

Unmanned Aircraft Systems

The current and potential uses of Unmanned Aircraft Systems (UAS), also commonly referred to as drones, Unmanned Aerial Vehicles (UAV), or Remotely Piloted Aircraft (RPA) and even model aircraft, are evolving more rapidly than the laws and regulations that govern them. Drone use, and all too often drone misuse, is prominently featured in local and national news headlines and across social media. Their increased prevalence and publicity is expected to continue over the next several years. Drone use has the potential to change how Minnesotans conduct business, move goods and access the nation's airspace. However, this great potential is not without significant challenges. This paper focuses on how UAS are being used and regulated today and what we might expect in the future. It also discusses the associated issues and risks proliferation of UAS present.

RAPID EVOLUTION

The term UAS is used to cover a broad range of aircraft that are becoming more readily available via the internet and in local retail stores such as Target, Best Buy, and even Menards. It is important to understand that the Federal Aviation Administration's (FAA) definition of UAS is not limited to the aircraft that is being flown, but to all the components necessary to support the aerial operation, such as support equipment and controls, and the human operator, are all considered part of an UAS.

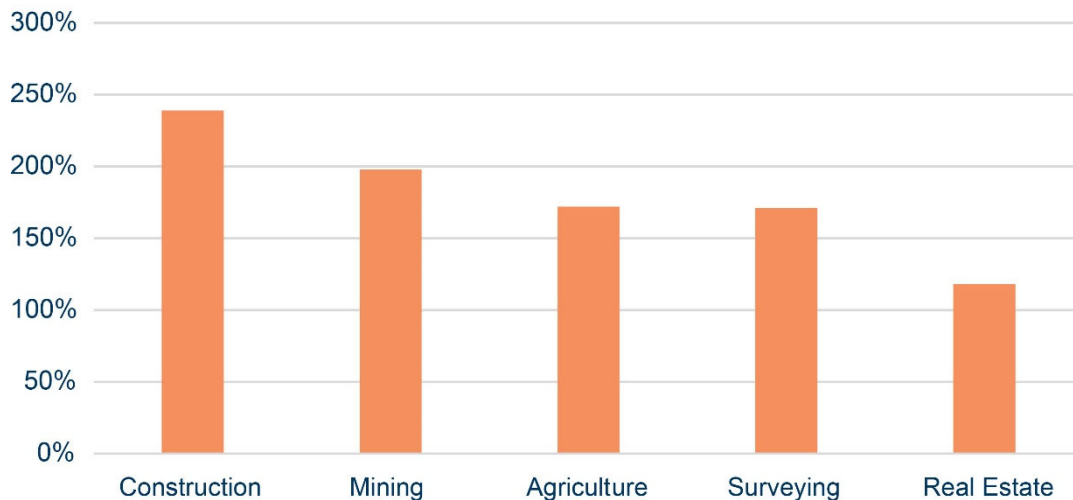
Figure 1: UAS quadcopter in operation¹



Drones are becoming increasingly available in a broad range of sizes designed to perform an equally wide range of tasks and functions. The evolution of sensor technology is allowing for diverse applications of drones. Drones today can have multiple cameras on-board and address specific needs through custom camera builds. Micro-sized drones being developed have the potential to operate nearly undetected in close proximity to unsuspecting persons on the ground while other, more commonly recognized models (see photo above), are relatively easy to see when operated in close proximity. Despite being more visible, these drones could still pose a safety threat to people on the ground and manned aircraft in the sky. Five years ago, military drones were most commonly associated with the term and likely in the context of military activities around the world. While UAS are still routinely utilized in military operations, commercial and recreational uses have eclipsed military use. Figure 2 shows the year over year growth of drone use in non-defense industries.

¹ DroneRush

Figure 2: Non-defense Industry Growth²



The availability and use of UAS are on the rise largely due to rapid advances in the underlying technology needed to manufacture the vehicles and their downward trending price point. UAS sales have increased steadily for the past 5 years, and is forecasted to continue on this trend. UAS global revenue was estimated to reach \$6 billion in 2017 and grow to more than \$11.2 billion by 2020³. Small hobbyist UAS ownership surpassed 1 million vehicles by the end of 2017.⁴ This large increase, up from 300,000 in 2016, stems from the federal regulation mandating all vehicles over 0.55 pounds to be registered with the FAA. This represents an exponential increase in UAS use of the National Airspace System (NAS), in addition to a significant increase in the number of “pilots” using the system. Many of the new UAS operators are not adequately prepared to operate an aircraft in the NAS. The ‘Know Before You Fly’ education campaign was established to educate operators on what constitutes safe and responsible small UAS flying, especially for model or recreational UAS operators who may not be experienced pilots or operators. Preparation for commercial small UAS operations are different and more strictly regulated by the FAA.

