

1. MEANING AND USAGES

A drone or UAV (Unmanned Aerial Vehicle), as is clear from the name itself, is an aircraft which is controlled from the ground and does not have any pilot operating it from the inside. It is the operated half of the UAS (Unmanned Aerial System). Now, it becomes essential here to distinguish between the terms UAV and UAS. A UAV can be seen as a subset of UAS. A UAS refers to the entire system that engages in the operation of a drone and hence is inclusive of the ground-based controller, any system of communication with the UAV and the UAV (drone) itself. On the other hand, a UAV refers solely to the aircraft.¹

The idea of operating an aircraft without risking a man's life first materialized in the beginning of World War II but in today's world it is used in various fields where they play a vital role. In a pandemic ridden world, none of us can question the importance of drugs and medicines in our lives. Drones have played an important role in delivering the same and other essential items in the remotest of areas. Their importance was also recognized by the Telangana government which in September brought a scheme to help vulnerable communities in procuring essential commodities with the help of drone delivery mechanisms.² They can also be used to carry sensors which may then help others to plan and analyze different crop patterns based on the information collected from them such as the moisture content, soil's fertility, nutritional content etc. After the crops are sown, they can be used for crop surveillance and monitoring.³ Further, they can be seen as a better and a much more effective means of spraying pesticides and herbicides as opposed to traditional agricultural methods. Upon that, drones with high resolution cameras are also widely used in the field of cinematography and photography.

2. HISTORY OF DRONES

Unmanned Aerial Vehicles (UAVs), colloquially known as drones have been around for much longer than people realize. The creation of the first known autonomous flying machine, better known as the first autonomous volatile machine of antiquity⁴ or the flying pigeon (see Figure

¹ *What's The Difference Between A Drone, UAV and UAS?* BOTLINK, <https://botlink.com/blog/whats-the-difference-between-a-drone-uav-and-uas> (Oct. 20, 2021)

² *Telangana govt gets permission to use drones for vaccine delivery* LIVEMINT, <https://www.livemint.com/news/india/telangana-govt-gets-permission-to-use-drones-for-vaccine-delivery-11619771090338.html> (Oct 20, 2021)

³ *Agricultural Drones - Application of Drones in Agriculture in India*, TROPOGO, (2021), <https://tropogo.com/blogs/application-of-drones-in-agriculture-in-india> (Oct 20, 2021)

⁴ *The flying pigeon of Archytas*, KOTSANAS, <https://kotsanas.com/gb/exh.php?exhibit=2001001#:~:text=the%20ancient%20Greeks%20%3E-,The%20flying%20pigeon%20of%20Archytas,autonomous%20volatile%20machine%20of%20antiquity> (Oct 20, 2021)

1) is credited to the ancient Greek Mathematician Archytas⁵. Centuries later, around 1489 - Leonardo Da Vinci designed the Aerial Screw (see Figure 2). Although scientists do not believe that the device would have worked⁶ but this implies that the concept of flight - manned or unmanned has always fascinated even the greatest of minds.

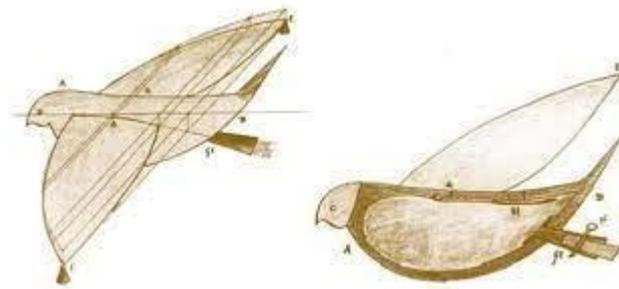
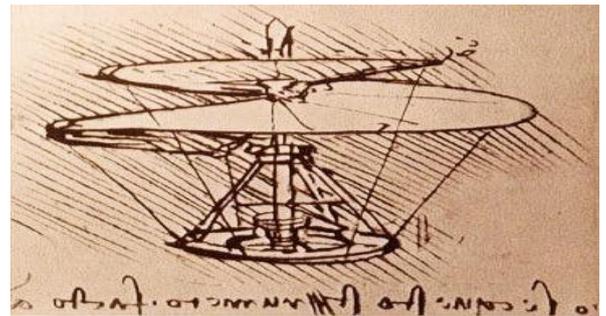


Figure 1: Archytas' Flying Pigeon
Image Source: <https://www.ancient-origins.net/>

Figure 2: Leonardo Da Vinci's Aerial Screw
Image Source: Wikipedia

Today when we think of drones, we tend to imagine quad copters and other wirelessly controlled rotorcrafts yet inventors and militaries around the world developed the first drone technologies in various different forms.



