An Exploratory Study of Unmanned Aircraft Systems Regulations in India and the Challenges Ahead in Evolving Aviation Ecosystem

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Abstract

The skies over central New Delhi in India were lit up by a spectacular display of over a thousand Unmanned Aircraft Systems (UAS) on the 75th republic day celebration in January 2022. The usage of UAS or drones, as commonly referred to, has gained momentum worldwide, including in India, signifying its importance in the aviation ecosystem. The advancement of technology and large-scale investment has fast-tracked the proliferation of UAS in civil, commercial, and military domains. The government of India and national aviation regulators are continuously working to provide a concrete regulatory framework to support the growth of the UAS sector and minimize the risk emerging from the operation of UAS. A recent step towards the same was taken by passing Drone, Rules 2021. The UAS ecosystem is still in its initial stages of development with uncertainties in privacy, safety, data protection, and governance issues. This paper aims to provide an overview of the UAS regulations in India and their implications for the UAS ecosystem. The paper highlights how such rules will affect civil and commercial UAS usage and its implication on the rights of individuals.

Keywords: Drone Rules 2021; UAS operations; Privacy; Risk; Safety; Security

I. Introduction

The world is assimilating varied changes brought by the technologies introduced by the Fourth Industrial Revolution. Unmanned aircraft systems (UAS) have been operational in various forms for ages in the military domain. The UAS application in civil and commercial environments is a much recent phenomenon. The

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unmatched characteristics, payload capacity, and low flying ability make it a reliable platform for multipurpose scenarios.

The UAS market is set for incredible growth to generate a massive economic and export ecosystem for countries to monetize the UAS ecosystem, including India.[3] The drone design, manufacturing, and service sectors have grown exponentially, incredibly fast-tracked by the Covid-19 pandemic.[4] The UAS has been used to supply vaccines and medical supplies to remote areas.[5]

The UAS ecosystem is presently catering to a) monitoring industrial and infrastructure projects, including road construction and bridge life viability[6], b) in the agriculture domain for spraying pesticides and monitoring crop patterns[7], c) in disaster management for the survey, planning, and rescue missions[8], d) in forest and wildlife management for animal census and tracking wildlife movement and

[3] Krishnankutty, P., Why India's drone market could become a multi-billion-dollar industry in next decade, The Print, July 23, 2021, https://theprint.in/india/governance/why-indias-drone-market-could-become-a-multi-billion-dollar-industry-in-next-decade/700817/ (last visited on June 25, 2022).

[4] Martins, B. O., Lavallée, C., & Silkoset, A., "Drone Use for COVID-19 Related Problems: Techno-solutionism and its Societal Implications" *Global Policy*, *12*(5), 603-612,2021, https://doi.org/10.1111/1758-5899.13007 (last visited on June 16,2022).

[5] UNICEF, *Unmanned aircraft systems: product profiles and guidance,* October 11, 2019, https://www.unicef.org/supply/reports/unmanned-aircraft-systems-product-profiles-and-guidance (last visited on June 25, 2022).

[6] Hammad, A. W. A., da Costa, B. B. F., Soares, C. A. P., & Haddad, A. N., "The Use of Unmanned Aerial Vehicles for Dynamic Site Layout Planning in Large-Scale Construction Projects", *Buildings*, *11*(12), 11-17,2021 https://doi.org/10.3390/buildings11120602 (last visited on June 12,2022)

[7] Sylvester, G. "E-agriculture in Action: Drones for Agriculture" Food and Agriculture Organization of the United Nations, https://www.fao.org/3/i8494en/i8494en.pdf (last visited on June 25,2022)

[8] Tusnio, N., & Wroblewski, W, *The Efficiency of Drones Usage for Safety and Rescue Operations in an Open Area: A Case from Poland*, *Sustainability*, *14*(1), 2021, https://doi.org/10.3390/su14010327 (last visited on June 25, 2022).

detecting poachers[9], e) in media and journalism for covering large scale events,[10] f) in law enforcement for tracking, surveillance, crime detection, and investigation, g) and for recreational purpose.