BUSINESS APPLICATIONS AND ECONOMIC IMPACT

Today, UAS are increasingly used for a variety of commercial purposes to achieve a broad range of goals and tasks. This trend is driven in part by the potential to save money, time and lives. Commercial use of drones will have a profound and undeniable impact on state, national, and global economies. Economic forecasts estimate a \$100 billion market opportunity for drone use by 2020 due to the growing demand from the commercial and civil government sectors. Full economic potential is likely to be multiple times that number, as the ripple effects of drone use reverberates through the economy⁵. The various industries using commercial UAS is depicted in Figure 3. Figure 4 shows the global sales in millions of the retail and consumer drone market.

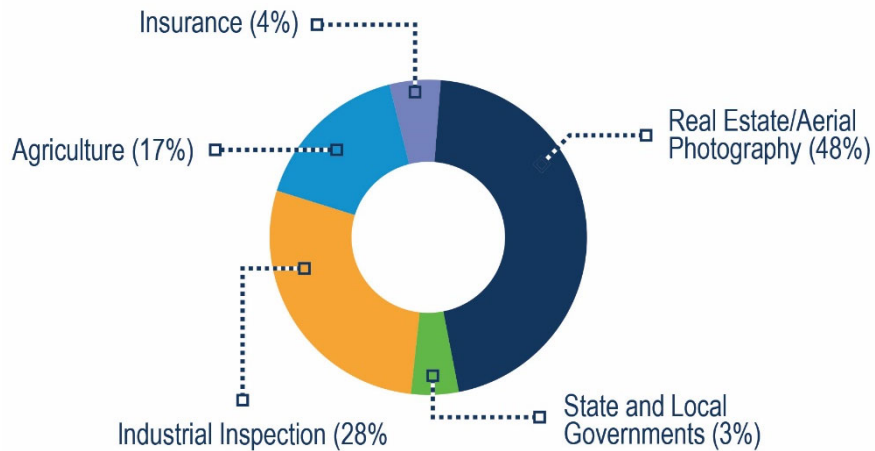
² 2018 Commercial Drone Trends, DroneDeploy, 2018

³ Gartner, Gartner Says Almost 3 Million Personal and Commercial Drones will BE Shipped in 2017 (Press Release)

⁴ FAA, UAS fleet to more than double by 2022 (Press Release)

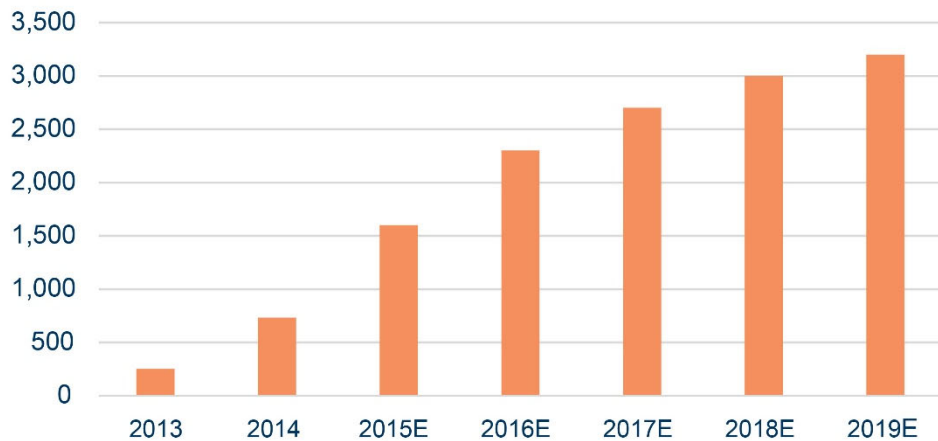
⁵ [Goldmansachs](#)

Figure 3: Commercial UAS Uses



Source: FAA Aerospace Forecasts FY 2017

Figure 4: Global Sales (in Millions of USD) Retail and Consumer Drone Market



Regulation & Registration

All aircraft conducting UAS operations in the National Airspace System (NAS) requires a licensed pilot, operational approval when flying in controlled airspace, and must be registered with the FAA.

To fly a UAS for commercial or business use, an operator must fly under the FAA's Small UAS Rule (Part 107), which was implemented on June 21, 2016. Prior to the Part 107 rule, remote pilots would apply for a Section 333 Exemption to allow for commercial use of UAS. The operator seeking to fly under the Part 107 rule will be required to be at least 16 years old, pass an aeronautical knowledge test at an FAA-approved knowledge testing center and undergo Transportation Security Administration (TSA) screening.