For example, on 15th July 1849 - the first recorded air raid in history - the Austrians in control of much of Italy at that time launched pilotless balloons armed with bombs controlled by timed fuses against the city of Venice.⁷ Although there is no prevailing consensus about the damages inflicted or the overall success of the airstrike, the Republic of San Marco did surrender to Austria on 22nd August 1849.⁸ Later, on 17th December 1903, brothers - Orville and Wilbur Wright conducted the first successful airplane flight. Fifteen years after that the Hewitt-Sperry Automatic Airplane (aka the Flying Bomb/Aerial Torpedo)⁹ was tested. The technology still

⁵ Archytas Creates the Flying Pigeon, COVE EDITIONS, <https://editions.covecollective.org/chronologies/archytas-creates-flying-pigeon> (Oct 20, 2021)

⁶ Leonardo da Vinci's Aerial Screw Inventions, LEONARDO DA VINCI INVENTIONS, <https://www.da-vinci-inventions.com/aerial-screw> (Oct 20, 2021)

⁷ Remote Piloted Aerial Vehicles, CTIE.MONASH (2021), https://www.ctie.monash.edu/hargrave/rpav_home.html#Beginnings (Oct. 20, 2021).

⁸ The first air bomb: Venice, 15 July 1849, AIRMINDED AIRMINDED, <https://airminded.org/2009/08/22/the-first-air-bomb-venice-15-july-1849/> (last visited Oct 20, 2021)

⁹ The Early Days Of Drones - Unmanned Aircraft From World War One And World War Two, WAR HISTORY ONLINE, <https://www.warhistoryonline.com/military-vehicle-news/short-history-drones-part-1-x.html> (Oct. 20, 2021)

being in its early stages lacked accuracy but the potential of Unmanned Aerial Vehicles in military contexts was soon realized.

As John F. Keane and Stephen S. Carr state in “A Brief History of Early Unmanned Aircraft¹⁰” numerous obstacles have hindered UAV development. Apart from the lack of matured technologies, they describe how if during the Second World War the US Army and the US Navy had made coordinated efforts rather than spending resources on separate projects namely Project Aphrodite and Project Anvil, the resulting instrument would have been a success. They make an excellent point with how it was difficult to sell pilotless aircrafts to senior service leaders who themselves were pilots. Nevertheless, the recognition of the benefits that unmanned aviation could provide in wars led to the expansion of the industry. This led to the commercialization of drones. In 2006, the Federal Aviation Administration of USA issued its first commercial drone permit¹¹ and in January 2021 it approved the first fully automated drone flights¹². This is how far drone technology has come. The approval grants American Robotics, Inc.-a Massachusetts based company permission to operate drones “beyond-visual-line-of-site” (BVLOS) and without the need of hands-on piloting through January 31, 2023.¹³

3. FUTURE OF DRONES

From being used for warfare, to being used for recreational and commercial purposes- drones have come a long way. According to the Global Drone Market Report 2020, the drone market size will grow from generating 22.5 billion USD in 2020 to 42.8 billion USD in 2025¹⁴. The industry will continue to expand as it incorporates newer technologies with UAVs. Following are some potential areas which might be seen in correlation with drones in the future.

3.1 INTERNET OF DRONES OR DRONE SWARMS

¹⁰ John F. Keane, *A Brief History of Early Unmanned Aircraft*, Johns Hopkins, APL TECHNICAL DIGEST (2021), <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.686.7958> (Oct. 20, 2021)

¹¹ Blue Origin West Texas Commercial Launch Site Environmental Assessment, Spaceref.com (2021), <http://www.spaceref.com/news/viewsr.html?pid=21124> (last visited Oct. 20, 2021).

