Assessing the Risks of Unmanned Aircraft Systems Integration (White Paper)

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The Policy

What it does
Provides conclusions and recommendations for the Federal Aviation Agency to improve its safety risk assessment approach for drones to effectively integrate into the Nation's Airspace.

Synopsis
In response to a request by the Federal Aviation Administration (FAA), the National Academies of Sciences, Engineering, and Medicine (NASEM) issued a summary report of its study of the risks inherent to the integration and certification of unmanned aircraft systems (UAS) into the National Airspace System. The NASEM committee, comprised of leaders from industry and academia, assessed how various stakeholders define and apply the concept of risk to draw the following conclusions for the FAA:

- Assessments of UAS risk to the public must be understood in comparison to the public's current risk assessments of other means of transportation prior to establishing UAS safety guidelines;
- Safety risks brought about by UAS should be considered in light of the safety benefits provided by the use of UAS;
- Risk assessment responsibilities can be delegated to industry partners and/or industry partners can be required to insure against UAS risks;
- Data collection and analysis will be imperative to inform risk assessments of UAS as the technology evolves; and
- Safety management as well as risk and performance-based approval processes of the FAA must be streamlined and made more consistent.

Considering these conclusions, the NASEM committee provided the FAA with the following 11 recommendations to improve the agency's assessment and mitigation of UAS-related risks:

1. FAA's consideration of requests for UAS certification and operation should be time bound and approval-oriented, providing applicants with specific suggestions for improvement in the event an application is denied;
2. The FAA should pursue a more holistic view of quantitative risk assessment for UAS including known risks for maintenance and emergency response tasks that would be mitigated by the approval of drones;
3. Within the next year, the FAA should publish guidelines for certifying UAS operations while considering probabilistic risk assessments provided by UAS applicants;
4. The FAA should pursue assessing the risks of UAS in comparison to other forms of risk to society and publish its findings and mitigation strategies;
5. The FAA should improve the Safety Risk Management Policies described in Order 8040.4B to rely on more quantitative assessments of UAS risks provided by UAS operation applicants;
6. The FAA should commit to providing timely feedback to UAS operation applicants and create an incentivization program to measure, promote, and reward the participation of UAS stakeholders assisting with UAS risk assessment;
7. The FAA should reorganize its management of UAS risk assessment to provide clear lines of authority, responsibility, and accountability. Technical training for risk assessment should also be provided to FAA decision makers;
8. The FAA should provide baseline levels of risk for categories of UAS operation and a means of requiring insurance in lieu of a separate risk assessment where the operation of a UAS deviates from its assigned category but the added risk is expected to be low;
9. Within six months, the FAA should collaborate with industry partners and the Drone Advisory Committee to establish minimum requirements for UAS safety datasets that can be voluntarily provided to the FAA for the Agency to distribute;
10. Where standards are not yet developed for new categories of UAS operation, the FAA should provide a standard set of requirements for operation that can be tailored to fit new needs and allow operation and data collection until standards can be set for the new UAS operation; and
11. The FAA should partner with national and international stakeholders in industry, academia, and the government to research methods and the interpretations of probabilistic risk analyses encouraged to be used in UAS risk assessment.
The Academies endorse a “more holistic approach to assessing UAS integration...based directly on risk... [and accounting] for mitigations to potential risks within the entire UAS system.” They conclude that safe integration of UAS operations based on these recommendations “has the potential to provide significant net safety benefits to society in addition to whatever economic benefit those operations might provide.”

Context

On June 28, 2016, the Federal Aviation Administration (FAA) published the **Operation and Certification of Small Unmanned Aircraft Systems** [17] (sUAS) which outlined the regulations governing the operation of sUAS in the National Airspace System (NAS). Following this policy, the FAA asked the NASEM to analyze the impacts of integrating UAS into the NAS. Accordingly, the NASEM “formed a committee that met three times between fall 2017 and early 2018.” This committee investigated the public health, safety, and economic growth consequences of UAS operation in the NAS and reported findings and recommendations to the FAA. The NASEM point out that the integration of UAS into the NAS is a “dynamic subject that was changing as the committee was finalizing its report and even during the report’s review.” After consideration of the NASEM’s findings and recommendations, the FAA announced an **advance notice of proposed rulemaking** [18] (ANPRM) on February 13, 2019 to consider additional rules and regulations to sUAS operations.

