The First 1,000 Commercial UAS Exemptions

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ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

EXECUTIVE SUMMARY

In late May 2014, the Federal Aviation Administration began accepting petitions for exemption to operate unmanned aircraft systems (UAS) commercially in the U.S. National Airspace System without an airworthiness certificate, which is allowed under Section 333 of the FAA Modernization and Reform Act of 2012. The agency approved the first set of commercial operators on Sept. 25, 2014 — six film and television production companies.

In the first year accepting exemption requests, the FAA approved almost 500 out of about 1,500 petitions. As of Sept. 1, 2015 the FAA had approved 1,407 out of over 2,650 petitions. The agency continues to approve about 50 new operations a week, a process expedited by the FAA rolling out a summary grant process where similar petitions are batched and analyzed together rather than individually. However, the number of applicants continues to greatly outpace approvals.

The flood of commercial exemption requests to the FAA shows that a mature UAS commercial market is waiting to be unleashed. Given the technology's potential, it is important that the FAA finalize small UAS rules as quickly as possible. Moreover, Congress needs to pass — and the president needs to sign into law — an FAA reauthorization measure before the current authorization expires on Sept. 30, 2015.

Equally as important, government and industry need to work together to permit expanded uses of UAS technology that pose no additional risk to the airspace system. For example, whether within the context of the rule, through the FAA reauthorization measure or by other means, we need to allow for beyond-visual-line-of-sight, nighttime operations and operations over heavily populated areas. Otherwise we risk stunting a still-nascent industry and restricting the many beneficial uses of this technology.

Despite the commercial UAS industry being in its infancy, companies across the U.S. are involved with manufacturing and operations, and the positive effects of finalized rules for airspace integration will be felt across the country.

KEY FINDINGS

The initial data show adoption of this enabling technology across many industries and in every corner of the U.S., foreshadowing great promise for the future of the UAS use.

Approved Operators

- There are approved operators from 49 states
- California has the most with 114, followed by Florida with 97 and Texas with 82.

Manufacturers of Approved Platforms

- California companies also manufactured the most platforms mentioned in approvals, totaling 140
- Florida follows with 19
- In all, 22 states house manufacturers of platforms.

Industry Use

- The exemptions also span more than 25 major industries, led by general aerial photography, which was mentioned in 512 of the first 1,000 exemptions
- Real estate followed with 350
- General aerial surveying, 301
- Agriculture, 164
- Construction, 134
- Film and television, 91
- Utility inspection, 78
- Environmental uses, 61
- Search and rescue, 52
- Emergency management, 38
- Insurance, 25.

Business Analysis

- At least 84 percent and as many as 94.5 percent of all approved companies are small businesses.
- Still, the 320 companies with data listed with research firm Hoovers add about $500 billion to the U.S. economy annually and represent 600,000 jobs.

Platforms

- The estimated cost for all approved platforms was over $10.7 million.
- About 1018 out of the 1480 total platforms were manufactured by DJI worth just over $2 million.
- The U.S. led the way with platform sales over $3.6 million for 256 platforms.
- Canada was just behind the U.S. at over $2.5 million, with only 35 platforms.

Prior to this year, data on commercial UAS operations in the U.S. were nonexistent. Now, we have been able to take a look at early trends regarding safe commercial operations and can establish a basis for recommendations for future growth.

It is clear in the data that, even though many industries have started to benefit from UAS operations, beyond-line-of-sight operations, operations over congested areas and nighttime operations will be critical to achieving the full societal and economic benefits of UAS use. To achieve this, a risk-based, technology-neutral regulatory framework will be essential to getting this industry off the ground.

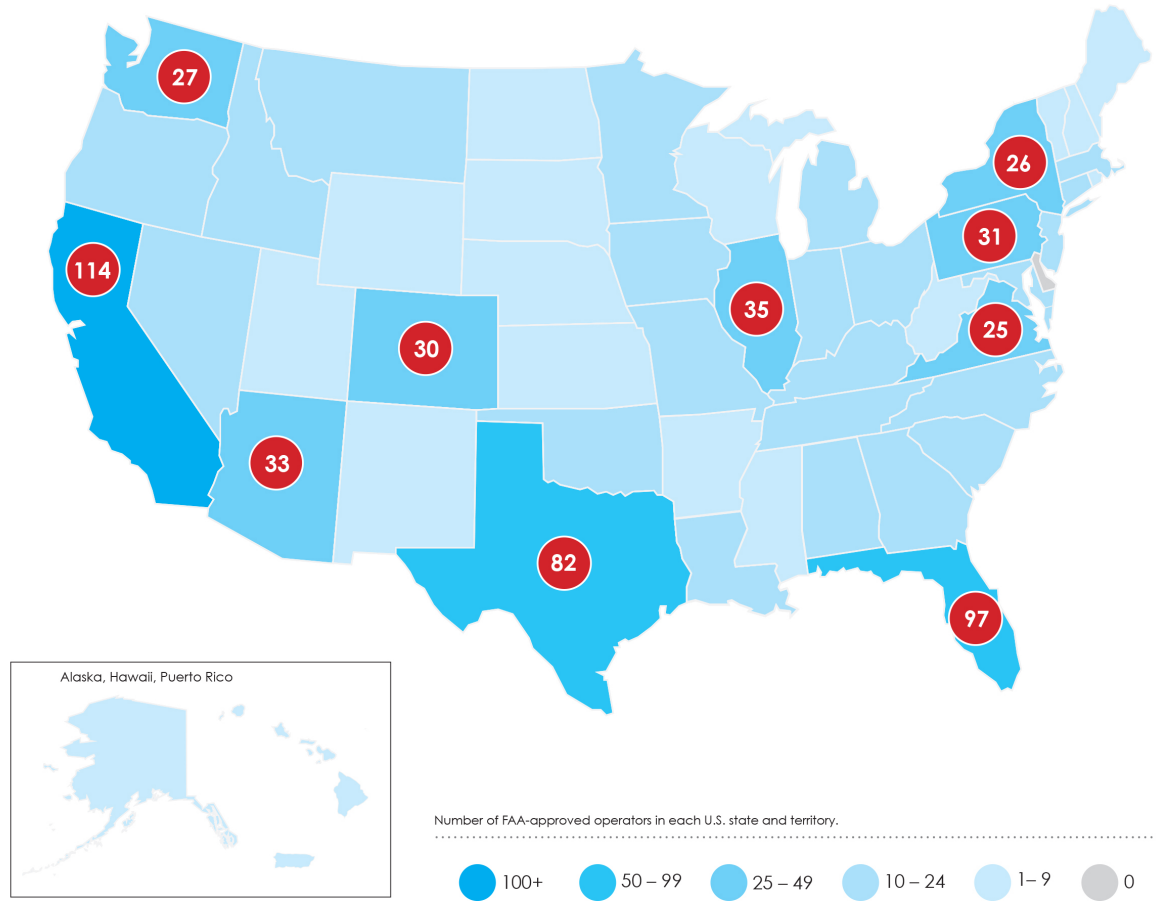
A risk-based, technology-neutral framework means that regulations should be based on the risk profile of a particular UAS operation instead of the platform being flown. For example, low-risk operations, such as aerial surveys above rural farmland and operations with micro UAS that weigh less than 4.4 pounds, would be regarded as "safe" and granted access to the airspace with minimal regulatory barriers, regardless of the specific technology used. This flexible framework will accommodate innovations rather than require new rules each time a new technology emerges.

The data have shown favor toward simple, low-risk operations. More than half of the approved platforms would fall into the FAA's proposed micro-UAS category, a weight class of UAS that is lightly regulated in countries with established UAS rules. Only one platform over 55 pounds, the Yamaha RMAX, which weighs over 200 pounds, has been approved so far.

Although research is still needed to understand full, high-level integration, more can and should be done to facilitate expanded operations that pose no threat to the National Airspace System,

TOP 10 STATES BY EXEMPTION

1. CALIFORNIA – 114
2. FLORIDA – 97
3. TEXAS – 82
4. ILLINOIS – 35
5. ARIZONA – 33
6. PENNSYLVANIA – 31
7. COLORADO – 30
8. WASHINGTON – 27
9. NEW YORK – 26
10. VIRGINIA – 25



especially in rural areas under 500 feet. The FAA recently made progress on this front by enabling nighttime flights, beyond-line-of-sight testing with daisy-chained observers from the flight team and operations up to 1,200 feet across North Dakota at the Great Plains UAS Test Site.

At this point, however, the industry is primarily being held back by the continuous rulemaking delays that make it difficult to innovate without standards and other parameters. In the 2012 FAA reauthorization, Congress mandated an August 2014 deadline for integration of small UAS into the National Airspace System and a September 2015 deadline for integration of all UAS — timeframes the FAA will miss considerably. We strongly advocate for swift rulemaking to take effect, not only to accelerate the safe commercial use of UAS and its benefits, but also to facilitate a larger data set to base future development on.

The six FAA-designated UAS test sites can help provide better access for industry testing, especially for these expanded use cases in places such as North Dakota, where the FAA has begun to allow expanded testing opportunities.

To facilitate this, in the upcoming FAA reauthorization, Congress should consider making the test sites eligible for federal funding under current FAA offices and programs that are engaged with UAS activities in order to help them perform the valuable research needed for integration. This would not specifically add new funding for the test sites; rather, it could allow for them to receive existing federal funding and give industry guidance and incentive to better utilize the test sites.

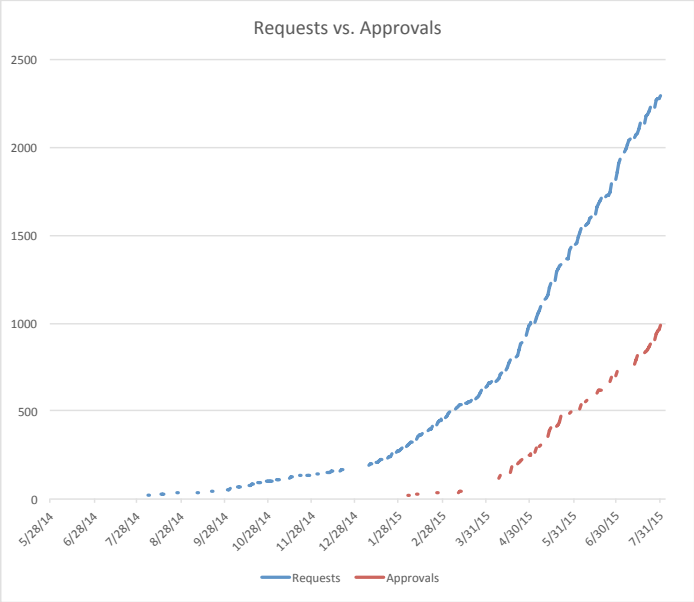
Technological barriers to full-scale integration will be challenging to conquer as well with such a limited data set. Government and industry must develop a comprehensive research plan to gather data on expanded use cases and establish recommendations and deadlines to achieve important research milestones. This includes an emphasis on developing a UAS traffic management system and coordinating UAS integration efforts with NextGen.

UAS integration should be a national priority, as delays and piecemeal solutions are greatly hindering the economic potential and societal benefits of the U.S. commercial UAS industry. Many other countries, including Canada, France, Australia and the United Kingdom, have had UAS rules in place for years, enabling industry there to progress, in some cases even with beyond-line-of-sight operations. The U.S. UAS industry is poised to be the leader in this field, as is shown by the rapidly increasing interest and innovation domestically. However, high-level leadership and coordination with industry and government partners is absolutely critical to ensure the United States regains trailblazer status in this global industry.

