A New Role for NASA in the Expanding World of Unmanned Aerial Systems

NASA's historic role of removing technology barriers to the development of the aviation industry needs to include a host of issues constraining the rapidly-growing industry of unmanned aerial systems (UAS). This industry promises to provide many benefits in wide-ranging applications: agriculture, real estate, power line and solar farm inspection, search and rescue, movie making, insurance claims, package delivery, news collecting, emergency response, volcanic eruptions, cloud seeding, delivering blood samples, game poaching, and tracking monkeys in Borneo to spot malaria outbreaks. Recent news articles are useful for illustrating the recognition of its importance and urgency.

The Market

A record amount of funding is being Invested In UAV Companies. Bloomberg News (6/19, Black) reported that venture capitalists are investing "record amounts of funding" into UAV companies. Jon Ollwerther, vice president of Marketing and Operations at AeroCine, credited the field's "potential" and "actual results" for the interest. According to the article, investors are willing "to look past the challenges" of bringing UAVs into the national airspace because they are looking to be part of the leaders in the field. Companies are even investing in the companies developing the systems that will manage UAVs.

Startup drone makers are finding record amounts of funding as venture capitalists prowl for early winners in what may become an $82 billion industry. From Silicon Valley to New York, firms including Kleiner Perkins Caufield & Byers, Lightspeed Venture Partners and ff Venture Capital are lining up behind unmanned aerial vehicle companies. Google Inc., General Electric Co. and Qualcomm Inc. also are jumping in with cash. http://www.bloomberg.com/news/articles/2015-06-19/drone-startups-grab-record-cash-as-kleiner-ff-venture-seek-wins

Flightglobal (8/18, Stevenson) reports that according to a market study by the Teal Group, the UAV market "will more than triple in value over the next decade" to $14 billion with sales of about $93 billion over that same period.

The Reno (NV) Gazette-Journal reported August 8 that the UAS market could top $11.4 Billion By 2022. However, the Federal Aviation Administration "acknowledged that the size of UAS markets" is dependent on a number of "regulatory and legal structures that grow up around the industry." The FAA has a Sept. 30 deadline to "issue rules to safely integrate commercial operation of unmanned aerial vehicles," but the article cites numerous regulatory, political and potential liability issues with UAS.

Fortune (8/9, Dillow) reports that the Federal Aviation Administration's streamlining the approval process for companies seeking to use UAVs, as well as loosening "certain aspects of its commercial drone regulations to allow approved companies greater flexibility in how they use commercial drones," has "driven a drastic uptick in the number of companies approved to fly" UAVs to over 1,000, compared to about 12 at the start of the year.

AUVSI (8/4/2015) reported that the Federal Aviation Administration announced it has surpassed 1,000 approved applications to fly unmanned aircraft commercially under a Section 333 exemption. The FAA has received more than 2,300 exemption applications. On July 30, AUVSI released a report on the first 500 commercial unmanned aircraft systems exemptions. The report indicated that UAS have been approved to support more than 20 industries, spanning almost every state.

Issues

The constraints to realizing these benefits are typically those of privacy protection, avoidance of restricted areas around airports, safeguards for operations outside line-of-sight, and integration with controlled airspace.

Protect Vulnerable Sites. Reuters (8/20, Morgan) reports that federal government agencies are working with state and local police to develop high-tech systems to protect vulnerable sites from UAVs. Reuters notes that in one previously unreported field test, New York police used a microwave-based system to track a UAV at Times Square and return it to its operator; the test was part of a nationwide development effort including DHS, the FAA, and the Defense Department.

Protect Airports. The AP (8/20, Eltman) reports that the FAA "is moving too slowly to implement rules requiring drone manufacturers to install technology that would prevent" UAVs from entering airports and other sensitive areas, according to Sen. Charles Schumer (D-NY). Schumer said that "he will propose an amendment to legislation funding the FAA this fall that would require manufacturers to implement geo-fencing or similar technology to prevent the unmanned aircraft from flying near airports and other sensitive security" areas.

