The Leading Edge: Innovation in U.S. Aerospace

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Written Testimony

of

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Chairman Larsen and Ranking Member Graves:

Thank you for inviting me to testify before the House Committee on Transportation and Infrastructure, and Subcommittee on Aviation. It is an honor to speak with you today about the historic and exciting work underway within The Choctaw Nation of Oklahoma to help safely advance commercial drone operations into our national airspace system. Our efforts have thus far clearly demonstrated some of the quantifiable benefits to society from drones, with agriculture and public safety being examples of impactful applications for us. Among other benefits, we are finding that drones can reduce the risk of injury to workers, improve productivity, and assist first responders.

I currently serve as the Executive Director of Advanced Technology Initiatives with the Choctaw Nation. The Choctaw Nation of Oklahoma is the third largest federally-recognized Native American Tribe, and the Choctaw Nation reservation is comprised of approximately 11,000 square miles in southeastern Oklahoma. I was fortunate to grow up in the heart of the Choctaw Nation, and both sides of my family have lived in that area for multiple generations. I have great respect and appreciation for the Choctaw people and Choctaw culture.

My professional career has revolved around transportation technology, and I have a fascination and passion for both the technology and policy aspects of transportation. I serve as a Transportation Commissioner with the Oklahoma Department of Transportation, and in that role I'm involved in the oversight and governance of our state transportation network of highways and bridges. I also serve on the Board of Directors of the Commercial Drone Alliance. My degrees are in aerospace and mechanical engineering, and for the first twenty years of my career I was a technologist, but I became actively involved in policy about fourteen years ago. During my career I have also been a university research administrator, an executive in the defense industry, an entrepreneur, and an engineer with the federal government.

Background on The Choctaw Nation of Oklahoma Drone Integration Efforts

In 2018, the Choctaw Nation made history by becoming the first and only tribal government to be selected by the U.S. Department of Transportation to participate in the Drone Integration Pilot Program - or "IPP". The Choctaw Nation of Oklahoma was selected as part of a group of lead participants consisting of tribal, state and local governments to focus on safely accelerating the integration of drones into our national airspace system. This was historic for the Choctaw Nation since, prior to the IPP, tribal governments had not been eligible to participate in many technology-related federal government-sponsored pilot programs. The Choctaw Nation of Oklahoma is also the first tribal government to be recognized by the FAA as a public aircraft operator or "PAO". We are proud to have an active role in the safe integration of drones into the national airspace system to support important applications for rural and tribal communities, where we believe that drone technology can improve our quality of life, health, and safety.

In 2020, the Choctaw Nation was invited to continue our collaborative relationship with the FAA as part of the FAA BEYOND program, which is focused on advancing beyond visual line of sight – or "BVLOS" – drone operations, as well as cargo delivery by drone. As part of both the IPP and

BEYOND, we are also focused on community engagement with public stakeholders. It has been exciting to be part of the Choctaw Nation team as we have accomplished many historic firsts for tribal governments in this exciting area of emerging aviation technology.

Although we have made progress in the IPP and BEYOND in understanding how the aviation safety regulatory system needs to evolve to integrate drones into our national airspace, overall our regulatory system is lagging behind the pace of technological advances, hindering the industry unnecessarily. Notwithstanding the best efforts of regulators to date, many advanced drone operations remain highly limited and highly reliant on a patchwork of unwieldy, one-off regulatory waivers rather than a stable and standardized regulatory foundation. Obtaining these limited waivers can be very time-consuming, and getting a waiver once will not necessarily make it easier to get the next waiver. Absent regulatory modernization, industry faces regulatory uncertainty that discourages investment and threatens the survival of companies attempting to innovate here in the United States. Sadly, we have witnessed very well-organized companies that were staffed with very qualified technologists abruptly close and cease operations, defeated by the lack of a clear regulatory path that enables regular operations.