In such widespread and diverse applications, it becomes necessary to have a clear regulatory framework to minimize conflicts that might affect the safety and rights of individuals. The UAS regulations must balance the challenges without compromising ethics and safety while allowing the required operational flexibility for sustained growth of the UAS ecosystem. India's Ministry of Civil Aviation has constantly updated UAS regulations since the first guidance regulations passed in 2018 to accommodate technological advancements and contemporary issues. The recent Drone Rules 2021[11], enacted to liberalize and accelerate the UAS ecosystem, is one more step in that direction. The rapid growth in UAS technology and widespread use necessitates a review of the regulatory policies to understand the technology perspective, rights of individuals, the role of stakeholders. The UAS ecosystem will need perfect synergy in policies, legislations, technology development for efficient operability of UAS.

The following article helps stakeholders understand the recent UAS regulations enacted by the Ministry of civil aviation, India, and the broad regulatory framework governing the Indian UAS ecosystem. The first section discusses the technological aspects and historical development of India's UAS ecosystem and regulations. The paper then discusses relevant provisions of Drone Rules, 2021. The third section discusses the impact of new rules and challenges ahead for the UAS ecosystem. The paper's final section has global developments ending with the conclusion.

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[9] López, J. J., & Pázmány, M. M, "Drones for Conservation in Protected Areas: Present and Future", *Drones*, *3*(1),2019, available at: https://doi.org/10.3390/drones3010010 (last visited on June 16,2022)

[10] Hamilton, J. F, *Drone Journalism as Visual Aggregation: Toward a Critical History*, *Media and Communication*, *8*(3), 64-74, 2020, https://doi.org/10.17645/mac.v8i3.3117 (last visited on June 12, 2022).

[11] PIB Delhi, "Ministry of Civil Aviation notifies liberalised Drone Rules", 2021, August 26, 2021, https://pib.gov.in/PressReleseDetailm.aspx?PRID=1749154 (last visited on June 23,2022).

II. Development of UAS Ecosystem and Regulations in India

The UAS technology has steadily developed in a user-friendly pattern making its usage and deployment relatively effortless. The UAS has various categories and sizes, including fixed-wing, rotary blade propulsion mechanisms, which can be deployed in an environment for commercial cargo-carrying to sustained aerial monitoring operations[12]. The UAS presently has enhanced speed, endurance, and payload carrying capacity, including autonomous flight features. The UAS now has an advanced onboard communication and navigation system, which helps it accomplish the designated mission accurately.[13] The endurance of drones has increased by introducing efficient onboard battery systems. The type of battery pack used varies for the sector and mission-specific parameters. The initial UAS operation was based on visual line of sight (VLOS), meaning the UAS operator always maintained visual eye contact with UAS during the operation. The majority of UAS operations in the future will be beyond visual line of sight (BVLOS), which needs robust communication with ground control.[14] There has also been the integration of drone technology into the existing aviation technology ecosystem. This is to accommodate drone traffic with the current manned air traffic management system. Further UAS are being installed with onboard sensors to detect and avoid obstructions. The UAS can also auto-return to its home base or launch pad in case of malfunction or loss of communication.

The Defence Research and Development Organisation (DRDO) and Indian defence forces have been working on various UAS platforms since 1980. The instances of recreational drone usage and unregulated use of UAS by civilians led

[12] M. Hassanalian, & A. Abdelkefi, "Classifications, applications, and design challenges of drones: A review, Progress in Aerospace Sciences", *Progress in Aerospace Sciences*, *91*, 99-131, 2017, https://doi.org/10.1016/j.paerosci.2017.04.003 (last visited on June 16, 2022).

