Flying over the Public: You Need to Know Who and What is Down There

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With pervasive introduction of diverse unmanned aircraft into hitherto unused volumes of the national airspace, potential injury and damage to people and assets on the ground (versus passengers aboard) is, for the first time, the primary subject of regulatory and liability safety concern. To most effectively, efficiently, and economically address this concern, aircraft operators, regulators, and insurers need specific, granular information about the numbers of people and value of property at risk beneath a specific route flown by a specified aircraft. In this paper, the authors describe an innovative new tool that provides such information in a user-friendly format, over the worldwide web--DownScan.

I. Background

FAA is taking the first real steps forward toward the promise of integrating UAS operations into the National Airspace System (NAS).

By Notice published on February 13, 2019[2], FAA is proposing to allow small UAS, under stated conditions, to fly over members of the public without a waiver. In general, the NPRM recognizes the reality that small UAS (Categories 1 and 2) are, or can be made to be, unlikely to cause significant harm to people and property on the ground and, if so, can operate with an acceptable level of safety under blanket approval based solely on their physical properties. As the aircraft increases in size and weight into Category 3 however, the potential for significant injury and damage to the public increases, and therefore FAA is imposing some operational precautions beyond physical innocuousness of the aircraft.[3]

Primary concern for people and property under the route of flight, as reflected in this NPRM, is new for the FAA. Historically, manned aircraft takeoff and land on unpopulated airport facilities and fly mainly in transit mode, under positive control over regular routings. As a result, death

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[2] 84 Fed. Reg. 3856

[3] The NPRM therefore proposes that: Category 3 UAS will be prohibited from flying over open air assemblies of people; or if they do operate over groups of people, those people need to be in an enclosed area and informed that UAS will be overflying; or that the UAV either not perform sustained flight over them, or that they be under a protective structure.

and injury to passengers and crews has been the main concern, while injury and damage to persons and property on the ground have proved statistically insignificant.[4] UAVs, in contrast, have no passengers or onboard crew to be concerned about. They fly random paths, often traversing or hovering over lots of people and over all manner of ground environments, primarily private property. Therefore, their primary inherent safety risk is injury and damage to the general public and property on the ground.

This disparity in primary risk concern between manned and unmanned aircraft is a distinction with considerable difference for UAS operators and the public. First, protection of the public on the ground (versus passengers and crew) will be the most important factor in FAA UAS certification and operational approval decisions. Second, UAS operators will face potential third-party liability risks that are very different in character from those applicable to manned aircraft operations, which will have to be accounted for by financial precautions and judicious flight planning.

II. Ground Injury and Damage Risk as the Primary Factor in Regulatory Approvals

FAA has tentatively concluded that Categories 1 and 2 small UAVs can be made sufficiently harmless, through structure alone, to fly under blanket approval over the general public with an acceptable level of injury or damage risk. Category 3 aircraft can fly under blanket approval on the basis of aircraft physical structure combined with operating restrictions. Some Category 3 operators may be able and willing to accept those operating limitations, namely avoiding populated areas, or controlling the ground environment over which they are flying. But the commercial vision for UAS is far more ambitious: Non-pilot dispatchers each managing many pre-programmed, fully automated vehicles flying beyond the line of sight. For these, and many of the envisioned UAS missions, conditions stated in the NPRM are far too limiting or impossible.

Moving to more aggressive missions and larger aircraft, operators who are not eligible for blanket approval will have to demonstrate to FAA that their operations can be performed with an "acceptable" level of safety. Because of their wide physical and operational diversity, it will be very difficult, if not impossible, for FAA to rely on traditional prescriptive standards to judge the safety of specific UAS. Instead, FAA's small UAS NPRM and a recent policy on "special class" type certification[5] introduce the innovative concept of certification/regulation by *proponent-proffered safety cases*. And for the first time, FAA is considering protection of the people and property on the ground--versus passenger/crew safety—as the primary consideration.

FAA must have a proactive role in this process going forward. FAA will now be establishing and declaring on what basis, and under what conditions generally it will consider UAS flights over the

[4] *See* "Common Risk Criteria Standards [321-07] for National Test Ranges: Supplement," pp. 5-34/38 (2007).
[5] On February 3, 2020, FAA proposed a policy whereby some UAS can be type certificated as a "special class" of aircraft under 14 CFR §21.17(b). FAA will announce and seek comment on the particularized airworthiness criteria for each such aircraft applicant as certification criteria for that class evolve. 85 FR 5905, https://www.federalregister.gov/documents/2020/02/03/2020-01877/type-certification-of-unmanned-aircraft-system

non-participating public "acceptably safe." Experts, among them the authors, have recommended that FAA consider as "acceptably safe" those operations that can be performed at a level of accidents and mishaps already prevailing in the subject piece of airspace (Target Level of Safety (TLS)),[6] which it can be asserted the public already accepts as reasonably safe.[7]