Flying for hobby or recreation only, an operator must fly under the Special Rule for Model Aircraft (Section 336). The operator must comply with the rules and regulations within FAA Advisory Circular 91-57A.

To operate within controlled airspace, the operator must apply for a waiver through the FAA's DroneZone Portal. This pre-screening operator process will expedite the waiver request time to allow for faster and more efficient flight requests, The FAA is currently looking into a real-time airspace authorization portal. The program is called LAANC or "Low Altitude Authorization and Notification Capability", the system was in the beta stage during 2018. In Minnesota, 20 airports are covered by the LAANC.

In addition to the FAA requirements, local and state regulations can require commercial operators to apply for a commercial operations license. In some states, the aircraft will also need to be registered with the state's Department of Transportation.

In Minnesota, registration with the state is required when operating commercially. Commercial registrants are also currently required to obtain a state commercial operator license for a fee.

There has been over 106,000, Remote Pilot Certificates issued under Part 107 by the end of 2018. Minnesotans represented 2,063 of the 106,321 remote pilots.⁶ The commercial, small non-model UAS fleet is set to grow from 110,604 in 2017 to 451,800 in 2022. The number of remote pilots is set to increase from 73,673 to 301,000 in 2022.⁷

AEC (Architecture, Engineering & Construction)

Drone use in construction continues to grow at a rapid pace UAS are playing a growing role in inspections, monitoring site progress, providing high accurate maps and measuring stockpiles. Engineers and architects now have data from UAS surveys for high accurate site survey maps to enable them to efficiently plan their projects.

While dozens of industries use drones, the fastest growing commercial adopters of aerial data come from the construction, agriculture and mining industries. Construction is currently the fastest growing sector- surging 239% in the last year- and is now the top industry using DroneDeploy.⁸

Drones today continue to play a large roll in taking humans out of high-risk environments. Specifically in the use for construction inspection, where infrastructure like bridges, wind turbines, oil, gas, electric utility lines can be safely inspected using drone technology. Inspections could be done routinely, or following severe weather in an effort to quickly assess damage or emergency repairs needs.

Growth and future uses of UAS might include the use of autonomous operations to validate materials on hand, or the ability to carry tools across a jobsite. The uses for UAV technology will continue to grow in the construction industry.⁹

Delivery

The Federal Aviation Authority (FAA) is launching a new program called the UAS Integration Pilot Program. In order for the UAS delivery market to take off, sufficient infrastructure must be in place. The development of advanced Universal Traffic Management (UTM) will allow regulation and safe tracking of all commercial delivery services. The program will also aim to provide security procedures, anti-hacking protection, medical supply deliveries and general commercial use.¹⁰

⁶ FAA 2018 Civil Airmen Statistics

⁷ [FAA, 2018](#)

⁸ Ibid.

⁹ [AUVSI Commercial Exemptions](#)

¹⁰ [FAA Pilot Program](#)

Companies like Amazon, Google and Zipline have started testing commercial drone delivery in Australia and the UK. Private customer trials are ongoing to gather data to improve safety and reliability of the operations.

There are many challenges to overcome for drone delivery systems to become reality, but the utilization for UAS for deliveries will have an impact on the markets ability to provide critical supplies and more efficient ways of providing products to consumers.

Photography & Filmmaking

UAS are often seen as a safer and more efficient alternative to the use of manned aircraft in many cases due to cost advantages in aerial observation and photography.¹¹ UAS use can significantly reduce the time spent collecting accurate data. Aerial images can be acquired from the sky, with resolutions as sharp as 1.5 cm (0.6 in) per pixel. UAS technology is viewed by some in the film industry as game-changing, being able to create shots that could never be achieved before, with directors of photography starting to conceive shots around the use of UAS.¹²

Public Safety

Technological advancements are underway in the drone development market to provide additional tools for markets with industrial and public safety applications in mind. Imaging sensor technology provides the ability to utilize two separate camera technologies on one drone without having to stop the mission and swap cameras. Some examples of sensor technology include thermal imaging, radiation, and gas detection.

The evolution of drones and sensors has enhanced operations in industries such as search and rescue, firefighting, disaster response and law enforcement.