INTRODUCTION

In late May 2014, the Federal Aviation Administration began accepting petitions for exemption to operate unmanned aircraft systems (UAS) commercially in the U.S. National Airspace System without an airworthiness certificate, which is allowed under Section 333 of the FAA Modernization and Reform Act of 2012. The agency approved the first set of commercial operators on Sept. 25, 2014 — six film and television production companies. Prior to this, the only commercial unmanned aircraft operations were approved through special airworthiness certificates, which require a lengthy process originally created for manned aircraft. The first certificates allowed for minimal UAS operations supporting oil and gas activities off the Alaskan coast.

In the first year after accepting exemption requests, the FAA had approved almost 500 out of about 1,500 petitions. As of Sept. 1, 2015 the FAA had approved 1,407 out of over 2,650 petitions. The agency continues to approve about 50 new operations a week, a process expedited by the FAA rolling out a summary grant process whereby similar petitions are batched and analyzed together rather than individually. However, the number of applicants continues to greatly outpace approvals.



In February 2015, the FAA released its "Notice of Proposed Rulemaking for Small UAS", a set of rules that would, once finalized, govern the commercial drone industry for platforms up to 55 pounds. Until this set of rules is reviewed and completed, the Section 333 exemption process remains the most effective way for commercial entities to gain access to the airspace for UAS operations. Although limited, it has begun to give us data on this emerging market and provides a snapshot of what is to come.

This report analyzes the first 1,000 commercial UAS exemptions to gain an understanding of where this burgeoning industry is, where it is headed, and what we can do to ensure innovation and its success moving forward.

Although this is only the smallest sampling of a nascent commercial UAS industry, it offers a glimpse into the technology's power to serve as a limitless economic driver and transform businesses in a way that will increase human potential, saving time and lives. A commercial UAS industry still remains largely grounded; however, we can begin to take a look at the current shape and scope of commercial use.

REPORT

In the 2012 FAA reauthorization, Congress mandated an August 2014 deadline for integration of small UAS into the National Airspace System and a September 2015 deadline for integration of all UAS, timeframes the FAA will miss considerably. As the next reauthorization approaches this September, we look to the current progress of industry and government collaboration and data collected from the first commercial uses to establish recommendations that will help accelerate the societal and economic benefits of commercial UAS use and ensure the safety of the national airspace.

As we progress through an analysis of the first commercial applications and accompanying systems, we gain a better understanding of the stages of airspace integration, the current successes and the limitations of the current process in enabling safe commercial uses of the technology.

In 2013, before the FAA developed a process to enable airspace access for commercial UAS users, AUVSI's economic impact report projected integration would add $82 billion in economic impact to the U.S. economy and create 100,000 new, high-paying jobs within the first 10 years of UAS integration.[1] According to the report, 80 percent of this impact would come from agriculture and related industries, which contributed $789 billion to the U.S. economy in 2013, according to the U.S. Department of Agriculture.[2]

INDUSTRY/OPERATION	# OF EXEMPTIONS
Aerial Photography	512
Real Estate	350
Aerial Survey	301
Aerial Inspection	242
Agriculture	164
Construction	134
Infrastructure Inspection	102
Film and TV	91
Utility Inspection	78
Environmental	61
Training	55
Search and Rescue	52
Research and Development	24
Emergency Management	38
Demos	26
Insurance	25
Mining	25
Oil and Gas	24
Advertising	22
Newsgathering	20
Landscaping	15
Flare Stack Inspection	13
Sports	13
Education	9

INDUSTRY/OPERATION	# OF EXEMPTIONS
Market Research	8
Security	6
Railroad Inspection	4
Aerial Communications Services	1
Maritime Operations	1
Mill Operations	1
Paving	1
Risk Management	1

The first 1,000 exemptions show that, although agricultural applications are referenced in greater than 15 percent of all approvals, there may still be inhibiting factors preventing greater adoption across this sector.

The benefits of UAS and other robotic technologies will be invaluable to the agriculture industry moving forward as agriculture professionals look for new ways to keep pace with the global market.

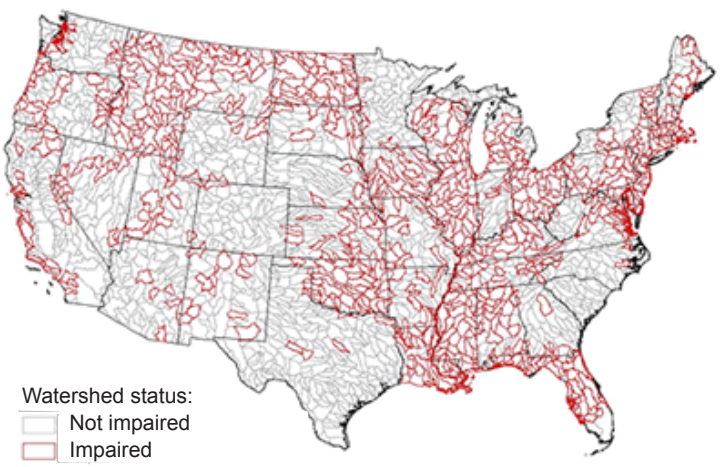
UAS enable analysis and improved planning for farmland that will result in increased efficiency, better yields and more accurate yield predictions. Better data can help farmers accurately prepare resources for harvest and prevent farmers from overstocking or having to leave mature crops in the field.

For example, if the projected yield in sugar beets exceeds the processing capacity, growers may have to leave beets in the ground.[3]

UAS are the most effective method for early detection of disease and nutrient deficiency in crops. In 2010, Georgia alone lost about $4.24 billion (16.5 percent) of its crops due to disease.[4] UAS will also help reduce negative environmental impacts of pesticide and fertilization use, which are essential to maintaining healthy crops.

For example, nitrogen is one of the most critical fertilizers used in agriculture. Sixty-seven percent of nitrogen used every year is lost, costing farmers money and resulting in water contamination. Data obtained from UAS can help farmers optimize inputs, such as nitrogen and phosphorous, and more precisely apply these nutrients or fertilizers to crops, saving farmers money and mitigating the environmental impact.[5,6]

Watersheds reported as impaired by nitrogen or phosphorus, 2007



Source: U.S. Environmental Protection Agency

Farmers are also facing pressing challenges beyond these environmental and societal considerations. The USDA predicts that between the years of 2015 and 2020, net farm income in the U.S. will fall to around $75 million from more than $125 million in 2013.[7] UAS will be vital in enabling farmers to combat this decline.

Although UAS are beginning to be a boon for farmers, regulatory limitations requiring line-of-sight and daytime operations may contribute to the inhibited adoption. The FAA's proposed rules

AGRICULTURE SPOTLIGHT

AGRICULTURE PLATFORM STATS
76 fixed wing
192 rotary wing
Avg. weight: 8.83 lbs.
16% micro UAS
Avg. Endurance: 41.65 min. (32.6 min. without 2 outliers)

John Nowatzki, agricultural machine systems specialist, North Dakota State University

Courtesy: Increasing Human Potential's Unmanned Unplugged Series

Crop producers are increasingly providing digital data to manage crop production on a more precise field scale. UAS crop and livestock monitoring, and imagery collected with UAS, will provide an additional timely dataset to increase precision management practices for farmers and ranchers and simultaneously provide more effective safeguards for the natural environment.

UAS will provide timely, high-resolution imagery and a real-time eye in the sky for agricultural producers to use to more precisely apply crop inputs, to validate past management decisions and to adjust in-season practices.

UAS are safer, less expensive and timelier than manned aircraft remote sensing. UAS operated in crop fields and livestock rangeland in rural fields under existing safety guidelines provide essentially no safety threat to people on the ground or manned aircraft. Additionally, manned aircraft operated in close proximity to crop and livestock operations are potentially more dangerous to the aircraft operator.

Yamaha RMAX for Crop Spraying in Napa Valley

Courtesy: Unmanned Systems *magazine*

Napa Valley doesn't use manned aircraft for spraying, instead relying on ground tractors. Spraying crops with those can take much longer — tractors can travel only about 3 mph, while the RMAX can move along at 12 to 15 mph.

Even if manned aircraft were used in Napa, the RMAX would have some advantages. It can fly very low over the grapes, thereby minimizing fertilizer waste and runoff, and it's more nimble and able to steer away from the houses and other structures that share the space with the vineyards

for UAS would not allow for beyond-line-of-sight or nighttime operations, and no Section 333 petitions have yet been granted for these operations. Farmers have used autonomous tractors for over a decade, including overnight, to assist in operations — the same should be allowed for UAS in these rural areas.[8] UAS can be used to manage many acres of land in a fraction of the time compared to on-foot scouting, including surveying 1,500 acres of land in one hour at one-inch image resolution using a fixed-wing design.[9]

Although these essential growth areas will be required for widespread successful UAS adoption across agriculture and other industries, there is very clearly a need for more research involving beyond-line-of-sight operations, nighttime operations, operations over congested areas, and, even further down the line, operations involving larger platforms and full-scale airspace integration.

These operations will eventually facilitate services like UAS package delivery or unmanned cargo delivery. However, the exemption process currently does not allow for these expanded operations even though in many instances, especially in rural areas, there is no additional risk to the airspace.

Industry and government must continue to collaborate on UAS development and form a comprehensive research plan that will allow stakeholders to identify areas that require additional resources and where industry should develop solutions.

Forty of 58 platforms have a maximum altitude over 10,000 feet, according to the manufacturers. Twenty of 71 platforms with the relevant data have a range greater than 10 miles. There has also been one platform approved that weighs more than 55 pounds — placing it outside the FAA's definition of small UAS — the Yamaha RMAX, at over 200 pounds. The RMAX and its predecessor have been used in Japan for precision crop spraying since the 1980s, and the remotely piloted helicopter continues to spray 2.4 million acres of cropland there a year, according to Yamaha's petition.

The technology to fly safely in expanded operational profiles exists in large numbers and continues to be developed. However, technology is outpacing regulation, and it will continue to as robotic technologies proliferate. This regulatory uncertainty discourages innovation. Companies will be reluctant to develop technologies too far ahead of rules in fear of spending precious time and resources developing platforms that may never fly. Additionally, as innovation is encouraged for UAS technologies, it will lead to advancements in industries such as health care, graphic imaging, remote sensing, data management and even manned aviation, which will help make the airspace safer for all users, similar to the way automated collision avoidance technology is making motor vehicles safer.

Another factor contributing to the agriculture industry's UAS approval rate reflects the rapidly expanding use cases for the technology, now that commercial entities have a pathway to operate.

The real estate industry has lead the way in these initial operations, with over 350 references in the first 1,000 exemptions (35 percent). After only recently embracing the benefits of UAS, with the first approval coming in January 2015, real estate agents and photographers are finding an economic advantage under the exemption process. Real estate operations generally only require the simple operational profiles the FAA has, thus far, been able to approve. Low-level flights over private property do not pose a threat to the airspace and lead to improved safety over manned operations in legacy use cases.

Among the petitions that reference real estate, 526 of the platforms with data available are rotary wing, while only 22 platforms are fixed wing. These instances are mainly from petitions approved for multiple industries and multiple UAS and may not actually be used for real estate operations.

The average weight for these aircraft is 6.42 pounds with an average endurance time of 27.4 minutes. DJI Innovations manufactured 464 out of the 562 platforms mentioned for real estate use. This includes 275 systems under three pounds. These data accurately portray the simple operational profiles required of real estate use.

REAL ESTATE SPOTLIGHT

REAL ESTATE PLATFORM STATS
22 fixed wing
526 rotary wing
Avg. weight: 6.42 lbs.
43% micro UAS
Avg. endurance: 27.40 min.

NATIONAL ASSOCIATION of REALTORS®

Courtesy: National Association of Realtors

Technological advances have made it cost effective to take pictures and videos from drones, aka Unmanned Aerial Vehicles (UAVs). Real estate professionals are interested in using this new technology to take videos and pictures to create dynamic marketing pieces for property listings, among other purposes.