¹² *FAA Approves First Fully Automated Commercial Drone Flights*, WSJ NEWS EXCLUSIVE, <https://www.wsj.com/amp/articles/faa-approves-first-fully-automated-commercial-drone-flights-11610749377> (Oct. 20, 2021)

¹³ *FAA Approves Fully Automated Commercial Drone Flights*, JD SUPRA, [https://www.jdsupra.com/legalnews/faa-approves-fully-automated-commercial-4067822/#:~:text=Patrick%20Paul%20P.C.&text=On%20January%2014%2C%20the%20Federal,\) %20through%20January%2031%2C%202023.](https://www.jdsupra.com/legalnews/faa-approves-fully-automated-commercial-4067822/#:~:text=Patrick%20Paul%20P.C.&text=On%20January%2014%2C%20the%20Federal,) %20through%20January%2031%2C%202023.) (Oct. 20, 2021)

¹⁴ *Drone Market Size 2020-2025*, DRONE INDUSTRY INSIGHTS, <https://droneii.com/the-drone-market-size-2020-2025-5-key-takeaways> (Oct 20, 2021)

“The cooperation of small and mini drones is capable of further improving the performance and the coverage area of UAVs.¹⁵” Indeed, a multitude of drones collectively working towards a common objective will augment the efficiency of the operation. Swarms of drones will and already have opened new avenues of application like entertainment, collaborative transportation, or even flying cellular networks to boost coverage and provide access to remote locations. They also have optimized existing ones – for example: a swarm of drones will effectively cover much larger areas than a single drone ever could – given that a better way of communication among individual drones is developed.

3.2 DRONES AND BLOCKCHAIN

One possible solution proposed as the “better way of communication” among swarm drones is the emerging, soon-to-be omnipresent blockchain technology. A decentralized ledger may enable mutual awareness among drones which will improve their anti-collision measures thereby enhancing safety and security. Blockchain technology integrated with unmanned aerial systems will assist in calculating safe and quick automated routes for UAVs when the aerial traffic becomes congested in the future.

3.3 USE OF GREENER ENERGY RESOURCE

The average flight time of even the most high-quality drones is 20-30 minutes. Lighter and more powerful batteries are the need of the hour. LG Chem Ltd. has been testing drones equipped with Lithium-Sulfur Batteries that might potentially replace conventional batteries¹⁶ and has reported that Li-S batteries have higher endurance in extreme conditions and have 1.5 times higher energy density per weight than conventional batteries.¹⁷ In future, solar energy powered drones can also become feasible.

4. THREATS POSED BY DRONES

It is quite normal for inventors to regret what they created because no one can predict how something will be used by the future generations to come or by different people from their own

¹⁵ Jingjing Wang et al., *Taking Drones to the Next Level: Cooperative Distributed Unmanned-Aerial-Vehicular Networks for Small and Mini Drones*, 12 IEEE VEHICULAR TECHNOLOGY MAGAZINE, 73-82, (2017), <https://ieeexplore.ieee.org/document/7995044> (Oct. 20, 2021)

¹⁶ *Blue Origin West Texas Commercial Launch Site Environmental Assessment*, SPACEREF (2021), <http://www.spaceref.com/news/viewstr.html?pid=21124> (Oct 20, 2021).

¹⁷ Stan Lee, *LG Chem tests drone with lithium-sulfur battery* THE ELEC, KOREA ELECTRONICS INDUSTRY MEDIA (2021), <http://www.thelec.net/news/articleView.html?idxno=1525> (Oct 20, 2021).

generation. But this might not be the case when we talk about misuse of drones because their first recorded use itself was as a form of military grade equipment. But nevertheless, the threats posed by it have gotten worse with time. Now it's being weaponized and it is being used by terrorists to hurt people. At the same time, they come with potential piracy risks.

4.1 NATIONAL SECURITY

Today, a large number of drones can be engineered in such a way that all of them act in cohesion and attack a specific target making them extremely lethal. Such a group of drones is called a drone swarm and this is what was used in the 2019 Saudi Aramco attack by the Houthi rebels. They (Houthis) confirmed that on the morning of 14th September 2019, they had launched 10 drones targeting the oil facilities at Abqaiq and Khurais which were owned and operated by world's largest crude oil producer, Saudi Aramco. Even though there weren't any casualties after the attack, it did have serious repercussions on the global crude prices. That one attack disrupted Saudi Aramco's production and they had to cut the same by 5.7 million barrels per day which was estimated to be 5% of the global production output. Due to that the prices in the international market shot up. As another consequence of the attack, Saudi Arabia started investing more in their anti-missile system. All this money which was used for investing in the anti-missile defense system could've been utilized in other projects such as environment protection or poverty eradication.

In another much recent incident, even India had to face an airstrike weaponized by drones. In the early hours of June 27th 2021, two armed drones attacked the Jammu Air Base, damaging the area close to the aircraft hangars. Even though there were no casualties, the area of the attack was of such sensitivity that it was being contemplated if this could be the next Pathankot strike.¹⁸

But the government has taken steps to make sure that these threats can be evaded. Rule 27 of the Drone Rules, 2021, prohibits people from placing “any arms, ammunitions, munitions of war, implements of war, explosives and military stores” on their drones without the authorization of the central government.

