVSI for UAS manufacturers and operators, A4A for airlines, NBAA for business aircraft operators, AOPA for general aviation pilots and companies, NATCA for air traffic controllers, AIA for aerospace and avionics manufactures, and AOCI and AAAE for airports and airport management, etc.

Addressing and Resolving Issues

As discussed above, airports and their customers may explore limited UAS operations at or around the airport under new FAR Part 107, namely those tasks the UAS can perform while being actively flown within direct line of unaided sight of the UAS pilot, and not flown over the general public. To the extent the airport or its customer can demonstrate an acceptable level of safety, some limited expansion from the Part 107 restrictions may be obtainable through the waiver and AMOC processes. If there are airport customers who believe they can operate larger, technically sophisticated aircraft under ATC control in a manner that is indistinguishable from manned aircraft, safety certification consideration under FAA's UAS Pathfinder program may be worth pursuing.

Airports may consider creating segregated, sanitized airspace and surface areas exclusively for UAS that do not conflict with routine operations of manned aircraft and ground operations. Safety risk analysis would have to be conducted to assure non-confliction with regular operations under all circumstances, including bad weather, emergency, security breaches, or other contingency situations.

Meanwhile, NASA is engaged in a public-private collaborative program to enable all nature of UAS operations in airspace below 500[1] feet—the UAS Traffic Management System (UTM). Even assuming the technical success of UTM however, under-500 feet is precisely the environment rife with privacy and public non-acceptance concerns. Geo-fencing of the airspace above non-consenting property owners has been suggested as a way of mitigating landholder resistance, but this would create a patchwork of authorized airspace that might prove operationally impractical. And the need for UAS to transit non-controlled airspace between UTMs, and for other marginally-equipped aircraft such as helicopters and general aviation to impinge on UTM airspace raise some very vexing detect and avoid issues.

[1] Title 14 CFR Part 107 currently limits altitude to 400 feet

WPG has recommended that rather than focus on incremental solutions, the most practical approach would be a comprehensive, aviation community-wide activity to integrate UAS fully in all aspects of the NAS.

Putting Potential Solutions into Practice

Taking into account the many uncertainties and challenges associated with UAS operations at an airport as outlined herein and in prior TRB work, the best approach might well be a limited experiment from which quantifiable costs and outcomes can be derived. And it will be even better if the experiment is directed toward demonstrating a viable (e.g. cost effective) business case. For example, an airport might explore with a package delivery firm already resident at the airport the concept of using UAS to dispatch small packages destined for the immediate locality, rather than by ground transport. Such an experiment would ferret out many of the issues that would be associated with more extensive UAS operations from an airport including unanticipated costs, the nature and extent of benefits, regulatory barriers (not only federal, but state, local, and airport), and potential liability and community acceptance issues.

Preparatory assessments and approvals for the experiment would include at the least:

- An assessment whether the planned operation can be performed within the confines of FAR Part 107, or whether waivers from those conditions (e.g. requiring LOS, and precluding operations over the public) will be required
- Whether the airport's physical plant, the operator's facilities, and ancillary services such as ATC and insurance coverage options are adequate and available
- Whether the UAS operator can perform the operation safely, both on and beyond the confines of the airport, including the last 100 feet to the delivery point, which is proving technically problematic
- Whether other customers of the airport especially other aircraft operators will object to the operation, and if so, whether their concerns can be addressed or mitigated
- Whether and to what extent the operation will be met by public non-acceptance, and if so, whether and how this discomfort can be addressed or mitigated.

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