Real estate professionals working with residential, commercial and land parcels can all benefit from the images and information obtained from using UAV technology. This imagery is an incredible tool for potential homeowners moving to a different city, buying a second home or trying to streamline the research process necessary to buy a new home. Many commercial properties or large parcels of land do not lend themselves well to traditional photography. Capturing the entirety of the plot will give a better representation of the property at hand.

Being able to easily view the information obtained through the use of UAV technology will help better inform the consumer. Just as digital photography made it easier to create high-quality, affordable images, real estate practitioners look forward to using UAV technology to take their listings into the next level in technical creativity and quality. Many real estate professionals want to hire a professional who offers UAV photography services, while some others are getting the FAA waivers and using the machines themselves.

Many industries that support real estate can also use UAV technology to enhance their businesses. Property appraisals, facility management, roof inspection, insurance evaluation and thermal imaging evaluations are all tasks that can be done expeditiously using UAV technology. Insurance companies can use UAV technology to quickly evaluate property damage in an area after a storm or other destructive event. That would expedite the information-gathering process for property owners and businesses to get back up and running.

APPROVED EXEMPTIONS BY STATE

STATE	TOTAL EXEMPTIONS
California	114
Florida	97
Texas	82
Illinois	35
Arizona	33
Pennsylvania	31
Colorado	30
Washington	27
New York	26
Virginia	25
Indiana	24
Ohio	24
North Carolina	23
Georgia	20
Oregon	18
Iowa	17
Michigan	17
Minnesota	16
Maryland	15
New Jersey	15
Louisiana	14
Massachusetts	14
Connecticut	13
Kentucky	13
Tennessee	13
Alabama	11
Missouri	11
Nevada	11
Idaho	10
Montana	10
Oklahoma	10
South Carolina	10
Wisconsin	9
Alaska	8
Kansas	8
Maine	7
Hawaii	6
Utah	6
Arkansas	5
Nebraska	5
North Dakota	5
Puerto Rico	5
Mississippi	4
New Mexico	4
South Dakota	4
Vermont	3
West Virginia	3
Wyoming	3
New Hampshire	2
Rhode Island	2

EXEMPTIONS BY STATE BREAKDOWN

CALIFORNIA	114
Aerial Photography	52
Real Estate	36
Aerial Survey	32
Film and TV	27
Agriculture	20
Construction	13

TEXAS	82
Aerial Photography	44
Real Estate	28
Aerial Survey	27
Aerial Inspection	26
Construction	13
Infrastructure Inspection	11
Utility Inspection	9

ARIZONA	33
Aerial Photography	15
Real Estate	13
Aerial Survey	10
Aerial Inspection	8
Agriculture	7
Search and Rescue	6

COLORADO	30
Aerial Photography	18
Aerial Survey	15
Aerial Inspection	11
Construction	6
Real Estate	6
Search and Rescue	5
Infrastructure Inspection	5

NEW YORK	26
Aerial Photography	16
Aerial Inspection	7
Real Estate	7
Aerial Survey	6
Film and TV	5
Research and Development	4

FLORIDA	97
Aerial Photography	63
Real Estate	42
Aerial Survey	26
Aerial Inspection	23
Construction	19
Agriculture	14
Film and TV	12

ILLINOIS	35
Aerial Photography	17
Real Estate	16
Aerial Inspection	10
Agriculture	8
Construction	6
Aerial Survey	6

PENNSYLVANIA	31
Aerial Photography	18
Aerial Survey	16
Real Estate	13
Aerial Inspection	9
Construction	6
Utility Inspection	6
Infrastructure Inspection	6

WASHINGTON	27
Aerial Photography	15
Real Estate	13
Agriculture	5
Construction	5
Aerial Inspection	5
Film and TV	4
Infrastructure Inspection	4

VIRGINIA	25
Aerial Survey	14
Aerial Photography	14
Real Estate	11
Aerial Inspection	5
Agriculture	4

Although real estate use significantly outpaced other uses overall, there are state and regional trends that favor other uses locally. California companies, unsurprisingly considering the state's population, make up 114 of the first 1,000 exemptions. These cases are led by real estate operations, at 36 exemptions, followed by film and television at 27.

As of the first 1,000 exemptions, the FAA has approved companies from 49 states, Puerto Rico, Canada and the United Kingdom. The only state not represented is Delaware.

Although the California film and television industry got off to a quick start with five of the first seven exemptions granted, the continued prevalence of closed-set filming exemptions shows clear strength in the Hollywood/Los Angeles film industry compared to other states. The next highest instances of film and television exemptions are Florida with 12 and New York with five.

UAS have already been used abroad on many major motion pictures, including the James Bond film "Skyfall" and both Avengers movies. The safety standards within the industry for closed-set filming are, at times, more stringent than the FAA's requirements for these operations. The on-set safety process requires everyone to sign a waiver and attend safety briefings, typically with or without UAS use. It is, therefore, logical that these operations were the first to apply for and receive exemptions, comprising the first seven and 10 out of the first 20 exemptions, because of its history and dedication to safety.

Dedication to safety, however, is not unique to the film and television industry. It is important for all commercial entities to operate safely in order to protect employees and their business interests. In some cases, UAS actually greatly improve safety in these commercial uses.

Film industry users no longer require low-flying manned aircraft to get certain aerial shots. Oil and gas operations and flare stack inspections, with the reduction in flammable fuel in the vicinity and the absence of manned aircraft maneuvering dangerously close to equipment and infrastructure, become much safer operations for inspectors using UAS.

FILM AND TV SPOTLIGHT

FILM AND TV PLATFORM STATS
1 fixed wing
167 rotary wing
Avg. weight: 13.44 lbs.
6.2 % micro UAS
Avg. endurance: 17.26 min.

Motion Picture

Courtesy: Mission Critical *magazine*

A pulse-quickening sequence in a 2012 James Bond movie, "Skyfall," which was shot in Istanbul, Turkey, is one often-cited example of effective aerial cinematography using a small UAS. Daniel Craig as 007 is shown from above and many other angles as he rides a motorcycle in a wild chase on the roofs of buildings, battles with a bad guy atop a speeding train, plunges off a cliff and is swept over a roaring waterfall.

"While we have already seen movies filmed with SUAS from overseas productions — take for example the roof sequence of 'Skyfall' — the sky is literally the limit in imagining what new angles and views filmmakers will thrill us with next," says Lauren Reamy, director of government affairs for the Motion Picture Association of America. "Every day, moviemakers are increasingly leveraging the latest technologies to advance their craft. Using SUAS is an example of that, one in which audiences will continue to see scenes and shots we could only have imagined a few years ago."

"Small unmanned aircraft systems are a safer, more efficient and a more flexible alternative in many cases," says Reamy. "For example, SUAS run on electricity, while manned helicopters require thousands of gallons of gasoline.

Independent filmmakers and other producers whose budgets don't allow for manned helicopters could save money and broaden their creative possibilities by using drones, says Richard Crudo, president of the American Society of Cinematographers. "The independents will embrace the cheapness of it, and the studios will embrace the trendiness of it."

"I find, as a cinematographer, where the shots are most interesting and most dynamic is down low," says David Wagreich, CEO and pilot for Astraeus Aerial Cinema Systems. "Typically, with full-scale helicopters, you're always asking to go lower. To be high and wide and looking down on something isn't as exciting as being down in the action. Typically, our best shots are at 50, 30 feet or below."

Previously, he says, for movies like "Spiderman," crews had to spend days — and tens of thousands of dollars — rigging cable cameras and programing their movements.

"There are a lot of production economies," Wagreich notes. "In comparison with full-scale helicopters, which can cost upwards of $30,000 a day to operate ... you can fly a UAS for [about] half the price."

The demand for unmanned aerial cinematography has been "very strong," says Treggon Owens, cofounder of Aerial Mob, but the time needed to gain clearance makes it a challenge to meet the demand. "The demand for the use of it is definitely outstripping our ability to get through the regulatory hurdles, but [FAA officials] are working on that very hard."

"What I really like about the drone is that it frees up your creativity," he says. "You are providing the filmmaker a whole new way to tell a story."

Advantages of UAS over manned helicopters for moviemaking include greater safety. Most fatalities of film crew members have involved manned helicopter accidents.

"The technology, from our perspective, is game changing," Astraeus Aerial's Wagreich says. "You can create shots that you could never achieve before."

With drones, he says, "you can show up and fly it in real time," saving time and money and allowing greater creativity. "I think what's going to happen now is directors of photography are going to start conceiving shots around UAS."

OIL AND GAS SPOTLIGHT

OIL AND GAS PLATFORM STATS
18 fixed wing
27 rotary wing
Average weight: 10.78 lbs.
2% micro UAS
Avg. endurance: 95.63 min. (41.76 min. without 2 outliers)

Flying With Flare

Courtesy: Mission Critical *magazine*

Flare stacks play a key role in oil and natural gas production by burning off unusable gas at drilling rigs and refineries, but inspecting the flame-tipped towers for damage has traditionally been dangerous and difficult. Advocates of unmanned aircraft systems say the technology could make such inspections far safer and easier.

Flare stacks can stand several hundred feet tall and emit 2,000-degree-Fahrenheit heat. Having inspectors climb flare stacks or nearby structures or elevating them with a sky lift is risky, and using manned helicopters can be cost-prohibitive.

Small UAS offer a better option, according to operators and manufacturers. The unmanned vehicles keep people out of harm's way and are relatively inexpensive and simple to operate. Their agility and compact size allow them to easily fly above and around flare stacks, potentially providing better views than other means. And flare stacks do not have to be shut down for UAS inspections.

"Drone technology improves safety, reduces liability, increases accuracy, and saves time and money for our customers while allowing them to continue work as usual during the inspection process," says Houston-based Total Safety U.S. Inc., one of several companies that plan to participate in the American UAS flare stack inspection market.

"The risk to an onboard pilot and crew during an incident or accident is eliminated with the use of a UA [unmanned aircraft] for the inspection operation," the FAA wrote in its approval document for Total Safety. "In addition, utilizing UAS to conduct flare stack inspections will reduce the need for inspection personnel to perform this hazardous activity."

"There are potentially 3,500 potential inspection sites just in the Gulf of Mexico," says Brian Whiteside, founder and president of VDOS Global, the first company approved for flare stack inspections. "There are something like 60,000 cell phone towers throughout the U.S., one-third of which have to be inspected every year. All the refineries throughout the U.S." are inspection candidates, as are the pipelines and windmills.

CONSTRUCTION INDUSTRY SPOTLIGHT

CONSTRUCTION PLATFORM STATS
12 fixed wing
192 rotary wing
Avg. weight: 6.17 lbs.
16.85% micro UAS
Avg. endurance: 24.30 min.

INFRASTRUCTURE INSPECTION PLATFORM STATS
25 fixed wing
173 rotary wing
Avg. weight: 8.83 lbs.
10.11% micro UAS
Avg. endurance: 28.48 min.

AGC of America
THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
Quality People. Quality Projects.

Courtesy: The Associated General Contractors of America

The Associated General Contractors of America, a nationwide trade association of construction companies and related firms, has engaged its more than 26,000 members in a discussion of UAS and their potential benefits to the construction industry.

Project Planning and Design – UAS have the potential to reduce the cost and improve the quality of the currently available maps of specific project sites. Improvements in the design and planning processes will reduce the number and degree of expensive changes that a project team has to make in the field and will help a project stay on schedule and within budget.