To implement this standard, a proponent for UAS operations should be prepared to proffer a two-part safety case. First, the proponent should demonstrate reliability/integrity of its vehicle and operation equivalent to the prevailing TLS in that area.[8] But second, the safety case should also contain a plan for protecting the public from any harm or damage that might occur as a result of the operation. This second element of the safety case would include: 1) a granular analysis and estimation of the environment, including population and property, overflown, (2) a showing that the operator has engaged, to the extent possible, in comparative route analysis and flight planning that minimizes the risk, and (3) that the operator is financially responsible, or has in place an insurance vehicle adequate to compensate any third parties who are injured or damaged if the flight goes awry.[9]

III. UAS Operators' Third-Party Liability to Anyone Injured or Damaged

Commercial airlines are liable *to passengers* under the normal rules of tort liability, which require the injured parties on US domestic flights to show that the airline was negligent or otherwise at fault in order to recover damages for death or injury resulting from a crash or mishap. Under international agreements[10], passengers on international flights and their representatives can recover limited amounts of damages without proving negligence or fault of the operator. For

[6] Matthews, et al., "An Achievable Path to UAS Integration in the NAS", https://www.safeaccess4uas.com/paper-uas-integration-nas.html ; FAA Sponsored Sense and Avoid Workshop, "Sense and Avoid (SAA) for Unmanned Aircraft Systems (UAS), Second Caucus Workshop Report," January 18, 2013.

[7] FAA Order 1100.161A, Ch. 5.1 (2/28/2020), https://www.faa.gov/documentLibrary/media/Order/FAA_Order_1100.161A.pdf. *See* also, European Union Aviation Safety Agency (EASA) Opinion No. 01/2020 Implementing Regulations, which in Article 2(b) states as the safety standard objective "maintain the current level of safety for manned aircraft." https://www.easa.europa.eu/sites/default/files/dfu/Draft%20COMMISSION%20IMPLEMENTING%20REGULATION%20on%20a%20high-level%20regulatory%20fram....pdf.

[8] Manufacturers may fulfill this role by testing, documenting results, and certifying aircraft types and models for reliability/integrity, etc. under stated operating parameters, which can be matched to the TLS in the proposed area of operation. *See* the following reference setting the TLS: Lin, Wescott and Fulton, "Target Level of Safety Measures in Air Transportation—Review, Validation an Recommendations (2009), https://www.researchgate.net/publication/265251293_Target_Level_of_Safety_Measures_in_Air_Transportation_-_Review_Validation_and_Recommendations; Busch, "Methodology for Establishing a Target Level of Safety" (1985), http://www.tc.faa.gov/its/worldpac/techrpt/cttn85-36.pdf ; FAA Operational Metrics, https://www.faa.gov/data_research/aviation_data_statistics/operational_metrics/ .

[9] FAA completes and enforces that protective construct through its new rule requiring that the UAS registration be prominently displayed on the outside of the vehicle. This measure will allow any aggrieved member of the public to itself identify the offending aircraft and operator, and seek redress from any insurance coverage in place, or if necessary in court under legal tort liability principals.

[10] *See* "Airplane Accidents", https://www.justia.com/injury/motor-vehicle-accidents/airplane-accidents/; "Liability in Plane Crashes," https://planecrashlawyersnetwork.com/liability/

airlines or other passenger carrying aircraft, the number and characteristics of passengers—and thus their primary potential liability for injury and death—are known or fairly easily calculable, and insurable.

By contrast, jurisdictions may apply the common law rule of strict liability to persons and property *on the ground* who are injured or damaged by aircraft.[11] This means that, in those places, the operator of the aircraft--especially a UAV which at this point is a fairly new and innovative technology for many users--is fully liable without dollar limitations, regardless whether or not the operator is negligent or at fault. In short, in many places there will be no such thing as a non-compensable UAS "accident". And FAA's new rule requiring UAS to display registration information on the outside of the airframe is going to make it much easier for persons aggrieved to identify and pursue the owner of an offending aircraft.

Consequently, UAS operators must be prepared to pay members of the public for any and all loss or damage caused by their vehicle, regardless of how careful or faultless their operation, even if the accident or mishap is caused by bad weather or other natural phenomenon. And UAS operators cannot necessarily rely on the aircraft manufacturer to assume liability or make good on a damage claim when a mishap occurs. The injured party's first recourse for a lawsuit is always the aircraft operator. Only if the operator proves that a defect in the aircraft led to the mishap can he or she recover the damage claim loss from the manufacturer.