The Science

Learn About the Science

**Unmanned Aerial Systems Traffic Management** [19]

Science Synopsis

**Unmanned Aircraft Systems** [21] (UAS) are defined as any flying machine that is not piloted by a human aboard the system. These systems mainly present as winged aircrafts or copters, but UAS encompass all aircraft systems that are unmanned. The most common UAS are small UAS (sUAS), also known as drones, are characterized as being less 55 pounds including everything on board. UAS operate either by remote control of a human or by autonomous systems. These devices can be used for recreational purposes as well as commercial, federal, and educational operations. Some examples include using drones to capture photos or videos, **deliver packages** [22], and **aerial imaging and mapping** [23]. In the US, drones operate in the NAS.

The **National Airspace System** [24] is comprised of “a network of air navigation facilities, air traffic control (ATC) facilities, airports, technology, and appropriate rules and regulations that are needed to operate the
system." Operation in the NAS is dependent on aircraft type, weather, and flight rules. Under the ATC, the Unmanned Aerial Systems Traffic Management [25] (UTM) ensures the safe operation of UAS. UTM systems are a network for “communication and coordination between the FAA, UAS operators, and other stakeholders...through automated systems”. This is accomplished through services such as:

- **airspace design**[26]: the designation or restriction of specific portions of the atmosphere for operations
- **corridors**: sub-sections of an airspace that an aircraft is restricted
- **geofencing**[27]: a means of overriding UAS operations to restrict flight navigation
- **weather and wind avoidance**: the coordination with meteorological monitoring systems to prevent severe weather and wind impediment
- **congestion management**[28]: mitigation of risks associated with increased UAS use
- **terrain and collision avoidance**: assistance to ensure that UAS can sense and avoid obstacles
- **route planning, re-routing, and location management**: directions given by the UTM to determine appropriate location, speed, spacing, and sequencing of all UAS
- **contingency management**: anticipation of and reaction to possibility of deviating from flight plans

*de minimis* risk

The *de minimis risk principle* [29]“prescribes that decision makers ought to ignore sufficiently improbable risks in the decision-making process.” In this report, the NASEM suggest that an overly conservative approach to UAS certification and operational guidelines can inhibit the integration of these promising technologies. The NASEM provide four examples in which these behaviors can be undermining to the establishment of safety regulations:

- Transposition and assumption of the burden of safety. If the FAA takes on the burden of responsibility, which should bear on the operator, “the fear of making a mistake can drive an overly conservative risk culture.”
- Risk avoidance. Avoiding risk by having strict regulations can be counterproductive and “degrade overall safety and quality of life.”
- Overanalysis and overreliance on data. The FAA is demanding quantitative data, but at the same time, is prohibiting operations of UAS to collect these data.
- Status quo thinking. Maintaining the status quo seems conservative but can prevent the introduction of helpful technologies and, in turn, delay opportunities to implement safety procedures provided by these systems.

The NASEM hope that this concept of *de minimis* risk can help structure the development of acceptable levels of risk presented by UAS.

Dynamic Nature of UAS

The NASEM mention the increasing applications of UAS during the investigation and final review of their report. In their report, they highlight an *incident* [30] in which a drone was used to release an inflatable “rescue pod” to save two swimmers in Australia. The NASEM bring this to attention to acknowledge how integration of UAS into the NAS can increase risks to manned aircrafts and people on the ground, yet they can also be used to mitigate risk and save lives. As a result of this duality, the promise and potential of UAS “cannot readily be accounted for with current safety assessment processes.” This drives the foundation for the NASEM’s recommendations, which suggest that risk averse attitudes towards UAS operations can inhibit the “safety-beneficial operations” these systems can provide.
Scientific Assumptions

One of the key points in this report is how the conservative risk culture adopted by the FAA is inhibiting the potential of UAS. In making this claim, the NASEM assume that UAS are not as hazardous as the FAA makes them out to be. The Academies suggest that lack of “empirical data in this nascent industry” has resulted in overly cautious approaches to UAS risk management that are founded on subjective analyses.

The NASEM also assume the risks associated with UAS integration into the NAS can be classified under the *de minimis* risk principle. In doing so, the NASEM recommend the FAA ignore this negligible risk and change their traditionally risk averse attitude.