Importance of Emerging Aviation Technologies

The Choctaw Nation of Oklahoma has an interest in emerging technologies because we see technology as a potential equalizer for opportunities in rural and underserved communities. As we have seen in the past, technology advancements can often help rural and remote areas make dramatic strides in improving the quality of life for communities. In my own lifetime, I have witnessed this with telecommunication technology, where today even the most remote areas of the globe can be connected through technology, and access to knowledge has expanded immeasurably.

Drones are the result of technological advancements in many areas. Distributed electric propulsion allows us to design drones that can weigh less than a pound as well as drones that weigh thousands of pounds, and virtually any size in between. Advances in electronics and onboard avionics allow an ever-improving level of safety, controllability, and reliability of these systems. Advances in machine learning and image processing can allow the development of systems that can analyze and respond to a physical environment in ways that a human physically cannot. The technology that supports drones continues to advance quickly, and in ways that can be harnessed to advance the safe, efficient, secure, and environmentally responsible use of the airspace.

The U.S. safety regulatory system for civil aviation has an enviable record of stewardship over the busiest and most complex aviation and airspace system in the world. To sustain this vibrancy, however, that regulatory system needs to evolve to enable and support emerging technologies and new entrants into the national airspace system. Our aviation safety regulatory framework is premised in large part on human eyesight as well as humans communicating with each other one at a time to safely coordinate flight activities. When humans are no longer in the aircraft, and the aircraft flies beyond the line of sight of a remote operator or pilot, then our safety regulatory system is simply not yet accommodating. Modernizing the regulatory framework is crucial in order to fully avail ourselves of the many potential benefits of emerging drone technology.

We are also at a time in our history when there is an increasing level of overlap between advanced ground transportation technology and emerging aviation technology. The growing prevalence of electric propulsion in both ground and aerial vehicles means that we will have common infrastructure challenges related to power availability, battery technologies, and charging stations. This will directly impact areas such as airport construction and modernization. Low-altitude aviation operations with drones will also benefit from broadband buildouts similar to the ways that advanced ground vehicles will leverage inter-connectiveness to achieve constantly improving levels of safety and operational efficiencies.

Overview of the Economic and Social Benefits of Drone Technology for Tribal Communities

Remote and rural areas within the United States – including Native American tribal lands and surrounding regions – have unique challenges that may be addressed by the use of small drones. The three primary areas where drones show promise are improving efficiencies with agricultural production, improving public safety, and enabling efficient infrastructure inspections.

It is important to note that there are also overlaps among these three areas. For example, not only can small drones be used to improve efficiency for agricultural operations, but they can also be used to address emergency response challenges for rural agricultural applications such as responding to medical emergencies that may occur involving large agricultural operations.

Some aspects of using small drones for public safety applications will also directly benefit scientific research, particularly in our understanding the atmosphere at lower altitudes and studying the lower atmospheric boundary layer to improve understanding of severe storms and ultimately improving severe storm prediction and forecasting capabilities. This improved understanding can in turn benefit the development of UAS Traffic Management (UTM) systems by creating drone management and safety systems that can accommodate dynamic weather conditions and flight conditions at low altitudes and at finer resolutions than is currently possible.

Addressing Rural and Remote Infrastructure Inspection

Traditionally, piloted helicopters have been used to inspect power lines as part of maintenance programs. These types of inspections can sometimes cost $1,000 or more[1] per hour, and can put the lives of the pilot and crew at risk of serious injury or death (an inspection typically requires both a pilot and also an observer/inspector within the helicopter). Drones can cut costs of inspections and also reduce risks to human life since the operations are “low, slow and near the live wire”.