UAS operators clearly face significant financial jeopardy. Only the most financially capable operators, or those who can somehow be sure that they are flying over completely open territory, should risk flying without some sort of third-party liability insurance coverage.[12] But without specific information about ground assets under specific flight paths, operators cannot be sure that the area below is risk-free, and insurance underwriting has to cover the highest potential injury and damage risks within the aircraft's general area of operations and performance capabilities. Drone insurance is becoming more and more available, but without much historical loss information or precise information about ground assets at risk it is difficult to assess correctly what is the right coverage for a particular flight. Under these circumstances, UAS operators are potentially flying under-insured, or may be paying for costly over-insurance.

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[11] *See* Geoffrey Christopher Rapp, *Unmanned Aerial Exposure: Civil Liability Concerns Arising From Domestic Law Enforcement Employment of Unmanned Aerial Systems,* 85 UND L. R. 623 (2009), https://law.und.edu/_files/docs/ndlr/pdf/issues/85/3/85ndlr623.pdf ; David I. Levine and Carel J. Stolker, *Compensation for Damage to Parties on the Ground as a Result of Aviation Accidents,* 22 Air & Space L. 60 (1997), http://repository.uchastings.edu/faculty_scholarship/1330 ; William L. Prosser, *Law of Torts (4th Ed.)* pp.514-516 (1971)*;* Lawrence Vold, *Strict Liability for Aircraft Crashes and Forced Landings on Ground Victims Outside of Established Landing Areas,* 5 Hastings L.J. 1 (1953), https://repository.uchastings/hastings_law_journal/vol5/iss1/1 ; *cf.* William C. Wolff, *Liability of Aircraft Owners and Operators for Ground Injury,* 24 J. Air. L. & Com. 203 (1957), https://scholar.smu.edu/jalc/vol24/iss2/4/

[12] E.g., European Union Aviation Safety Agency (EASA) Opinion No. 01/2020 Implementing Regulations Article 18(8) would require UAS operators to have "required liability and insurance cover appropriate to the risk of the service(s) provided…." https://www.easa.europa.eu/sites/default/files/dfu/Draft%20COMMISSION%20IMPLEMENTING%20REGULATION%20on%20a%20high-level%20regulatory%20fram....pdf.

IV. The Need: Custom Information

The authors suggest that the best way to protect the public from harm, reduce the risk of liability for UAS operators, and "right size" their insurance coverage is to get smarter about who and what is on the ground beneath specific flight paths. It will be even better if the people and asset values at risk along the route are adjusted to take into account the probability of a mishap, and the nature and extent of possible damage unique to physical and operational characteristics of the specific UAS. This information will allow operators to flight plan around the highest risk routings, and to have in place insurance coverage sufficient to compensate anyone injured or damaged, without incurring unnecessary costs by over-insuring. It is hoped that insurers will use this information for more precise risk analysis that minimizes insurance premiums for lower risk operations, and offer the more innovative and accessible coverages such as per flight insurance. The route specific information also will provide regulators a tool by which to better evaluate an operator's proposal[s], and proffered TLS benchmark.

V. The Solution: DownScan

Estimating the third-party liability risk to people and property on the ground under specific flight paths is, however, complicated. UAS routes overfly areas of varying population density, and private property of variable value. The potential loss risk over specific routings can vary widely. Data for such calculations, however, exists.

DownScan's developers[13] have created a tool for extracting such information and associating it with specific aircraft routings in a user friendly format—**DownScan**. DownScan is a proprietary[14] web-hosted tool that identifies the risk of encounters with people and property on the ground beneath a specific aircraft's route or pathway and converts it into useful and easily comparable dollar values.

It is designed to help aircraft operators explore and compare alternative routings for the purpose of deciding whether or not to undertake a particular flight or mission, managing or minimizing risk to third-parties by choosing less or least risky routes, and informing decisions about how much third-party liability insurance to buy. Government certifiers and regulators can use DownScan as a measure in determining the relative safety acceptability of an aircraft certification or operation proposal vice a benchmark TLS. And insurers can use DownScan values for underwriting analysis and pricing.

DownScan values are automatically computed using the best publicly available data on populations and local real estate values, including census data. The total asset and human life values at risk beneath a particular route are adjusted according to the physical and performance characteristics of the specified aircraft. For example, small, slower, more frangible aircraft can be expected to cause less damage or severe injury than larger, harder, faster ones. These

[13] *See* http://www.downscan.com/about.html#team for information about the DownScan developers.
[14] US Patent Application No. 62/614665 (01/08/2018) pending

calculations are based on sophisticated formulae developed by the DOD, NASA, FAA and research institutions, through extensive testing and research on dedicated Test Ranges.