Safety – Building contractors would like to use UAS to inspect the work being done on roofs or curtain walls, or other vertical surfaces, rather than ask their employees to get onto a lift, to climb a scaffold or to descend from a higher elevation in a bosun's chair. Similarly, civil contractors would like to use UAS to inspect bridges, towers, wind turbines and similar structures without putting their workers at risk. UAS can also help contractors determine the safest way for work to flow throughout a project site and to identify potentially dangerous areas that they may need to barricade.

Efficiency – As noted, UAS have the potential to help contractors monitor their jobsites, how equipment and materials are laid out, and how the work actually flows. This would also help them plan and supervise their site logistics.

Quality – UAS have the potential to reduce the cost of inspecting the quality of work done at higher elevations, including the many joints in a building's envelope and the caulking, flashing or other work needed to prevent water from penetrating. UAS would also make it much easier for contractors to inspect welds and other structural connections at whatever elevation they may be. Contractors report that small UAS often provide a vantage point that manned aircraft simply cannot match.

Environmental Compliance – UAS would also make it much easier for contractors to document their compliance with a host of environmental and other requirements. Among these requirements are storm water controls that the U.S. Environmental Protection Agency and its counterparts at the state level require contractors to inspect every seven to 14 days (depending on the state) and after rain.

Other Possibilities – In the future, contractors might also find that they can use UAS to carry tools, equipment or construction materials from one location to another. If appropriate for such use, UAS would be far more versatile than the cranes being used today.

Similarly, the construction and infrastructure inspection industries improve inspector safety by eliminating the need for dangerous inspections of towers or bridges that may require climbing by harness for manual inspection. It is also a very efficient way to document progress at a construction site, either for the owner or for planning purposes.

Sixty-one unique platforms were approved for infrastructure inspection, totaling 198 references in the first 1,000 exemptions, including 173 rotary wing and 25 fixed wing. Slightly more robust than those approved for general construction operations, the infrastructure inspection platforms have an average endurance of 28.5 minutes and 8.83 pounds. This includes more advanced platforms, such as five references of Altavian's Nova F6500, which can fly for 90 minutes at 15 pounds; the Microdrone md4-1000, which can fly for almost 90 minutes at 12 pounds; and Lockheed Martin's Indago quadrotor, which, at almost five pounds, flies for 50 minutes.

These systems, as is common with the higher end, industrial multirotor platforms, can cost anywhere from $10,000 to $50,000 and up depending on sensor payload. However, the three most common systems for construction and infrastructure remain DJI models — Phantom 2 Vision+, Phantom 2 and Inspire 1.

Despite the overwhelming majority of the approved systems coming from DJI, which manufactures abroad — 1018 out of 1480 (69 percent) — U.S. manufacturers still come out ahead in total platform sales. The 256 platforms manufactured in the U.S. cost an estimated $3.6 million, followed closely by Canada at $2.5 million with only 35 platforms. Total estimated platform cost for all 1480 platforms was about $10.7 million, leading to an estimated average platform cost of $7,242.59 per unit.

PLATFORM SALES BY COUNTRY

MANUFACTURER LOCATION	TOTAL ESTIMATED COST
United States	$3,609,215.09
Canada	$2,568,780.00
China	$2,2110,537.20
Switzerland	$1,078,000.00
Germany	$641,608.00
Latvia	$110,000.00
New Zealand	$104,413.54
Slovenia	$100,107.00
Japan	$86,000.00
Belgium	$60,000.00
Netherlands	$55,000.00
France	$50,006.97
Australia	$40,000.00
United Kingdom	$33,103.82
South Africa	$28,971.00
Austria	$20,000.00
South Korea	$17,500.00
Taiwan	$5,787.59

Canada's Aeryon Labs has benefited from its SkyRanger UAS with over $2.2 million in sales over 14 references. The SkyRanger has also been selected by the Michigan State Police as its platform for law enforcement operations across the state. China and its 1061 platform references falls to third with just over $2.1 million in sales, as many of the systems are lower end or consumer models.

TOP MANUFACTURERS BY SALES

ORGANIZATION	TOTAL PLATFORM SALES
Aeryon Labs, Inc.*	$2,452,000.00
DJI Innovations Corp.	$2,048,928.96
SenseFly*	$1,093,000.00
AeroVironment*	$780,000.00
Trimble*	$356,993.00
PrecisionHawk*	$350,000.00
Vanguard Defense Industries	$300.000.00
Lockheed Martin Corp.*	$240,000.00
Microdrones, GmbH	$234,000.00
UAV Solutions, Inc.*	$200,000.00
Leptron Unmanned Aircraft Systems*	$188,183.39
Altivan, Inc.*	$160,000.00
Aibotix GmbH	$154,060.00
3D Robotics	$134,048.80
Martin UAV*	$115,000.00

** AUVSI Corporate Member*

TOP PLATFORM SALES

PLATFORM	TOTAL PLATFORM COST
Aeryon SkyRanger	$1,580,000.00
DJI Inspire 1	$726,000.00
senseFly eBee	$326,304.00
Puma AE (RQ-20A)	$500,000.00
DJI Spreading Wings S1000	$465,300.00
Trimble UX5	$356,993.00
PrecisionHawk HawkEye Lancaster Mk III	$350,000.00
ShadowHawk	$300,000.00
DJI Phantom 2 Vision+	$240,932.00
Scout	$240,000.00
Indago	$200,000.00
Md4-1000	$200,000.00
senseFly eBee Ag	$198,000.00
DJI Spreading Wings S900	$193,800.00
Qube	$180,000.00

Many of the SkyRangers have been approved for utility inspection operations, which will improve the safety and speed of inspection services for power lines, transmission lines and pipelines.

According to Southern Company Services' petition, UAS "would vastly reduce risks to crews responsible for power line inspections and significantly hasten power restoration in the event of storms, hurricanes, tornadoes and other weather events."

UTILITY INDUSTRY SPOTLIGHT

UTILITY PLATFORM STATS
25 fixed wing
119 rotary wing
Avg. weight: 9.18 lbs.
8.2% micro UAS
Avg. endurance: 35.92 min.

Courtesy: San Diego Gas & Electric

Unmanned aircraft systems provide SDG&E another way to manage our electric and gas operations. The versatile technology helps us complete aerial inspections in remote areas that are otherwise difficult to access and locate the cause of power outages faster.

Initial operations used a UAS measuring 16 inches in diameter and weighing less than a pound. These small devices use a camera to inspect utility equipment and relay live images back to the controller. A UAS can access sections of our system that are difficult for our crews to reach and alert them if repairs are needed. They can also improve day-to-day operations and quicken our response time during emergency situations.

BENEFITS OF UAS TECHNOLOGY

- Inspections – Improved ability for SDG&E to complete aerial inspections of power lines in remote areas. Currently, linemen have to climb transmission towers to complete an inspection in these remote areas. A UAS allows us to see the tops of poles and cross arms where damage is hard to see from the ground.
- Restoration – Allows us to respond to power outages in remote areas quicker. This can help shorten power outages since crews can complete inspections and troubleshoot affected areas quickly.
- Situational awareness – Improves clarity for ground crews and system operators, especially during emergency situations and extreme weather conditions.
- Environmental protection – Achieves noise reductions and helps us avoid the use of helicopters and other heavy machinery on roads.

SDG&E inspects more than 26,000 miles of transmission and distribution power lines for safety and compliance purposes. Use of a UAS may prove to be a powerful new ally in the effort to keep equipment functioning securely, safely and reliably.

Beyond-line-of-sight operations will be essential to the future use of UAS for utility inspection, as companies have thousands of miles of service lines to inspect.

The Mid-Atlantic Aviation Partnership at Virginia Tech, one of the six FAA-designated UAS test sites, recently tested an American Aerospace Technologies RS-16 UAS to inspect 11 miles of Colonial Pipeline Co. energy pipeline in 90 minutes with a chase plane for safety.[10]

A closer look at domestic manufacturers of approved platforms reveals broad representation from the states. With the small sample size it is encouraging to see that 22 states already have manufacturers with UAS approved for commercial operations.

California manufacturers have the most platforms mentioned in the exemptions with 140, including 88 platforms from 3D Robotics. Florida was next with 19 platforms, 16 manufactured by Altavian.

Despite the commercial UAS industry being in its infancy, companies across the U.S. are involved with manufacturing and operations, and the positive economic effects of finalized rules for airspace integration will be felt across the country.

Looking forward, the industry and its economic effects promise to expand rapidly. To date, exemption requests have increased exponentially since May 2014, reaching over 2,500 by August 2015. If this exponential growth continues, there will be 6,590 exemption requests by the time FAA reauthorization is set to expire on Sept. 30, 2015 (Fig. 11.1, next page).

More realistically, using a standard linear regression starting at 500 exemption requests, if the recent pace of exemption requests does not continue to increase, there will be nearly 3,000 requests by the end of September 2015 (Fig. 11.2, next page). The case-by-case exemption

PLATFORMS MANUFACTURED BY STATE

STATE	# OF PLATFORMS
California	140
Florida	19
Washington	18
North Carolina	14
Colorado	10
Illinois	10
Maryland	8
Ohio	8
Kansas	7
Arizona	7
New Hampshire	5
Texas	3
Massachusetts	2
Minnesota	2
Tennessee	2
Idaho	1
Missouri	1
Mississippi	1
Oklahoma	1
Oregon	1
South Carolina	1
Virginia	1

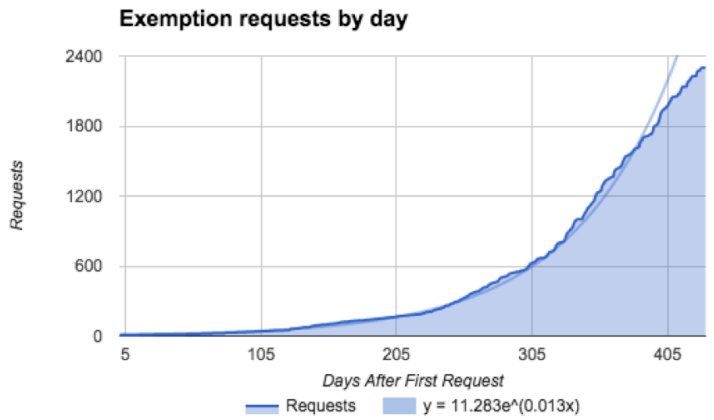


Fig. 11.1

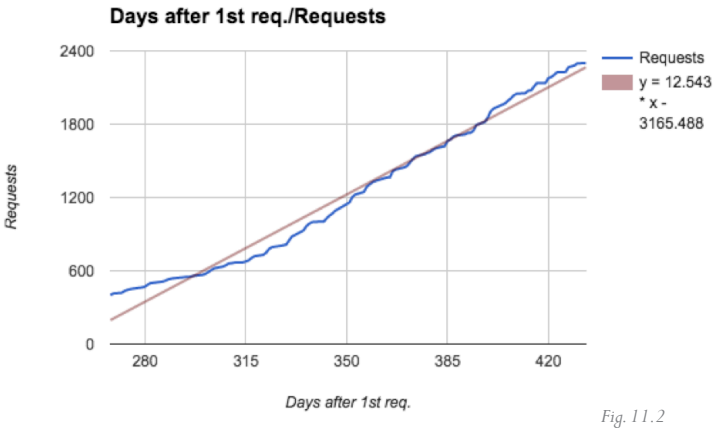


Fig. 11.2

process will continue to struggle to keep up with requests if rules and reauthorization are further delayed.

This number jumps to 25,896 potential commercial operators by Sept. 30, 2020. This figure is many times higher than commercial air traffic numbers, which the FAA claims is about 7,000 at any given time.[11] As many more operators take to the air, it will be crucial to develop a UAS traffic management system and integrate UAS activities with Next Generation Air Transportation System plans. NASA and industry collaborators are currently working on these issues that will require coordinated government support moving forward to support the proliferation of UAS use.