Inspect Power Lines and Solar Farms. The Charlotte (NC) Observer (8/20, Hanson) reports that Duke Energy has contracted with AeroVironment to consider whether the company should use UAS to conduct inspections of power lines and solar farms, which the Observer notes could lower costs and "improve Duke's response to storms and other outages." Additionally, the National Agricultural Aviation Association (NAAA) has called for UAS to be equipped with collision-avoidance features to prevent them from impacting crop dusters.

Integrate UAVs Into the National Airspace. FierceGovernmentIT (8/19, Sarkar) reports that the Government Accountability Office (GAO) just released a report on the FAA's efforts to integrate UAVs into the national airspace, including "drone challenges as well as the agency's case-by-case approval of drone operations, use of six designated sites to conduct tests, and drone regulations in other countries."

Solving these problems is urgent... The CBS Evening News (8/12) reported on comments by FAA Administrator Michael Huerta regarding complaints by pilots "in record numbers" about unmanned aerial vehicles and what the agency plans to do about them. Meanwhile, Bloomberg News (8/12, Levin) reports that the number of complaints could at least quadruple to more than 1,000 this year if the current rate continues.

Programs Addressing the Issues

Air Traffic Control. The AP (8/10) reports that a project out of NASA's Ames Research Center will have 12 groups test UAV software at the space agency's Crows Landing Airport as part of testing "an air traffic control system for drones." Richard Kelley, chief engineer at the University of Nevada-Reno's (UNR's) Nevada Advanced Autonomous Systems Innovation program.

USA Today (7/29, Weise) reports that on Wednesday, Parimal Kopadekar, manager of NASA's Safe Autonomous System Operations Project, delivered a keynote address at the Unmanned Aerial Systems Traffic Management (UTM) conference. Kopadekar said that when it comes to NASA's work on developing a system to manage small, low-flying UAVs, "we have 125 collaborators and it's growing. ... We don't want to pick winners. We will want to set the parameters but keep the operation open." Dave Vos, "lead of Google's secretive Project Wing, which is working with NASA," said that everyone who wants to participate should because the competition will help the marketplace.

Bloomberg News (7/24, Levin) reported that Google is among the companies "who have signed agreements with NASA to help devise the first air-traffic system to coordinate small, low-altitude drones." The article noted that many details need to be worked out, including whether it "will be privately or publicly run – or even if it will be a single system."

Network World (7/14, Cooney) reports on NASA's efforts to develop the software that will allow UAVs to fly alongside larger planes in the national airspace. Maria Consiglio, head of the NASA Langley Sense and Avoid/Separation Assurance Interoperability, said, "The most difficult problem we are trying to solve is how do we replace the eyes of the pilot in the cockpit? We have developed, and are currently testing, detect-and-avoid algorithms. We're also running multiple research experiments to support the validation of this technology." Keith Arthur, a co-project engineer with the team, said, "NASA has taken a nebulous concept — well clear — and come up with an elegant mathematical solution for it that can be implemented in software. So those who are interested now can take that and run with it. They can make avionics software that will keep people safe." The article notes that the system is now being tested in simulations at Langley's Air Traffic Operations Lab.

The KING-TV Seattle (6/22, Farley) website reports on the Langley Research Center's efforts to safely integrate UAVs into the national airspace. Part of that work involves "realistic simulations" with "virtual airplanes and virtual drones" to determine how they can all share the skies without colliding, "one of flying's fundamentals."

Andrew Tarantola at Engadget (6/23) writes that NASA is testing a "sense-and-avoid system" for unmanned aircraft systems (UAS) at the Armstrong Flight Research Center as part of the Unmanned Aircraft Systems Integration in the National Airspace System (UAS-NAS) project. Project manager Laurie Grindle said, "Our team is working toward solving our common goal of overcoming the challenges of integrating UAS into the National Airspace System; a topic that has increasingly proved its relevance as several industries across the country identify the need to fly UAS. ... Completing these recent flight tests has brought us one more step toward accomplishing that goal." Under the first phase of the project,

Heather Maliska, Armstrong's UAS-NAS deputy project manager, said NASA's "researchers and project engineers will be gathering a substantial amount of data to validate their pilot maneuver guidance and alerting logic that has previously been evaluated in simulations" using a Ikhana UAV. The next phase in August will allow a Beechcraft T-34 "to both fly itself and communicate with air traffic control without human intervention."