4.2 PERSONAL PRIVACY

Drones, usually equipped with high-definition video recording devices may be a welcome presence in many scenarios but they certainly are not welcome to capture

¹⁸ *Drone attack at Jammu air base: 2 suspects detained, IAF chief monitoring situation / What has happened so far*, INDIA TODAY (2021), <https://www.indiatoday.in/india/story/drone-attack-jammu-air-base-top-points-1819969-2021-06-27> (Oct. 20, 2021)

intimate or personal moments of people who may not be aware that they are being watched. Leading E-commerce websites are brazenly selling UAVs while marketing them as “Spy-Drones” and some people are actively using them for that very purpose. From expensive ones being used by unscrupulous paparazzi to harass celebrities in their homes, to affordable ones being used by the average peeping tom for spying and voyeurism, drones have been used in all sorts of privacy violations. It must be made clear that the usage of drones per se is not a data protection or privacy issue but the type of data (pictures, videos or even audio) being captured using drone mounted instruments, even if done without malicious intentions has the potential to breach an individual’s privacy. Right to Privacy has been recognized as a fundamental right in India and thus defining proper laws for when privacy is breached using Unmanned Aerial Systems becomes a paramount task.

The Unmanned Aircraft System Rules, 2021 notified on 12th March 2021 had some provisions for the same purpose. As per Rule 27(h) in Part VI of UAS Rules, 2021 – an authorized unmanned aircraft system operator had the responsibility to “ensure the privacy of a person and its property during operation” whereas The New Drone Rules 2021 do not even mention the word “privacy”. This is tragic as The Personal Data Protection Bill is also pending, rendering the citizen’s privacy vulnerable.

Our current privacy jurisprudence does not offer clear guidelines to adjudicate claims against privacy violations – drone related or not. Many solutions to these threats may emerge once we have a Personal Data Protection Law set up in place.

In the specific context of civilian drone use a possible way forward may be to integrate a notice board as a part of the digital sky platform. The public can then access information about the locations and the purposes of drone operations being conducted around them. This information, possibly along with a privacy impact assessment conducted by the operator itself, when available publicly, will serve to minimize intrusion, and therefore, conflict.

5. LAWS REGULATING DRONES IN INDIA

Taking note of the threats mentioned earlier, it becomes essential to understand how drones are being regulated in India and the steps which the government has taken to keep an eye over their misuse. For this, we can have a look at the Drone Rules 2021. The latest drone rules are quite thorough in terms of classification and regulation of UAVs.

5.1 TYPES OF DRONES

To simplify the process of registration and for the purpose of removing ambiguity in terminology, the rules classify drones, based on their weight, into five different categories. They are nano, micro, small, medium and large. Further details about the same have been mentioned in table below:

5.2 TYPES OF ZONES

The new rules have made significant reduction in the assigned zonal boundaries for drone operations and classified them into three different categories. Figure 3 explains the different zones according to the new rules.

First is the Red zone which is the no-fly zone. Drone operations are absolutely prohibited in these areas barring some exceptional circumstances. Areas that come under the red zone include up to 5 km of radius of any operational airports and all the other areas that the government might notify. Next, the yellow zone includes the area ranging from 5 kms up to 8 kms of an operational airport and the area above 200 feet

8kms an	Type	Weight (in kg)	ranging from to 12 kms of operational airport.
	Nano	0 to 0.25	
	Micro	0.25 to 2	
green	Small	2 to 25	Finally, the
area	Medium	25 to 150	zone is the
	Large	150	where no
			permit is
			required for
			operating

drones up to the range of 400 feet or up to 200 feet in the area between 8 km to 12 km

from the perimeter of an airport. It is usually used with reference to hilly areas which do not have too much air traffic. For checking the traffic and knowing the designated red zone, a person can use the Digital Sky Platform. It is an “online platform hosted by the Directorate General of Civil Aviation for various activities related to the management of unmanned aircraft system activities in India.”¹⁹ Details concerning various zones are updated there.