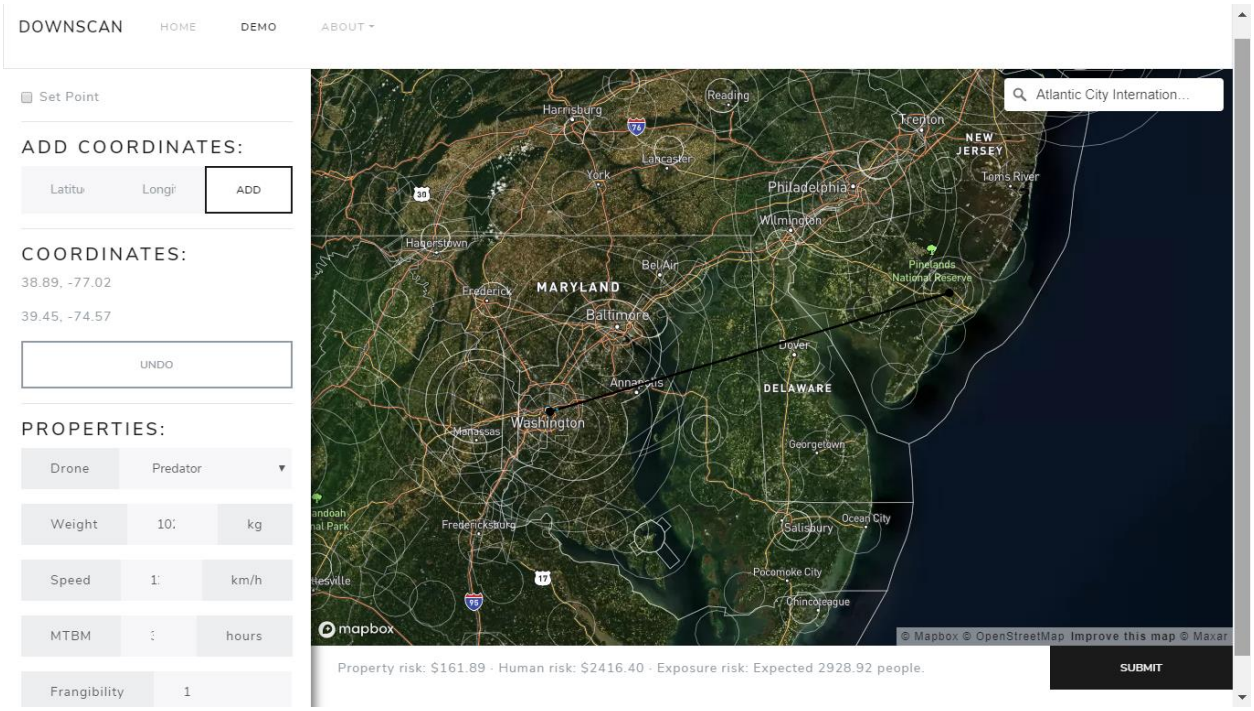
DownScan generates and displays the following outputs:

- *Property Risk.* Actuarial risk in dollar value for residential property damage based on property values and density as well as aircraft characteristics
- *Human Risk.* Actuarial risk in dollar value for human life based on population density and aircraft characteristics
- *Exposure Risk.* The total number of people under the aircraft path (width of the path is aircraft-dependent).

Because of the constant moving and changing activities of populations and fluctuating real estate values over time, DownScan values can be an estimate only, but are an informed estimate based on the most reliable, most granular data available at a given time. DownScan's developers will continuously update the DownScan to access newer or better population and property data bases as they become available, and over time add additional vehicles and their characteristics to the Aircraft drop down menu.

VI. How to Operate DownScan

Using DownScan is easy. The user goes to http://www.downscan.com and clicks on the tool page. He/she draws a proposed route by (1) entering origin, destination, and waypoint addresses in a search box, or (2) navigating, scrolling and clicking points on an active map display, or (3) entering geographical coordinates of route points into data boxes. Next, he/she inputs the aircraft's physical and operating characteristics by either selecting an aircraft from the dropdown menu, or entering custom information into data boxes. Then, clicking the SUBMIT button beneath the map prompts DownScan to compute and display the potential risk values, which appear beneath the map display. The screenshot below shows a sample DownScan analysis of the route between FAA headquarters in Washington, DC, and the FAA Hughes Technical Center in Atlantic City, NJ, using a Predator aircraft. DownScan values appear in small print beneath the map.



VII. Conclusion

Aviation policy makers, scientists and regulators are struggling with the thorny problem of how to integrate widespread operation of large numbers of diverse unmanned aircraft into the National Airspace, while at the same time protecting people and property on the ground from injury and damage.

Granular and specific information about who and what is on the ground beneath the proposed flight path can immeasurably improve the ability of operators to minimize risk through informed flight planning. And the public is most effectively and most economically protected against the consequences of an accident or incident through right-sized insurance coverage based on the best information available about who and what is at risk.

By providing this information, DownScan now enables UAS operators to fly over people with the minimum level of risk and the maximum level of responsibility, and gives FAA a tool for assessing and assuring acceptable protection of the public while simultaneously opening the door to increased integration of UAS operations into the NAS.