The Utica (NY) Observer Dispatch (7/25, Cooper) reported that NASA will "work with all six of the sites selected nationwide for the testing of unmanned aircraft in civilian airspace," although the amount of work and the amount of NASA grant money each site will receive will differ. Oneida County is now working with Northeast UAS Airspace Integration Research Alliance (NUAIR) on its grant application. NUAIR's Lawrence Brinker stated that NASA has already visited the UAV test site at Griffiss International Airport "to learn more about what it has to offer."

Insurance. Business Insurance (7/14) reports that when a "drone manufactured by Australian-based Flirtey" makes its first delivery on July 17, it will usher in "a new chapter for aviation insurance coverage." The delivery of "medical supplies to a clinic in Virginia's Appalachia area" will be "a group effort by NASA, Virginia Tech and Mid-Atlantic Aviation Partnership." Kevin Kalinich, global practice leader for cyber/network risk at Aon Risk Solutions said that there is a new "intangible peril" with UAV deliveries because of hackers, which could cause a package, like a medical supply, to arrive late or not at all. Terry Miller, president of Transport Risk Management Inc., said that while it has never covered a case where a UAV was hacked, the company will probably issue insurance "if it's a risk that makes sense."

AUVSI (6/17/2015) Insurance company Allstate announced that it has received permission from the Federal Aviation Administration to fly unmanned aircraft to research property claims made by its customers. The work will be done as a part of the Property Drone Consortium, which was granted Section 333 exemption status by the FAA.

Analysis

It appears that issues involving UAS in the national airspace system are widely recognized and are being addressed by NASA with Langley participation. However, numerous issues remain.

USA Today (8/20, Della Cava) reports that British insurance giant Lloyd's of London just released a report of a risk report called "Drones Take Flight". It focuses on five factors "that could hamper the growth of businesses using unmanned aerial robots for jobs ranging from crop monitoring to parcel deliveries," which are all "critical" to firms insuring companies using drones. The five issues cited in the report are

1) the potential for hackers to redirect flights
2) a lack of standard international regulations
3) crashes resulting from poorly trained operators
4) privacy concerns
5) lax enforcement of regulations

Solutions include mandatory training for UAV operators and improved high-tech safety systems that include geo-fencing and drone-collision avoidance sensors, all appropriate topics for NASA research.

The following table includes these issues and others related to a range of applications.

Application/Issue	No visual contact	Hacking	Boundaries	Risk Management	Privacy	Training	Regs & Enforcement
Real estate	X		X	X	X	X	X
Power lines	X		X				X
Search and rescue	X		X	X			X
Movies			X	X		X	X
Package delivery	X	X	X	X			X
News collecting	X	X	X	X	X	X	X
Emergency response	X	X	X			X	X
Cloud seeding	X		X	X		X	X
Monkey tracking	X		X			X	X
Agriculture	X		X			X	X
Game poaching	X	X	X	X		X	X

Next Steps

Further analysis is needed to assess the relative importance of addressing the issues for each application and the relative importance of the applications. Initial values can be developed by a small group of analysts after brief reviews of the literature.

A subsequent step would design research projects to address the issues, keeping in mind the relative importance of the application areas. Again, project concepts can be developed initially by planners rather than subject matter experts to follow the logic of the process. The relative values of the projects can then be calculated as the product of the sum of their relative contributions to each application and the relative value of the application.

Relative cost estimates can then be made and project priorities established by their value/cost ratios. The end product would be a research program proposal with its justification clearly developed. This process permits discussion of the program to be focused on the variables used to establish value and cost. It also permits easy changes to the variables to develop alternative resource allocations in response to critical reviews. The process also permits identification of the sensitivity of the values of variables used in the process thereby providing guidance for efforts to improve their quality.

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