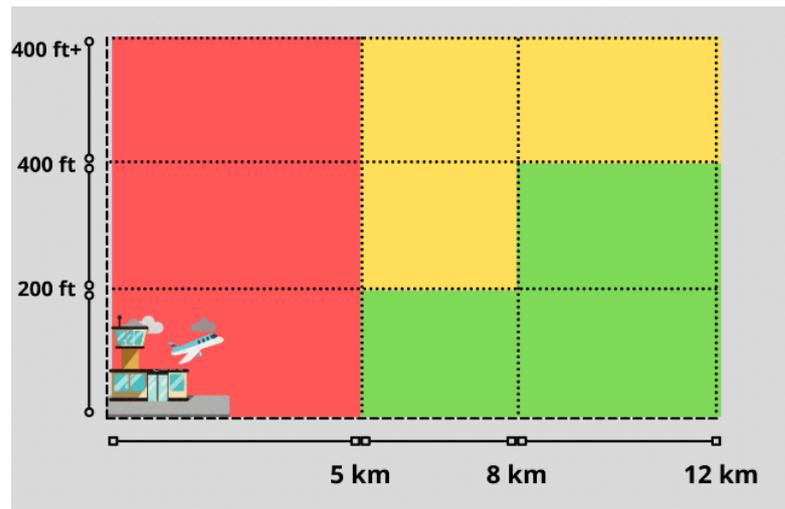


Figure 3: Zonal classifications according to Drone Rules 2021

5.3 LICENSING AND EXEMPTIONS

Any individual that plans to fly a UAV other than Nano drones or micro drones (for noncommercial purposes) has to mandatorily opt for getting a remote pilot license. He has to complete the training specified by the director general for the category of drone he wishes to obtain the license. After the training when the remote pilot training organizations submit an application for him on the digital sky platform, he is granted a remote license certificate. Within 15 days after the issuance of the certificate, the director general should authorize him the license. But as an exception to the above-mentioned rules, Rule 36 allows for operation of: (a) nano UAS and (b) micro UAS for non-commercial purposes without a remote pilot license.

5.4 CERTIFICATION

Rules 7, 8 and 9 describe in brief that on the recommendation of the Quality council of India or any other authorized testing entity – The Director General of Civil Aviation or

¹⁹ Drone Rules, 2021, Rule 3(g) (India)

any entity authorized by the Director General of Civil Aviation may issue a “type certificate” for any particular type of UAS. It also empowers the Central Government to specify the standards for obtaining said type certificate and possibly promote the use of made in India technologies and the NavIC system. Rule 13 then provides that a type certificate shall not be required for manufacturing or importing an unmanned aircraft system. Operating model RPAs and Nano UAS also do not require a type certificate.

5.5 PENALTIES

Rule 49 and 50 mention penalties that a person might incur in case of showing any kind of non-compliance with the same unless and until the same have been caused by unavoidable circumstances like weather, etc. Violation of 22nd and 27th rule is considered to be a cognizable and non-compoundable offence. Upon that, the director general also suspended the license and certifications and levied a fine of up to Rupees 1 lakh on persons who fail to comply with these rules.

5.6 SECURITY FEATURES

Rule 12 empowers the Central Government to notify various special security features and make them the mandate. These may include NPNT (No permission - No Takeoff) firmware, tracking beacons or geofencing capabilities. Once in place, these technologies will make the enforcement of restrictions upon drones a piece of cake.

6. CONCLUSION

It is now clear that drones have a lot of potential to be an asset in various sectors and the government understands that. It has brought in laws which will help in liberalizing their operations by easing the licensing process, reducing the area restricted for drone operation, decreasing the types of fees charged from drone operator from 72 to 4²⁰, etc. and has also tried to make sure that they are not being misused for causing public nuisance. The provisions for licensing fully automated drones are also in line with that of developed countries like the USA. The decision to make the policy more lenient, even after the recent incident in Jammu, shows the government’s valiant approach to promote the use of drones, but this will have to come with a focus on the development of counter-drone technologies to address the potential security threats. At the same time, the government may opt for subsidizing drones for promoting their use in fields like agriculture as it will help in increasing the efficiency in the sector.

²⁰ *Drone rules eased: What you need to know - Simpler drone rule*, THE ECONOMIC TIMES (2021), <<https://economictimes.indiatimes.com/industry/transportation/airlines/-aviation/drone-rules-eased-what-you-need-to-know/simpler-drone-rules/slideshow/85712299.cms>> (Oct. 20, 2021)

Since drone technology and its usages are still evolving, the laws regulating the same will continue to be a work in progress. The current laws have tried to make a balance between liberalizing the rules while simultaneously keeping a check on their misuse and should further aim at aiding their operations in vital fields wherever possible.