Relevant Experts

Michail Zavlanos [31], Mary Milus Yoh and Harold L. Yoh, Jr. Associate Professor in Mechanical Engineering and Materials Science, Pratt School of Engineering. Dr. Zavlonos specializes in networked control systems with a focus in flying and communication maintenance of robotic and sensor networks. The Challenge: Controlling Drones After You Lose Communication With Them [32]

Mary “Missy” Cummings [33], Professor in the Department of Mechanical Engineering and Materials Science. Her research interests include human-unmanned vehicle interaction, human-autonomous system collaboration, human-systems engineering, public policy implications of unmanned vehicles, and the ethical and social impact of technology.

Robert L. Winkler [34], James B. Duke Professor of Business Administration. Professor Winkler’s primary research areas include decision analysis, risk analysis, statistics, and forecasting.

The Debate

Scientific Controversies / Uncertainties

Matthew Kalas [35], an attorney in Locke Lord’s Litigation Department, posits that the perspectives presented by The Academies “may be more pabulum than real food for thought.” Just a few days before the report was released, The US Senate Committee on Homeland Security & Governmental Affairs held a hearing [36] to address the emerging threats of drones.

In the hearing, Senator Ron Johnson [37], the sponsor for the Preventing Emerging Threats Act of 2018 [38], says, “I am concerned that the federal government does not have the legal authorities it needs to protect the American public from [threats posed by malicious drones].” Kalas suggests the assumption of the *de minimis* principle held by the NASEM is ill-founded given this recent hearing.

In contrast, Patrick Byrnes [39], a partner in Locke Lord’s Litigation Department, affirms the NASEM’s points. Byrnes says The Academies’ findings “[echo] what many in the industry have been saying for years.” He suggests industry stakeholders have held sentiments that the FAA has been “overly conservative” in their risk assessments.
Endorsements & Opposition

Patrick Byrnes [39], Partner in Locke Lord’s Litigation Department and member of the Aviation & Defense Group, statement [40], June 12, 2018: “The National Academies of Sciences, Engineering, and Medicine’s report finding that the FAA has taken an “overly conservative approach to safety risk assessments” in attempting to integrate the commercial use of drones into the National Airspace System is a very welcome development, and echoes what many in the industry have been saying for years.”

Matthew Kalas [35], attorney in Locke Lord’s Litigation Department, statement [41], June 12, 2018: “The new FAA-funded report from the National Academies of Sciences, Engineering, and Medicine urging a probabilistic, risk-based assessment with strong words suggesting a top-down change in mindset at the FAA may be more pabulum than real food for thought... The Senate Homeland Security & Governmental Affairs Committee, just a few days prior, heard testimony on the pressing need to address the security risks posed by drones, yet the academies assumed as a ‘guiding principle’ to its report that the ‘introduction of UAS will not degrade safety or security.’”

Federal Aviation Administration, statement [42], June 11, 2018: “The report confirmed that the FAA executive team has a consistent approach to risk management. The specific recommendations are aligned with FAA’s ongoing efforts and we see them as an endorsement of our efforts and encouragement to accelerate our efforts particularly in the area of change management.”

Potential Impacts

The FAA has taken many of these recommendations into consideration. For example, the recommendation advising the “FAA should establish and publish specific guidelines for implementing a predictable, repeatable, quantitative, and risk-based process for certifying UAS systems and aircraft and granting operations approval” has been followed. On February 13, 2019, the FAA published an ANRPM on the Safe and Secure Operations of Small Unmanned Aircraft Systems [18].

Status

This report of the National Academies of Science, Engineering, and Medicine is the result of three meetings convened by the National Academies between Fall of 2017 and Winter 2018. It was published to the Federal Aviation Agency and made public on June 11, 2018.

This report has influenced FAA actions. As the FAA requested the NASEM to conduct this study, the FAA views this report as a piece of insight that can help shape policies regarding UAS operations. The FAA continues to revise its Operation and Certification of Small Unmanned Systems [17], as indicated with their ANPRM [18] (SciPol brief available [43]).

Related Policies

S. 3511 - Drone Safety Enhancement Act[44]
Creates funding for the Federal Aviation Administration to review standards, manage education, and coordinate
interagency efforts for operating Counter-Unmanned Aircraft Systems.

84 FR 3732 - Safe and Secure Operations of Small Unmanned Aircraft Systems

Seeks public comment regarding the public safety and national security risks associated with integrating unmanned aircraft systems into the National Airspace System.

H.R. 302 - FAA Reauthorization Act of 2018

Defines the authorizations of the Federal Aviation Administration, including (counter)drone operations, as well as sets safety standards and certification processes.

**Recommended Citation**


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- unmanned aircraft systems (UAS)
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