The numbers for potential operators do not take into account petitions that have been closed without approval, which add to 399 compared with 1,407 approvals as of Sept. 1, 2015. These are largely due to petition documents with insufficient information and in some cases may include operators that have reapplied successfully. It also does not factor in an upper limit based on fixed population and therefore finite demand for potential operators.

Taking into account the percentage of closed petitions to approvals, there stands to be 21,175 commercial operators by Sept. 30, 2015. However, this figure may still be understated considering the growing pace of exemption requests, the wide-ranging UAS uses that grow every day, and pending rules that will not require an exemption process to operate. Assuming no further rate increase in operators and similar platform sales, platform sales alone may reach over $225 million by September 2020, even though the majority of the current platforms are low-end consumer models. As the industry develops with established rules, more high-end industrial platforms will be used, especially in expanded use cases such as beyond line of sight. Currently, government UAS, such as NASA's Ikhana research UAS, can cost millions of dollars per aircraft.

The wide disparity in UAS technology and the infancy of the commercial industry poses interesting problems for insurers. Although many insurance companies, such as United Services Automobile Association and State Farm Mutual Insurance Co., are already benefiting from the technology themselves by keeping inspectors out of harms way, the same institutions are grappling with how to insure UAS platforms and operations.

INSURANCE INDUSTRY SPOTLIGHT

INSURANCE INDUSTRY PLATFORM STATS
8 fixed wing
40 rotary wing
Avg. weight: 7.09 lbs.
3.37% micro UAS
Avg. endurance: 27.44 min.

NAMIC® National Association of Mutual Insurance Companies

Courtesy: National Association of Mutual Insurance Companies

A number of insurance companies and UAS operators have recognized the potential value of UAS to property/casualty insurance and have obtained Section 333 exemptions from the Federal Aviation Administration to explore and develop such insurance operations. The primary business cases for property/casualty insurance use of UAS are for routine property assessment and disaster management.

In the normal course of its business, a property/casualty insurance company will assess the condition of a potential policyholder's property to gauge the appropriate risk and coverage for the property. In many cases, the property may include spaces where access is restricted or dangerous to examine, such as a pitched roof. Rather than subject its personnel to undue risk, an insurance company can use a UAS to examine areas that are limited in access. This can provide data more quickly and with fewer hazards to company employees.

Similarly, when damage or loss occurs at policyholder locations, properly accessing the actual damage can subject insurance company personnel to physical danger and bodily risk. In many cases, a UAS can provide the needed access and assessment remotely, limiting the danger to insurance company personnel.

Insurance companies responding to disaster situations have a heightened need and responsibility for property assessments and claims adjudication. In situations with severe and widespread damage, the need for insurance companies to respond quickly and adequately can increase exponentially. Insurance companies are now exploring the use of UAS in claims appraisals in major disasters like Hurricane Katrina and Superstorm Sandy, where the extent of the damage may exceed the number of available inspectors and be inaccessible.

But the insurance use of UAS is not just limited to responding to major disasters. They can also play a key role after regional natural events or disasters that may not cause widespread damage but still affect the property of hundreds of policyholders. In the wake of more localized events such as tornadoes or hailstorms damaging small towns, UAS can provide a more rapid response to assess damage, leading to faster payment of claims.

The exemptions thus far have been dominated by small businesses. Retired veterans and aviation professionals, hobbyists, and boutique photographers have latched on to this proliferating technology to create new revenue streams, even though the process currently requires at least a private, recreational or sport pilot's license to operate. These licenses mandate a minimum of 20-40 general aviation flight hours and cost thousands of dollars.

Some approved businesses and individuals have had to come up with creative ways to comply with the pilot's license requirement. For example, Alon Sicherman, a freelance photographer from New York, didn't find out about the requirement until he received his exemption in June 2015. After extensive research on the easiest way to be compliant, he realized he could spend one month and about $5,000 learning how to fly a hot air balloon.

Other approved operators without a pilot's license, such as Tucson, Arizona-based Realtor Douglas Trudeau, have resorted to hiring local retired pilots for around $100 per hour whether they had experience flying a UAS or not.[12] Although these requirements are onerous, because of the authorization granted to the FAA by Congress, the requirement can only be changed through finalized rulemaking.

Until the small UAS rule is finalized, regulatory inconsistencies like this may be preventing some approved operators from taking to the air. For example, before late March 2015, approved operators had to apply separately for a certificate of authorization to fly in a particular area under particular operating limitations, which could take several months. In March, the FAA streamlined this process by awarding a COA to all Section 333 exemption holders provided they stay under 200 feet and away from airports, among other requirements; however, if an operator wanted to fly beyond these limitations, they would still have to apply for a separate COA.

Once the rule is finalized, businesses that follow the regulations set forth will be able to fly commercially up to 500 feet without having a separate COA or a private pilot's license.

Among the first 1,000 exemptions, 320 had business data listed with Hoovers. Of those, 268 are small businesses or sole proprietors, which make up almost 84 percent of the businesses listed. Companies with missing data are likely small or new businesses as well. Assuming this, small businesses make up 94.5 percent of the approved operators so far.

Large corporations receiving early exemptions include Chevron USA, Dow Chemical Co., the U.S. Automobile Association and Amazon.com.

SUMMARY OF THE LEGAL BASIS FOR SECTION 333 APPROVALS

DENTONS

Courtesy: Jim Williams, Principal

The lawyers and staff at Dentons have helped many current exemption holders navigate the complex legal processes created by the FAA Section 333 process and will continue to support the industry's needs after the small UAS rule is final.

There are many legal questions that are consistently asked about the Section 333 process:

- Why is the FAA requiring pilot's licenses for SUAS operators?
- Why can't I just pass the FAA pilot's written exam?
- Why is the FAA requiring registration for unmanned aircraft?

Many people don't realize that the FAA's authority to regulate aviation in the U.S. is strictly limited by the authorizing laws that created the FAA. The original law creating the FAA was passed by Congress in 1958, and every few years, Congress has passed updates to that original document. The last update was the FAA Modernization and Reform Act of 2012 (FMRA); it was the first FAA reauthorization to mention UAS.

The reasons the FAA requires registration and pilot's licenses for UAS operations can be found in the authority that Congress granted the FAA in Section 333 of the 2012 act and the previous authorizing laws that are still in effect.

The FAA is required by its past authorizing laws to require all aircraft 1) to be registered (i.e., N number per Title 14 Part 47), 2) to be airworthy (i.e., have a valid airworthiness certificate per Title 14 Part 91 § 91.203, Civil aircraft: Certifications Required), and 3) to be operated by a certificated airman (Title 14 Part 61 § 61.3, requirement for certificates, ratings and authorizations). In 2012, the FAA was authorized to allow exemptions to the airworthiness requirement in Section 333 of the FMRA. However, Congress did not provide relief from the other two requirements, and the FAA is not allowed to grant exemptions from any rule that is specifically called out in its authorizing legislation.

The legal requirement to register aircraft is easy to interpret, as there is only one aircraft registry and only one process to obtain registration. However, the requirement to be a "certificated airman" is much less clear. There are multiple types of airman certificates, with different ratings available under most types. Under strict interpretation of the existing rules, operation of unmanned aircraft requires a commercial airman's certificate, which requires many hours of flight training in manned aircraft. Early on, the FAA determined that this was excessive and reduced the requirement to the private pilot's certificate. Upon additional reflection, the agency realized even that was overkill and lowered the requirement to a sport pilot certificate (Title 14 Part 61, Subpart J.) A sport pilot certificate has the lowest flight training requirements for all airmen certificates. The FAA can't lower the bar any further until the new small UAS rule becomes final. In this proposed rule, a new type of airman certificate, which will have no manned or unmanned aircraft flight training requirements, is created for UAS pilots.

The Section 333 approvals are strictly a stopgap effort to allow low-risk commercial operations until the small UAS rule is final. The FAA has taken advantage of the flexibility provided by Congress in the FMRA of 2012, but can't really serve the need for small UAS commercial operations until the rule is final. However, there will still be a need for exemptions after the small UAS rule is final. We already know of many operators who want to operate beyond the strict limitations in the proposed rule (e.g., beyond visual line of sight). The exemption process can be used to approve those operations under the new structure created in the small UAS rule.

Other large companies have taken another route to the skies. A coalition of 15 news media companies have partnered with the Virginia UAS test site, including The New York Times, Gannet and NBCUniversal. CNN has also formed a partnership with the FAA to begin testing in congested areas under the FAA's Pathfinder Program.

Operations in public areas over people are essential to covering the news. UAS provide a quick and easy way to obtain valuable aerial footage to improve public awareness of emergency situations and current events. These can augment low-level news helicopter coverage and enable a safe, low-cost way to inform the public and first responders. As more and more commercial UAS operations take to the air, their consistency and track record of safe operations will provide a compelling case to begin wider testing in congested areas.

NEWSGATHERING SPOTLIGHT

NEWSGATHERING PLATFORM STATS
3 fixed wing
38 rotary wing
Avg. weight: 6.45 lbs.
2.3% micro UAS
Avg. endurance: 23.97 min.

ArrowData *Courtesy: ArrowData*

ArrowData is an innovative aerospace and data services company headquartered in Las Vegas. that specializes in persistent data collection, transmission, analytics and distribution services. It was the first company to receive a Section 333 exemption for newsgathering and the only company among the first 500 to focus solely on these operations.

ArrowData recently flew a CineStar 8 HL unmanned aircraft for ABC7 (KGO) in San Francisco on July 9, 2015, and both ArrowData and the TV station cannot be happier with the combined effort. The company integrated live unmanned aerial vehicle shots with numerous "hits" throughout the evening newscast.

"We provided live shots of the demolition of historic Candlestick Park that is being transformed into a housing and office space development called Candlestick Point," says ArrowData. "This was the first time a newscast in the Bay Area had used live UAV video to supplement its newscast. We also took numerous weather shots live from the UAV. KGO developed a specific website for this effort allowing viewers to see the video from our aircraft at all times during the broadcast.

"This debut of 'aerojournalism' was weeks in the making. After receiving a Section 333 exemption, we worked extensively with local authorities from the FAA in the Bay Area to ensure safe operations. We keep in regular contact with the FAA so they are familiar and comfortable with our operations.

"It is clear to us that TV news organizations want to use UAVs to cover TV news. They are more economical than helicopters and in many cases can provide better video. We are hopeful that as we continue to prove safe operations to the FAA, regulations will be relaxed involving flying over people and near airports. This will make using UAVs more effective when covering breaking news."

Because of the current regulatory limitations, newsgathering operations were mentioned only 20 times in the first 1,000 exemptions, most of which accompanied other, more accessible applications. This valuable industry will remain grounded until regulations allow for operations over people, which will begin to open the door for coverage of news, emergencies, public events and sports.

The 320 companies with available business data accrued 2014 sales of approximately $500 billion. As potential applications for commercial UAS continue to grow, the technology stands to quickly impact companies that contribute a significant percentage of the U.S. gross domestic product.

However, operators are not the only ones being affected by the UAS industry. Manufacturers small and large are embracing the newest wave in aviation and creating platforms, software data analytics tools, and other technologies for unmanned aircraft systems.

INSURING UAS PLATFORMS AND OPERATIONS

NAMIC® National Association of Mutual Insurance Companies *Courtesy: National Association of Mutual Insurance Companies*

Insurance coverage for UAS and attendant liability will be necessary for any responsible commercial use of UAS. Commercial users of UAS will want insurance coverage for any loss or damage to the aircraft and systems and will also seek liability coverage for any accidental loss or damage that may result from the UAS use. At present, however, most existing commercial property/casualty insurance policies may not include "aircraft," which is the designation given to UAS by the FAA. While limited insurance coverage is now available, any widespread commercial development of UAS use will require broader and more cost effective property/casualty insurance coverage.