Tribal governments are also growing increasingly reliant on small drones for a variety of GIS-related tasks to support tribal government operations and needs. Within The Choctaw Nation of Oklahoma GIS operations currently, a small drone flight operation can cost $500 each (including

[1] https://ac.els-cdn.com/S2212827113006823/1-s2.0-S2212827113006823-main.pdf?_tid=ca7d5d82-8ba4-4144-9f45-c2533115c2c4&acdnat=1527878253_f77e8b4ca794b4b5e553a30add32eb53

costs for transportation, labor, supplies, etc.). When operated under a visual line of sight, or VLOS scenario, a typical GIS mapping or inspection mission can require multiple flights. For example, a single beyond visual line of sight (BVLOS) flight with a range of 2.5 miles could replace as many as five (5) or more VLOS flights, resulting in as much as a 5-to-1 cost saving. When BVLOS operations are enabled for GIS operations, higher productivity and lower operational costs can be achieved.

Addressing Delays in Medical Response in Rural Areas

In 2017, Reuters Health reported on the results from a study[2] published in the Journal of the American Medical Association (JAMA) Surgery that analyzed the differences in wait times for emergency medical services between urban and rural areas. Whereas wait times averaged 7 minutes in urban settings, rural settings had wait times of 14.5 minutes or more (and some wait times could be up to 30 minutes or more for rural areas). For very large agricultural operations in very remote areas, wait times could be significantly more than 30 minutes.

In the case of heart attacks, extended wait times can prove fatal. For example, it has been reported that access to automatic external defibrillators (AEDs) when used swiftly in the first 3-5 minutes of a person collapsing have been shown to dramatically increase the survival rate of people suffering from cardiac arrest[3], since brain cells begin to die after 4-6 minutes of oxygen deprivation. Unfortunately, wait times in rural areas more often prove problematic and fatal in these situations.

Another important health challenge in rural and remote areas is emergency delivery of insulin, epinephrine, or related drugs and medications that can be critical for treating emergency medical conditions. Even if medical professionals and first responders are on the scene of a medical emergency, their response can be hindered by lack of available equipment or supplies.

Small drones can fly in direct paths and arrive on scene much faster than ground vehicles such as ambulances. Assuming a 30 second preparation time before launch, a small drone can easily reach any location within a 4.5 mile radius of launch within 5 minutes (or less), providing more than a 63 square mile area that can have a response of 5 minutes or less. However, these scenarios would typically require beyond visual line of sight (BVLOS) and also possibly night operation capabilities.

Addressing Farming and Ranching Occupational Hazards

According to the 2016 Census of Fatal Occupational Injuries[4], farming and agricultural operations ranked 8th in the list of "most dangerous jobs" in 2016, with an average of 23.1 fatal injuries per

[2] https://www.reuters.com/article/us-health-emergency-response-times/be-prepared-for-ambulance-wait-times-idUSKBN1A42KQ
[3] http://www.cprandfirstaid.net/cpr/aed-guidelines.html
[4] https://www.bls.gov/news.release/pdf/cfoi.pdf

100,000 workers. Additionally, the CDC reports that every day about 100 agricultural workers suffer a "lost-work-time" injury[5].

In 2017, the National Children's Center for Rural and Agricultural Health and Safety released a report card and estimated that every three days a child dies in agricultural-related incidents[6]. Around 17% of those deaths involved motor vehicles, including all-terrain vehicles (ATVs). For "working youth", tractors were the leading source of fatalities followed by ATVs.

Livestock and herd-based agricultural operations have unique occupational hazards. These types of operations typically require a significant amount of surveillance activities and travel/movement on the ground, including:

- Visual inspection/observation/surveillance using ground transportation (ATVs, farm trucks, etc.) to assess complete inventory status and overall health
- Locating animals that are separated from the herd that make them vulnerable to attacks by predators or other potential risks
- Periodic inspection of very long fence lines to ensure the integrity of the fencing system
- Identification and tracking of dangerous predators and/or invasive species such as wild feral hogs
- Surveillance and inspection of water sources and feedstocks to ensure integrity
- Assessment and management of grazing patterns and plans to ensure healthy use of land and resources

Searches for lost animals that have separated from the herd can be time-consuming, disruptive to ongoing operations, and expensive. For example, a cow may separate from the herd when she is about to give birth, which can put the cow and calf at risk of attack and death by predators. Complications with the birth can also put both animals at risk. The loss of a cow/calf combination can result in a financial loss of $4,000 or more for the agricultural producer based on beef prices. Cattle producers can spend a significant amount of time searching for a lost herd animal, many times at night, which increases the risk of injury or death to the agricultural workers that are involved. There are additional costs due to the depreciation of ground vehicles used in these searches, since often times farm trucks or ATVs are used to cover remote rough terrain.