Drones equipped with thermal sensors for search and rescue have proven to substantially accelerate the search time. Improvements in drone speed has allowed rescuers to scan search areas much faster than traditional search methods. Speed of recovery is critical in search and rescue and the use of drones could make a difference in saving a life.¹³



¹¹ Planning Magazine, October 2015

¹² AUVSI Report, September 2015, Full AVUSI Report

¹³ [Market Watch, 2017](#)

Firefighting teams equipped with drones now have the ability to scout, monitor and evaluate blazes from a far. New drone camera technology provides the ability to fly far away from hazards, while at the same time capturing high quality data. Thermal imagery sensors allow firefighters to see through the smoke to safely detect the source of the fire or locate persons trapped

Tactical missions and suspicious material inspections are a few ways law enforcement can use drone cameras and sensor technology. Radiation sensor technology is evolving and one day may allow law enforcement to detect unlawful items during large public gatherings to ensure the public's safety. The deployment of a small UAV for an officer on the scene will provide fast aerial surveillance during tactical missions.

ISSUES & CONCERNS

While it is clear that the many current and proposed uses of UAS in today society could have immeasurable positive impacts on the global economy as well as public health and well-being, the technology is certainly not without its drawbacks.

Privacy & Law Enforcement

As UAS become more prevalent, so do concerns an operator may violate the privacy of another. Use of drones for surveillance purposes raises privacy and civil liberty issues. Drones are capable of advanced surveillance and contain equipment such as live-feed video cameras, infrared cameras, heat sensors and radar. Others may be equipped with 'wi-fi hackers' and fake cell phone towers that can determine one's location or even intercept texts and phone calls. Drone manufacturers have admitted that some designs will accommodate 'less lethal' weapons such as tasers or rubber bullets.

Privacy laws have not kept pace with drone technology. A public concern is that without an understanding of the implications, law enforcement could use drones to collect evidence on citizens without a warrant or proper legal process. In Minnesota, few communities have taken steps to directly regulate drone usage. The City of St. Bonifacius, the City of Arlington, Three Rivers Parks District, and the University of Minnesota are among the cities regulating drone usage. In most cases, a local ordinance banning the use of aerial drones is put in place because of concerns about citizen's privacy. States continue to pass legislation preempting local lawmakers from enacting their own drone regulations. 26 states have enacted laws addressing UAS issues and an additional six states have adopted resolutions. Common issues addressed in the legislation include defining what a UAS, UAV, or drone is, how they can be used by law enforcement or other state agencies, how they can be used by the general public and regulations for their use in hunting game. Twenty states passed 26 pieces of legislation, though not all were related to privacy. Legislation requiring law enforcement agencies to obtain a search warrant to use UAS for surveillance or conduct a search is currently in place for 18 states.¹⁴

Safety

The responsibility to safely fly UAS applies the same as it does for manned aircraft operations. Due to the small size, shape, color and lack of lights can make it very difficult for human pilots to visually identify UAS in-flight compared to traditional manned aircraft. UAS are usually not equipped with "sense and avoid" capabilities. Sense and avoid technology may be incorporated voluntarily and potentially required in the future for UAS. Amazon Inc. is promoting its proposed delivery drones' safety features would include Amazon's "sense and avoid" technology.

Reports of potentially unsafe UAS operations are increasing and include unauthorized operation at and near airports. A February 2017 FAA report lists 1,274 possible UAS encounters nationwide, with five in the Twin Cities area, compared to 874 sightings in 2015. This troubling trend points toward an increased risk of a mid-air collision. One particularly concerning instance of UAS use

¹⁴ NCSL Transportation

interfering with manned aircraft operation occurred in summer 2015 when wild fire-fighting operations had to be suspended due to unauthorized drone use in the vicinity¹⁵.

Other safety concerns include UAS crashes or mechanical failures potentially resulting in injury or property damage. Drones also pose a potential homeland security risk, as terrorists could find a number of ways to threaten people and property.

Many users are considering obtaining liability. There are insurance companies that offer policies to cover liability and damages in the event of a UAS crash or mechanical failure.¹⁶ Congress is considering legislation requiring drone manufactures to implement 'geo-fencing' solutions on all drones. Geo-fencing would limit, using embedded software, firmware, and GPS, where drones can fly.

EDUCATION

The FAA is conducting significant education and outreach efforts. The primary educational campaign being implemented is known as Know Before You Fly. Know Before You Fly is an on-line and print-based educational campaign that aims to provide prospective UAS users with the information and guidance they need to fly safely and responsibly.

Following an initial beta testing period, on January 6, 2016 the FAA released a mobile application known as B4UFLY to assist UAS operators to determine whether there are any restrictions or requirements in effect that could limit safe operation of a UAS, such as a nearby airport or other hazard.

¹⁵ [Washington Post, 2015](#)

¹⁶ [Planning Magazine, October 2015](#)