NAMIC has surveyed its members and learned that many insurance companies do not have the requisite clarity of federal, state, and local laws and regulations they need to adequately assess the insurable risk of UAS loss and liability from any UAS damage or loss. While the replacement value of the aircraft is easily determined, the standards for liability for UAS commercial use are vague and uncertain, with basic tenants of privacy, property rights and applicable tort law still being developed. Separate standards for hobby and commercial UAS use exist at the federal level, while states and municipalities are enacting a hodgepodge of various standards for UAS use and liability. This muddle of regulation and risk assessment makes it very difficult to develop and offer a commercially viable insurance contract for UAS coverage.

THE PLATFORMS

So how about the platforms themselves? We've already covered some industry specific analysis of the platforms referenced in the first 1,000 exemptions, but what are the broader characteristics of commercial UAS?

HOW BIG ARE THE PLATFORMS? (Appendix A)

The smallest length and width noted for approved platforms was 0.82 feet with three feet as the median dimension. The Yamaha RMAX has the longest length at 11.9 feet, while the AeroLogix Consulting GeoStar has the largest wingspan at 13.1 feet.

The majority of the systems flying are small, sub-three-foot systems; however, some larger systems have taken to the air as well. The RMAX will be used for precision agriculture applications, and the GeoStar will support agriculture, construction, environmental and emergency management applications.

HOW MUCH DO THE PLATFORMS WEIGH? (Appendix B)

The HyperLite Black Ops 275 from Thrust-UAV was the lightest UAS at 0.3 pounds, and the RMAX was by far the heaviest platform at 207 pounds. The median takeoff weight among all platforms was 3.75 pounds, somewhat skewed by the large number of lightweight platforms, while the overall average fell in at 7.59 pounds. Greater than 50 percent of the platforms noted fall into the micro UAS category at less than 4.4 pounds. Weight figures largely reflect maximum gross takeoff weight, which includes the weight of the airframe plus the maximum payload capacity.

These numbers once again portray the infancy of the commercial UAS industry and reflect the simple operational profiles currently approved. In order to support domestic innovation from UAS manufacturers and a wealth of different business operations, expeditious rulemaking will be essential.

HOW LARGE OF A PAYLOAD CAN THEY CARRY? (Appendix C)

The median payload capacity for approved systems is 1.43 pounds while the average is 4.18.

A four-pound payload capacity is sufficient for capturing aerial imagery from cameras such as the GoPro or other lightweight consumer and prosumer cameras. Many inexpensive consumer drones can even come with their own cameras, reducing the need for additional payload capacity at all. However, the average payload number should increase as operators use more advanced imaging devices such as lidar or multispectral photography to support inspection and agriculture applications and for high-end videography where cameras for film, television and news media often greatly exceed this mean figure.

Spraying applications for precision agriculture or in cases where an unmanned cargo helicopter delivers water or fire suppressant to wildfires will require even higher payloads. The Lockheed Martin unmanned K-Max helicopter can lift over 6,000 pounds and has transported millions of pounds of cargo in support of military operations to date.

HOW FAST CAN THEY FLY? (Appendix D)

The Penguin 1720 tops the charts with a maximum speed of 81 mph. The median maximum speed for all platforms was 33.5 mph with the average at 39.7 mph. These fall well under the 100 mph speed limit outlined in the FAA's proposed rules. Although the proposed rules may not be as permissive as they could be in some cases, the guidelines do generally encompass the range of commercial operations thus far. A swiftly finalized rule will be an essential step in enabling this transformative industry.

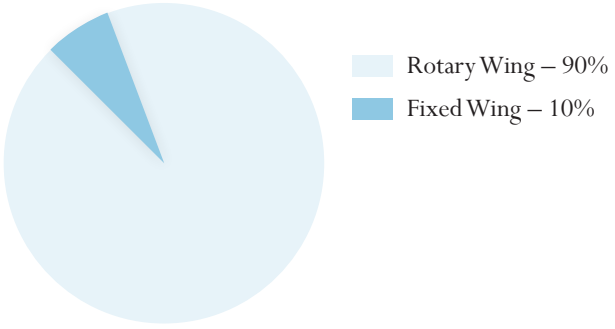
HOW LONG CAN THEY FLY? (Appendix E)

The Bumblebee-S from Shenzhen Shengtian Model Co. has the lowest endurance of approved platforms at 10 minutes and has been approved to support real estate, search-and-rescue, agriculture, construction, and other aerial inspection applications. The median endurance for all platforms is 25 minutes with the mean at 28.25 minutes. The MLB Super Bat and Penguin B and C platforms are not displayed on the graph. The MLB Co. Super Bat can fly for 10 hours and span a distance of 400 miles. The Penguin B and C models from UAV Factory have a 20-hour endurance with a top speed of about 80 mph and will support agriculture, oil and gas, and environmental applications.

The capability for long-endurance times has been firmly established in platform innovation. Aurora Flight Science's Orion UAS flew for 80 hours last December. ETH's AtlantikSolar recently broke the under 50kg UAS record for endurance using solar panels to power an 81 hour flight. These specifications will be particularly useful for high altitude UAS that may someday provide internet across the globe, particularly in undeveloped areas. However, many of the simple operational profiles currently approved do not require such robust specifications and contribute to the low average endurance.

Battery power is a key technological weakness, with most platforms capable of only around 30 minutes of flight. As the majority of approved platforms are electric multirotors, this explains the low endurance data across the board despite the few long-endurance systems approved.

WHAT TYPES OF PLATFORMS ARE BEING USED?



ROTARY-WING TYPE	% OF PLATFORMS
4-Rotor (Quadcopter)	74.70%
8-Rotor (Octocopter)	18.90%

ROTARY-WING TYPE	% OF PLATFORMS
6-Rotor (Hexacopter)	5.50%
Helicopter	0.60%
12-Rotor and other	0.30%

LAUNCH TYPE	% OF PLATFORMS
VTOL	89.80%
Hand Launch	8.30%
Launcher	2.40%

RECOVERY TYPE	% OF PLATFORMS
VTOL	91.30%
Skid/Belly	8.00%
Parachute	2.40%
Other	1.20%

PROPULSION TYPE	% OF PLATFORMS
Electric Motor	99.60%
Combustion Engine	0.50%

(Values in charts may total >100% because some platforms qualify for more than one of the criteria.)

The majority of platforms referenced in the exemptions are rotary wing, at almost 90 percent. Among these, about 75 percent are quadcopters followed by 19 percent octocopters. About 10 percent of the aircraft referenced had fixed-wing designs, over 50 percent of which come from agriculture use cases. Large plots of land require the endurance advantage carried by fixed-wing designs. Fixed-wing platforms may become more prevalent once beyond-line-of-sight operations unlock greater potential for agricultural applications, utility inspections and others. Now, with the line-of-sight requirement, there is little need for platforms that fly for farther and longer, exceeding this basic capability.

Nearly all of the referenced platforms rely on electric propulsion, which improves safety, especially in cases where legacy tools require flammable fuel. For the simple operational profiles currently approved, the increased weight and endurance using a combustion engine can be limiting in other ways including decreasing efficiency, increasing operational complexity, and contributing to environmental and safety concerns. In the future, UAS innovation will drive forward novel solutions to the energy problem, including developments and integration with fuel cells, solar panels and even aerial recharging technologies.

TAKEAWAYS

The rate of UAS operators is finally growing after years of awaiting rules and a pathway to the airspace, and the initial data show great promise for the future of the industry. Prior to this year, data on commercial UAS operations in the U.S. were nonexistent. Now, we have been able to take a look at early trends regarding safe commercial operations and can establish a basis for recommendations for future growth.

It is clear in the data that, even though many industries have started to benefit from UAS operations, beyond-line-of-sight operations, operations over congested areas, and nighttime operations will be critical to achieving the full societal and economic benefits of UAS use. To achieve this, a risk-based, technology-neutral regulatory framework will be essential to getting this industry off the ground.

The data have shown favor toward simple, low-risk operations currently; however, more can and should be done to facilitate expanded operations that pose no threat to the National Airspace System, especially in rural areas under 500 feet. The FAA recently made progress on this front by enabling nighttime flights, beyond-line-of-sight testing with daisy-chained observers from the flight team and operations up to 1,200 feet across North Dakota at the Great Plains UAS Test Site.

At this point, however, the industry is primarily being held back by the continuous rulemaking delays that make it difficult to innovate without standards and other parameters. We strongly advocate for swift rulemaking to take effect, not only to accelerate the safe commercial use of UAS and its benefits, but also facilitate a larger data set to base future development on.

The six FAA-designated UAS test sites can help provide better access for industry testing, especially for these expanded use cases in places such as North Dakota, where the FAA has begun to allow expanded testing opportunities.

To facilitate this, in the upcoming FAA reauthorization, Congress should consider making the test sites eligible for federal funding under current FAA offices and programs that are engaged with UAS activities in order to help them perform the valuable research needed for integration. This would not specifically add new funding for the test sites; rather, it could allow for them to receive existing federal funding and give industry guidance and incentive to better utilize the test sites.

Technological barriers to full-scale integration will be challenging to conquer as well with such a limited data set. Government and industry must develop a comprehensive research plan to gather data on expanded use cases and establish recommendations and deadlines to achieve important research milestones. This includes an emphasis on developing a UAS traffic management system and coordinating UAS integration efforts with NextGen.

UAS integration should be a national priority, as delays and piecemeal solutions are greatly hindering the economic potential and societal benefits of the U.S. commercial UAS industry. Many other countries, including Canada, France, Australia and the U.K., have had UAS rules in place for years, enabling industry there to progress, in some cases even with beyond-line-of-sight operations. The U.S. UAS industry is poised to be the leader in this field, as is shown by the rapidly increasing interest and innovation domestically. However, high-level leadership and coordination with industry and government partners is absolutely critical to ensure the United States regains trailblazer status in this global industry.

RESEARCH METHODOLOGY

The UAS industry is in its infancy and has barely begun to take to the air. These Section 333 exemptions are only a small sample size and may not perfectly reflect the industry once finalized rules are put into place, but this report will provide the most accurate snapshot of the budding U.S. commercial UAS industry currently possible.

This report features spotlights from eight key industries with a clear stake in the future of the UAS industry and which, to varying degrees, are already taking advantage of the so-far limited opportunities available through the exemption process.

These industries — real estate, agriculture, construction, film and television, oil and gas, utilities, insurance and newsgathering — will all benefit greatly from developing established UAS operations and have unique concerns and requirements moving forward.

For example, operations over congested areas will be essential to newsgathering operations, whereas for precision agriculture surveys over a large farm, there is very little need to fly over anyone not involved in the operation, but a great need to fly beyond line of sight.

The report also includes an overview of the legal basis for Section 333 exemptions, contributed by the former head of the FAA's UAS Integration Office, Jim Williams.

This analysis, although it covers the first 1,000 exemptions, only truly looks at 923 unique companies who received the first 1,000 exemptions. Many companies received multiple exemptions, with six being the most received by Florida-based Open Sky Drones. These instances of multiple exemptions for a single company are likely because the scope of their operations varied enough that each use case required its own exemptions. Otherwise, adding a platform or new operational location to an exemption would only require an amendment to the original exemption.

Always keep in mind, there is much more data that can be drawn from the exemptions than can be summed up in this report.

INDUSTRY/TYPE OF OPERATION

The nature of the language in each exemption is vague and leaves open to interpretation the industry or operation each entity will support. For instance, a petition may request "aerial acquisitions and research" or "aerial acquisitions within the National Airspace System." This phrasing can cover most operations currently conceived with UAS and does not give a precise account of the type of operation that will be supported.