Many agriculture-related injuries and deaths occur in remote rural locations. As noted earlier, rural and remote locations have much longer emergency management response times, since it physically takes longer for an ambulance or first responder to arrive at the scene of an accident or injury. Injuries that occur with livestock and herd operations can have even worse response times since in addition to limited roads and highways in the rural locations, the actual scene of the injury or accident may be at a significant distance from any roadways and not easily accessible by vehicle. For example, depending on the location within the Choctaw Nation's own 44,000+ acre ranch operation, it could take up to an hour or more to reach a remote site within the ranch boundaries

[5] https://www.cdc.gov/niosh/topics/aginjury/default.html
[6] https://agfax.com/2017/04/24/farm-and-kids-every-3-days-a-child-dies-in-ag-related-accident/

using ground vehicles. As noted earlier, these types of delayed response times can prove fatal in some situations.

Impacts on STEM and Workforce Preparation

A very positive impact of the IPP and BEYOND on The Choctaw Nation of Oklahoma has been with science, technology, engineering and mathematics (STEM) and future workforce development. The visibility of our drone research and testing activities has stimulated interest for our K-12 students and our STEM educators. The Choctaw Nation of Oklahoma has leveraged this interest to create drone camps for our Choctaw youth as well as other opportunities to support STEM activities within our region and to work to ensure a future workforce pipeline to support emerging aviation technologies.

Many of the public schools within our region are in historically impoverished areas that have been underserved. The visibility of our IPP and BEYOND activities coupled with the heightened interest in STEM as a result of those activities, is enabling us to reach students at an early age where positive STEM experiences and exposure to STEM opportunities can help instill confidence and strengthen interest in future STEM careers. STEM outreach and future workforce development will remain a priority of our emerging aviation efforts within The Choctaw Nation of Oklahoma.

Enhancing Weather Research and Forecasting

A major challenge for improving the predictions and forecasts for severe storms is achieving a better understanding of the lower altitudes of the atmosphere, particularly the lower atmospheric boundary layer. In 2009, the National Research Council[7] stated the following:

> *"The vertical component of U.S. mesoscale observations is inadequate. Assets required to profile the lower troposphere above the near-surface layer (first 10) are too limited in what they measure, too sparsely or unevenly distributed, sometimes too coarse in vertical resolution, sometimes limited to regional areal coverage, and clearly do not qualify as a mesoscale network of national dimensions. Likewise, vertical profiles below the Earth's surface are inadequately measured in both space and time. The solutions to these particular deficiencies require leadership and infrastructure investments from each of the pivotal federal agencies."*

For the past several years, researchers at Oklahoma State University (OSU) and the University of Oklahoma, in collaboration with National Oceanographic and Atmospheric Administration (NOAA) and the National Science Foundation (NSF) have conducted research to determine the feasibility of using small drones to "profile" and observe atmospheric conditions at low altitudes in a repeated manner. The Choctaw Nation of Oklahoma is proud to be a collaborative partner with these institutions as part of this research. The results have been very promising thus far, and it is believed that this improved data collection could have a profound impact on the accuracy of

[7] https://www.nap.edu/download/12540

weather models and our overall understanding of the atmosphere at the lowest altitudes (which are most critical for understanding severe weather phenomena). The potential benefits of monitoring and measurement of the lower altitude atmospheric conditions could result in extended warning times for severe weather, including tornadoes, and also improved accuracy when issuing severe storm warnings. On average, dozens of deaths occur in the United States each year from tornado outbreaks[8].