Some petitions take up to half a page to list all of the potential uses, with the phrasing, "including but not limited to," similarly obscuring the actual operations that will take place. Reasons stated for doing so by the petitioners are to take advantage of servicing multiple markets that require similar operational profiles and to cover commercial work for any new market opportunities that may arise.

This analysis only takes into account key operations that are either 1) explicitly cited in the petition or 2) a main service provided by a company with vague petition language. We have also grouped general photography services, such as event photography or more ambiguous photography/videography applications, into the category "Aerial Photography." The areas of "Aerial Surveying" and "Aerial Inspection" follow suit for general survey and inspection operations that are not explicitly described. A distinction between survey and inspection applications is defined by the scope of the operation. Whereas survey involves large scope aerial data collection, inspection relies on more nuanced aerial data.

The "Environmental" category includes activities supporting forestry, geological mapping and studies, land management and planning, and even mosquito control, among others. "Emergency Management" covers all first responder or disaster relief activities that are not specifically "Search and Rescue."

Three outlier industries supported by commercial UAS approvals — including risk management specified by a risk management firm, paving specified by a paving company and mill operations specified by a mill — could not fit into a broader category. This does not mean, for instance, that many of the approved operators will not use UAS for risk management practices; however, it would be for the support of a specific industry.

PLATFORMS

The platform data used in this report were taken from AUVSI's Unmanned Systems and Robotics Database, which is the world's largest database of air, ground and maritime unmanned platforms.

The data collected on platforms referenced in the first 1,000 Section 333 approvals include 155 platforms with publicly available specifications. These 155 platforms total 1480 approved uses in the first 1,000 approvals. Ninety-two proprietary designs, which are largely referenced only once in the approvals, have not been included in this analysis. These include platforms such as Amazon's proprietary multirotor SUAS, where public specifications are not available. The platform data only include those platforms referenced in the exemptions, not necessarily those that are currently registered and operational.

A note should be made that many of the data, especially regarding system endurance, are manufacturers' figures for ideal conditions and do not accurately reflect practical operations where factors such as payload and wind conditions could greatly diminish actual endurance times.

For industry-specific analysis, remember that as many petitions may include more than one industry and more than one platform, there is no precise way to measure which of these platforms might be used for which industry application.

There are also a few cases where certain data are not available for a system. For example, a manufacturer might leave out endurance or weight information from its specifications in cases where the data downplay the features of the system, where lightweight platforms are made for larger payloads or where the information could not be easily assessed, such as for maximum altitude.

DEFINITIONS

Small Unmanned Aircraft System (SUAS) – An aircraft with no pilot on board that weighs up to 55 pounds.

Operational Profile – The parameters involved with support of a specific operation, including altitude, range, duration and location.

Risk based, technology neutral – A risk-based, technology-neutral framework means that regulations would be based on the risk profile of a particular UAS operation instead the platform being flown. This flexible framework will accommodate innovations rather than require new rules each time a new technology emerges.

Fixed wing – A vehicle capable of flight using wings that generate lift caused by the vehicle's forward airspeed, like commercial airliners.

Rotary wing – A flying machine that uses lift generated by blades that revolve around a mast, like a helicopter.

Line of sight – A requirement for unmanned aircraft to be flown within view of the operator.

Beyond line of sight – An operational parameter where an unmanned aircraft can fly beyond the operator's view.

National Airspace System (NAS) – The airspace, navigation facilities and airports of the U.S. including associated information, rules, services, policies, procedures, personnel and equipment.

Hoovers – A research firm with a database of more than 85 million companies.

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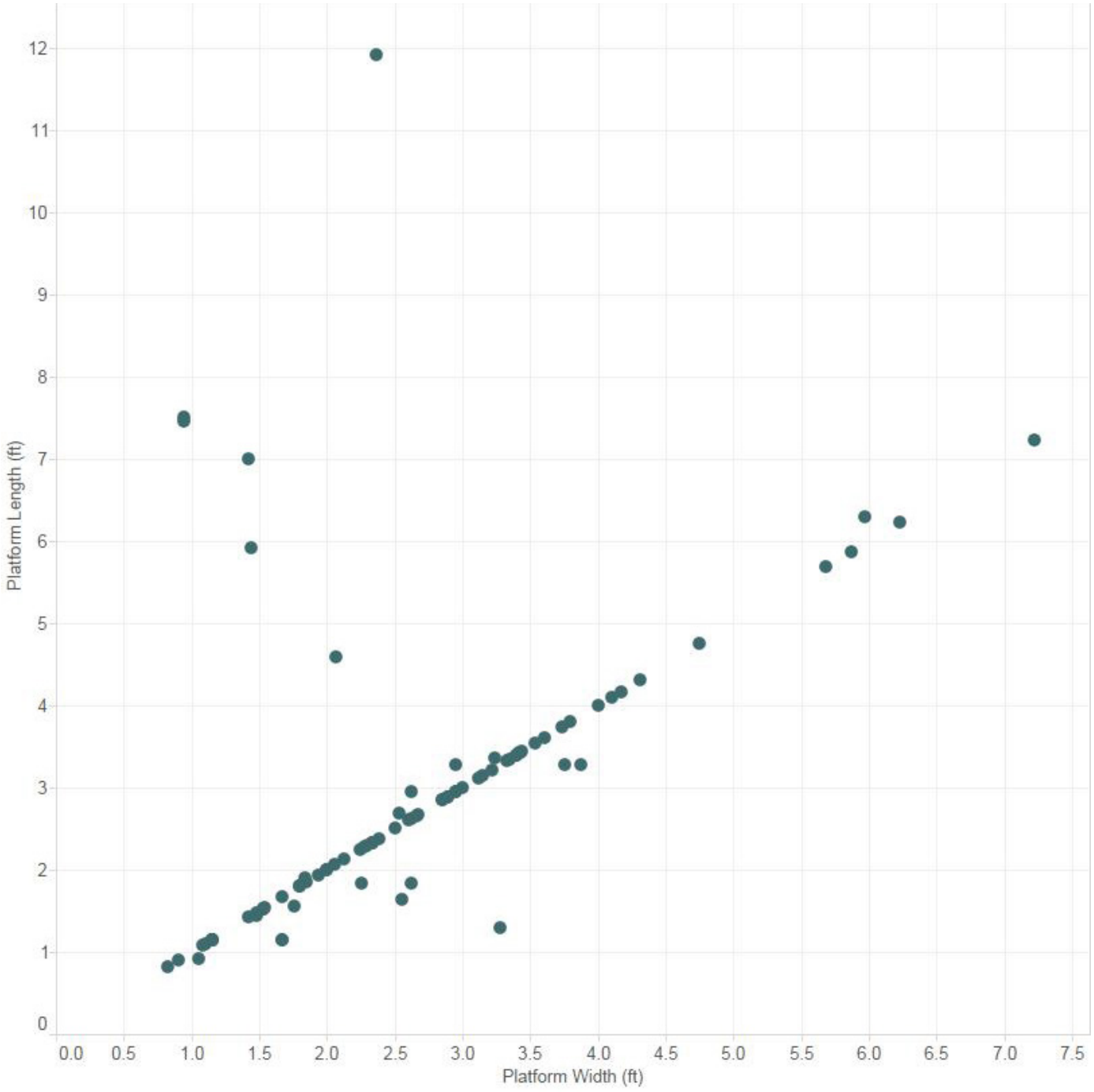
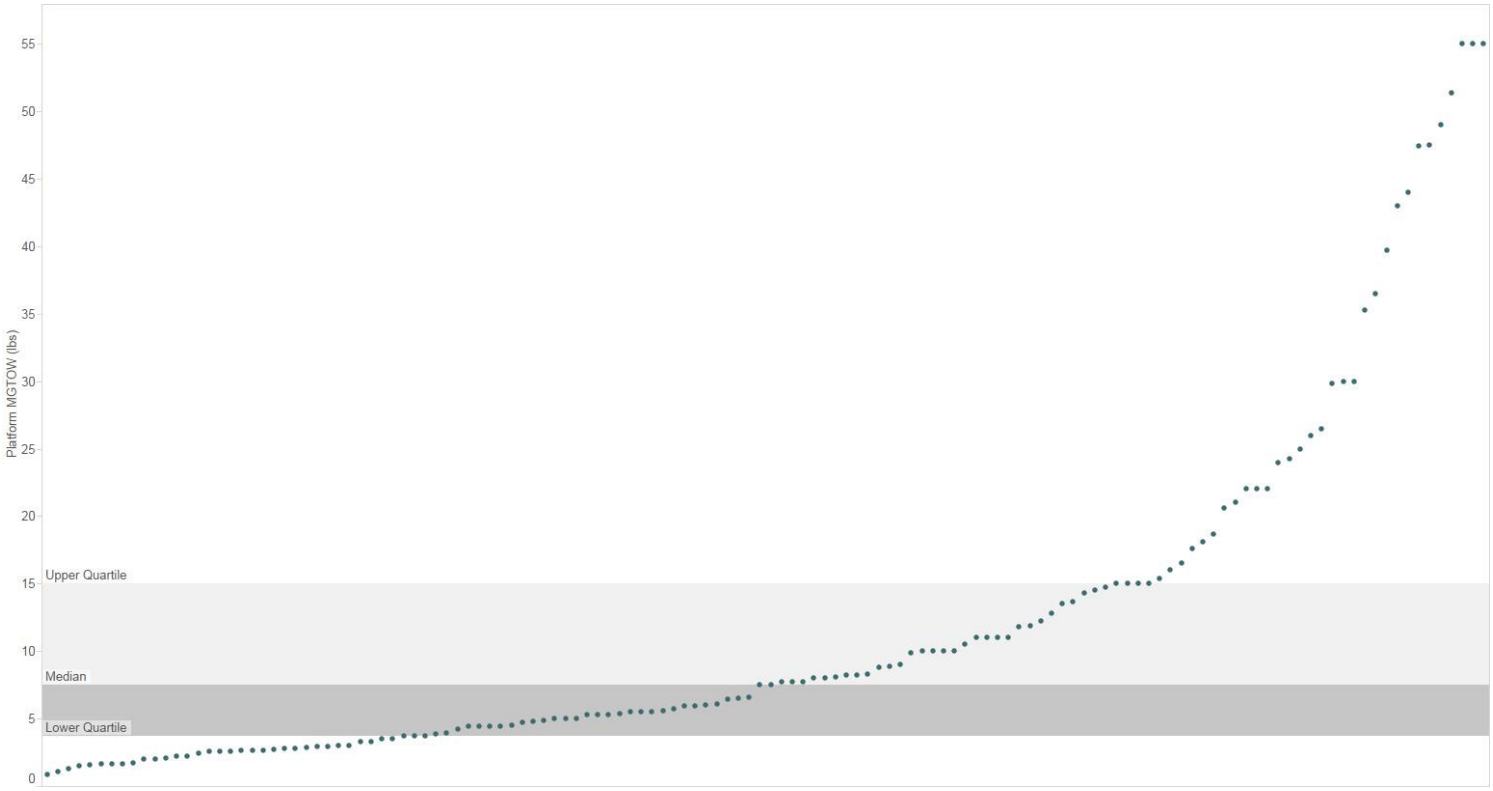
APPENDIX A

How big are the platforms?



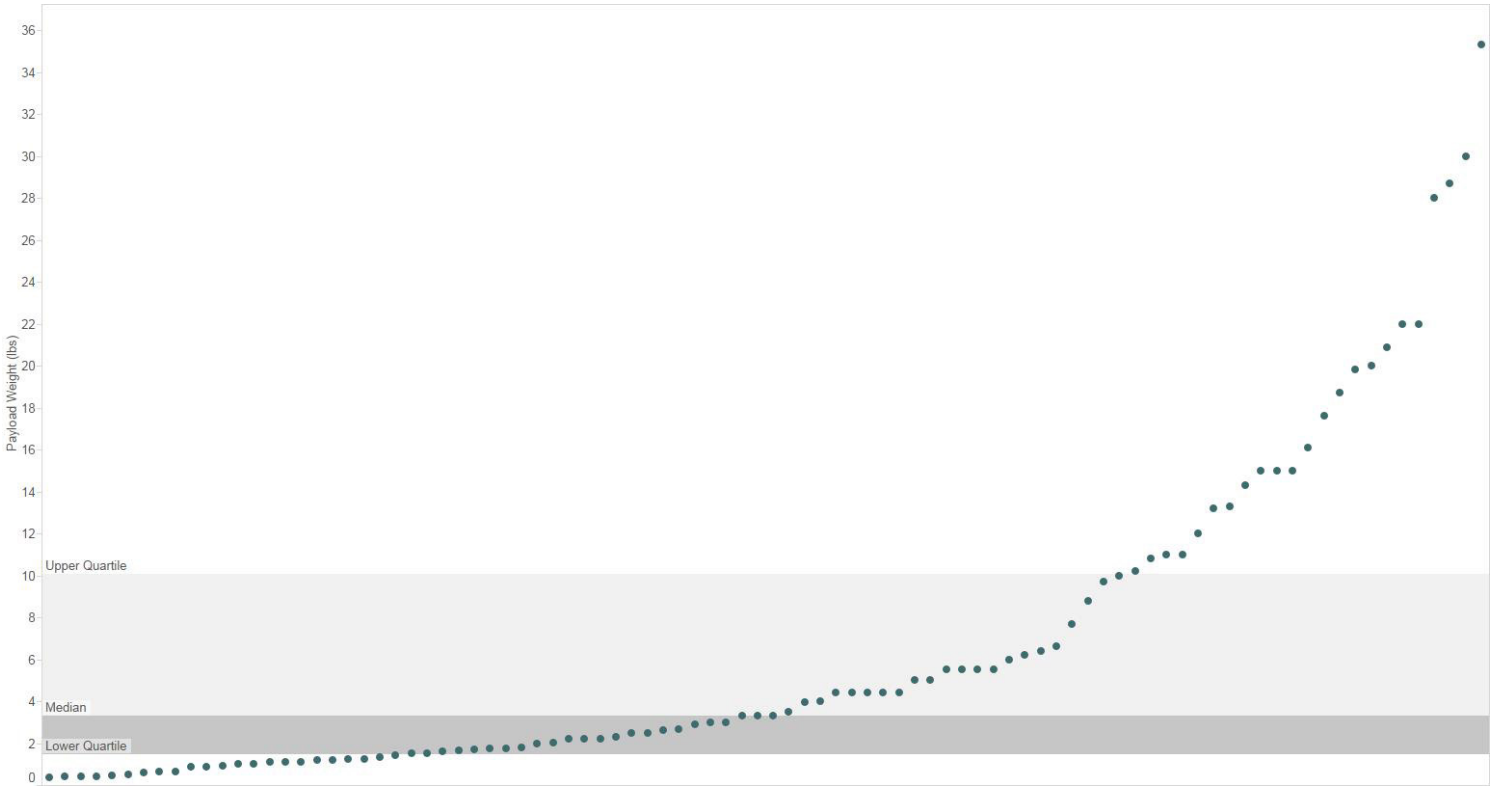
APPENDIX B

How much do the platforms weigh?



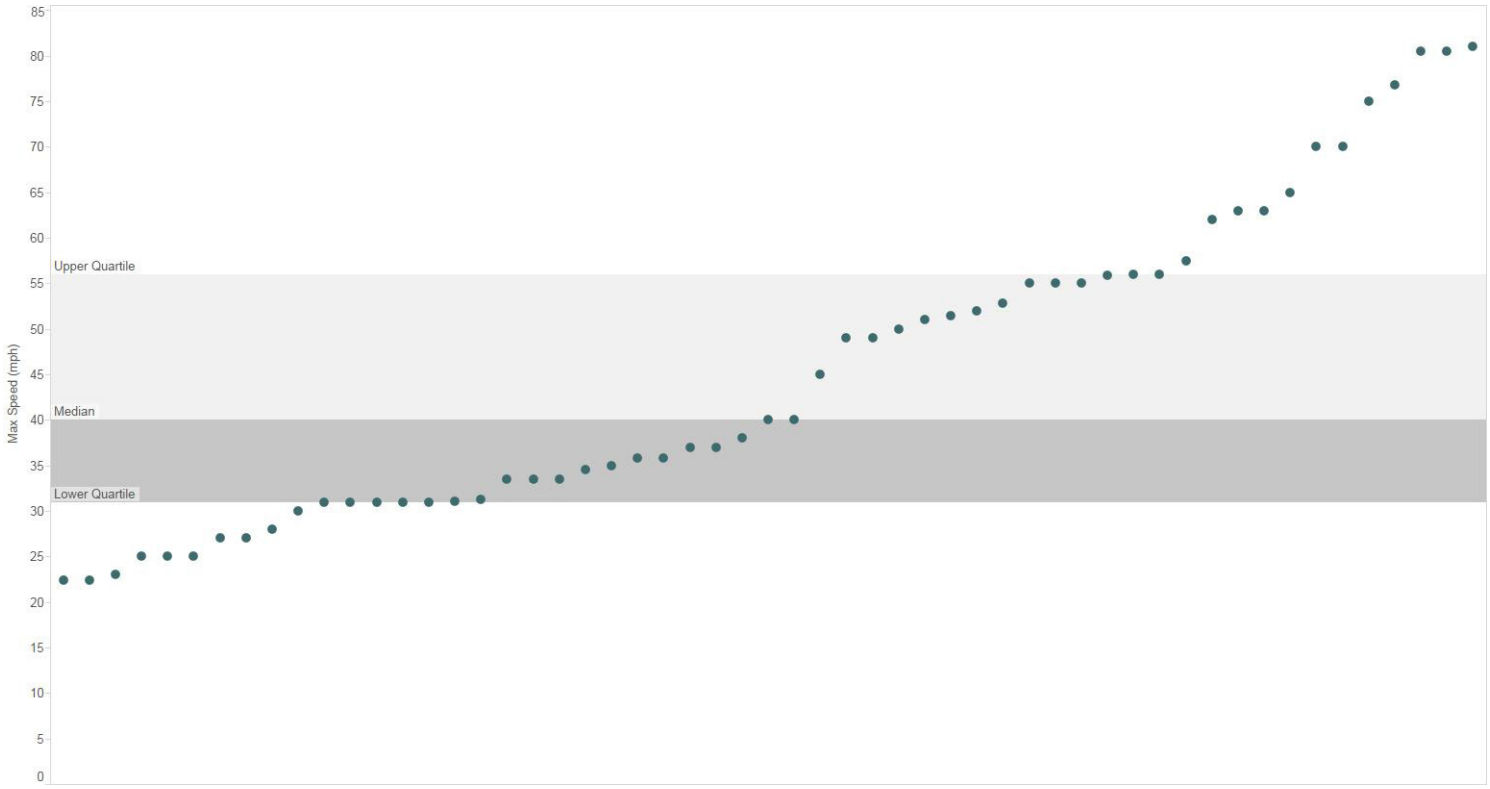
APPENDIX C

How large of a payload can they carry?



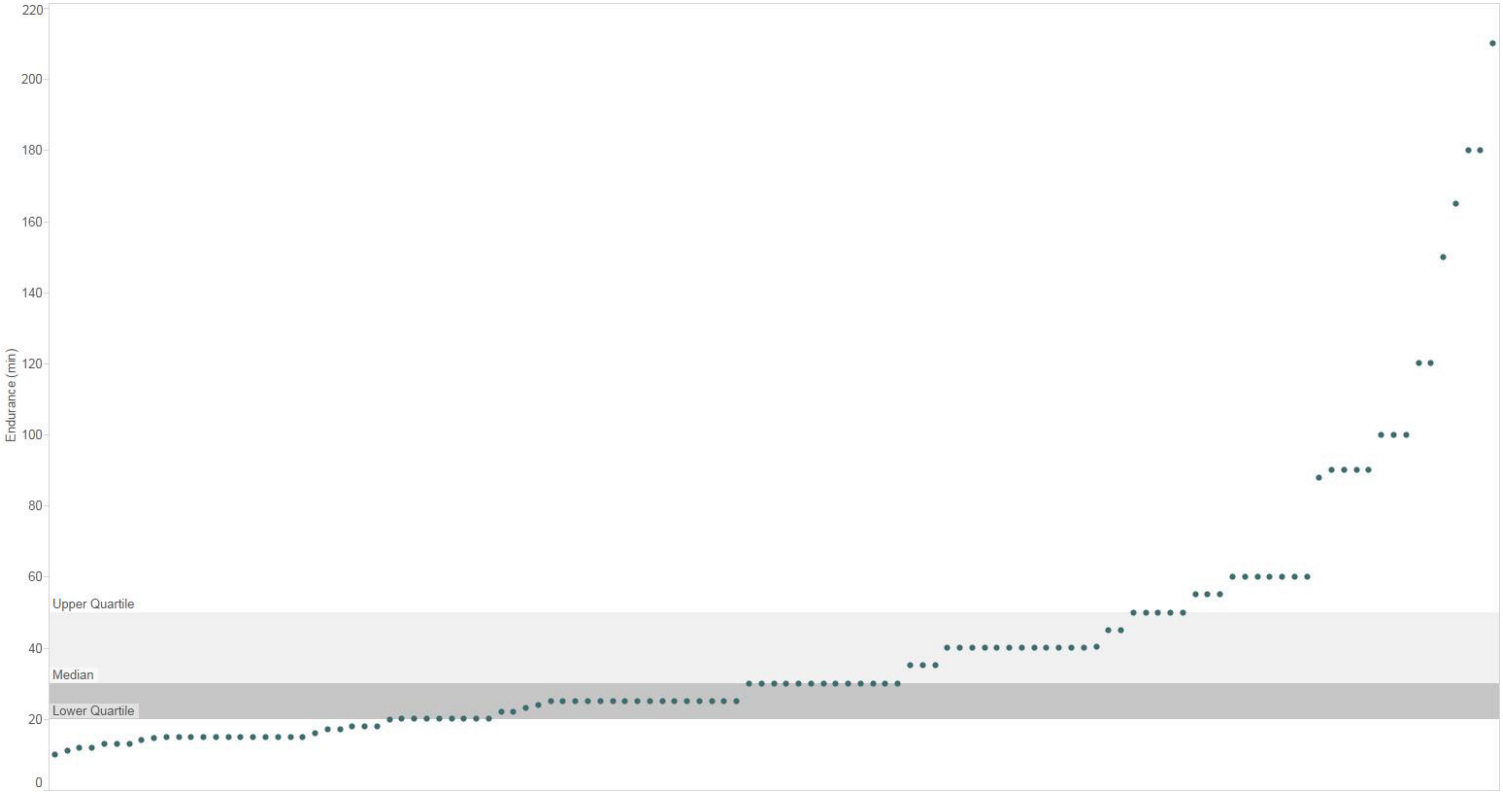
APPENDIX D

How fast can they fly?



APPENDIX E

How long can they fly?



CONTRIBUTORS

Writer and Researcher: Scott Kesselman

Lead Researcher: David Klein

Editors: Danielle Lucey and Brett Davis

Graphics: Kellie Sigler and Victoria Bottlick

Other contributions: Chloe Svolos and Joseph Amato

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