In addition to public safety benefits arising from improved understanding of lower altitude weather conditions, it is also likely that this information and understanding will improve path planning and routing for low altitude drone operations, particularly when operating within a future UTM framework. Smaller drones are more susceptible to lower-intensity weather events like gustiness. Current weather models utilize grids that are too coarse for practical benefit to UTM systems. Improved observations and monitoring can assist in developing more refined and accurate weather models for low altitude observations, which ultimately can enhance safety and reliability of small drone operations.

In order to utilize small drones for observation and monitoring of the lower boundary layer in a meaningful way, it will be necessary to move away from visual line of sight (VLOS) operations with ground crews and toward "one-to-many" and "unattended" operational scenarios. Therefore, "one-to-many" and BVLOS challenges are the significant regulatory hurdles to enabling widespread use of small drones for regular atmospheric vertical profiling on a scheduled and recurring basis. These "vertical atmospheric profiling" operations will represent a unique type of BVLOS mission and operation, since the small drones will often be tightly-constrained within a cylindrical volume of the lower altitudes, and the operations will occur on known intervals and schedules (such as regularly every half-hour or hour).

Improved weather observations will have two potentially quantifiable impacts: 1) potential reduction in lives lost due to severe weather (when wide-scale monitoring and observations are in practice and use and data can be successfully ingested into predictive weather models); and 2) improvement in planning and routing for operations like drone deliveries (reduction in the loss of platforms and payloads due to gustiness and low-intensity weather phenomena).

Specific Recommendations for Congress

In conclusion, we need support and mandates from Congress to more efficiently transition the lessons that we learn from initiatives like the IPP and BEYOND into permanent reform to our regulatory system. We simply cannot remain in a regulatory state where operations are only enabled by limited case-by-case exemptions and waivers, since this is not a long-term practical approach to managing regular expanded aviation operations.

To accomplish this, I offer two specific recommendations for consideration to enable a safe acceleration of drones into the national airspace system. For additional recommendations, please

[8] https://blog.nssl.noaa.gov/nsslnews/2009/03/us-annual-tornado-death-tolls-1875-present/

see the Commercial Drone Alliance's 2021 UAS and AAM policy priorities documents, included as an appendix to this statement.

First Recommendation: Codify the BEYOND Program and Provide Funding. The first recommendation that I offer is for Congress to codify the BEYOND program, and to provide a statutory foundation for the program with clear congressional direction and oversight. The BEYOND lead participants have made - and are making - substantial investments of resources, money and time to support research and testing to safely integrate drones into the national airspace. Any legislation addressing BEYOND should include provisions for reporting and accountability of the FAA directly to Congress. Although the legacy FAA drones test sites are eligible for grant funding from NASA and the FAA, the BEYOND lead participants are often excluded from consideration for funding from programs such as the UTM Pilot Program (UPP). The BEYOND lead participants should also be eligible to receive funding from the FAA and NASA to support more generalized integration efforts and be allowed to fully participate in these initiatives. The BEYOND lead participants are making important contributions to a critical national policy challenge, and it is important that these entities be eligible for federal funding and support.

Second Recommendation: Enable Site-Specific Regular Operations. The second recommendation that I offer is to mandate that the FAA accelerate opportunities for communities and sites that can demonstrate the ability to safely scale regular operations, such as drone delivery. Some sites, such as The Choctaw Nation of Oklahoma, have already made significant investments in ground-based radar and other safety infrastructure and mitigations to support safe drone operations today. This can serve as an opportunity for industry to innovate and demonstrate economic viability by allowing these sites to move forward and scale their low-risk low altitude drone operations.

The Choctaw Nation of Oklahoma has made significant investments based on our own bold and ambitious vision and plans. We believe the future is bright, and that our quality of life can be enhanced by responsibly harnessing emerging aviation technologies. But we need the federal government's full support to ensure that these technologies flourish and provide the benefits to society that we strongly believe are possible.