[13] Isik, O. K., Hong, J., Petrunin, I., & Tsourdos, A., "Integrity Analysis for GPS-Based Navigation of UAVs in Urban Environment", *Robotics*, *9*(3),2020, https://doi.org/10.3390/robotics9030066 (last visited on June 12,2022)

[14] Politis, E., Panagiotopoulos, I., Varlamis, I., & Dimitrakopoulos, G, "*A survey of UAS technologies to enable Beyond Visual Line Of Sight (BVLOS) operations"*, Adacorsa, available at: https://adacorsa.automotive.oth-aw.de/index.php/publications-2/scientific-publications/120-a-survey-of-uas-technologies-to-enable-beyond-visual-line-of-sight-bvlos-operations (last visited on June 23, 2022).

the Directorate General of Civil Aviation (DGCA) to enforce a ban on the use of UAS in October 2014.[15] Similarly, the Directorate General of Foreign Trade (DGFT) also banned the import of UAS from abroad. The DGCA recognizing the importance of UAS, simultaneously opened the consultation process with stakeholders to formulate suitable rules calling suggestions from the general public. The draft guidelines[16] were published in April 2016, setting the stage for the first official regulatory framework for the use of UAS in India. After several rounds of discussion, on 27-August-2018, the Government of India introduced the Civil Aviation Requirements for Remotely Piloted Aircraft Systems (CAR 1.0).[17]

The CAR 1.0 introduced a contactless digital framework named Digitalsky Platform[18] along with unmanned traffic management protocols. The Digitalsky platform would act as a one-stop forum for registering all categories of UAS, including UAS pilots and UAS owners. The regulator intended to track and authorize all the UAS flights within the civilian airspace. The platform would remotely approve all the fights once the pilots apply for prior digital authorization without paperwork or bureaucratic approvals. The regulations exempted nano drones from flying without prior consent, subject to certain conditions. The CAR 1.0 introduced the classification of drones based on weight and payload carrying capacity. The UAS categories were as follows starting with a) Nano, having a payload capacity of less than or equal to 250 grams, b) Micro, having a payload capacity of more than 250 grams but less than or equal to 2 kilograms, c) Small, having a payload capacity of more than 2 kilograms but less than or equal to 25 kilograms, d) Medium, having a payload capacity of more than 25 kilograms but

[15] PIB, "Rules for Commercial use of Drones", August 4, 2015, https://pib.gov.in/newsite/PrintRelease.aspx?relid=124316 (last visited on June 25, 2022).

[16] PTI, "DGCA releases draft guidelines for unmanned flying devices", Mint, April 27, 2016 https://www.livemint.com/Politics/bAB3DaJLWsn3B5G5AfGS7N/DGCA-releases-draft-guidelines-for-unmanned-flying-devices.html (last visited on June 23,2022).

[17] PIB, "Government announces Regulations for Drones, August 27, 2018, https://pib.gov.in/newsite/printrelease.aspx?relid=183093 (last visited on June 25,2022)

[18] "Digitalsky Platform", Welcome to DigitalSky, available at: https://digitalsky.dgca.gov.in/home (last visited on June 05, 2022).

less than or equal to 150 kilograms, e) Large, having a payload capacity of more than 150 kilograms.[19]

The CAR 1.0 granted Indian citizens, Indian-owned or controlled corporations, and Corporations controlled by the Indian government to register for Unique Identification Number UIN. This rule indirectly put a blanket ban on foreign nationals and foreign corporations to own UAS in India. The CAR 1.0 also provided a separate Unmanned Aircraft Operator Permit (UAOP) for entities offering UAS service as operators. The training requirements under CAR 1.0 was bestowed upon flight training organization certified by DGCA. The UAS operator must have attained the minimum age of 18 years to be eligible for attending and achieving qualification as a certified UAS operator.[20] The curriculum mandated both theoretical and practical aspects to be tested as parameters to achieve the tag of the UAS pilot. The training standards were designed to equip the UAS pilot to manage contingent situations.

The flight restrictions for UAS operations under CAR 1.0 were divided into three segments. The first zone was a no-fly zone where UAS operations were restricted. The second zone was controlled airspace where flying was permitted based on prior permission. The remaining zone was uncontrolled airspace where authorization was not mandatory was UAS operations. The controlled airspace operations mandated continuous communication with drone ATC during and before launch authorization. The onus was on the UAS operator to comply with local policy and risk assessment to be carried out before each UAS operation. The CAR 1.0 granted DGCA powers for suspension/cancellation of UIN and UAOP for any violations. In case of a breach of penal law codified under the Indian Penal

[19] Jhunjhunwala, R., & Dwivedi, S. "Flying Drones In India Legal From 1 December 2018! Indian Aviation Ministry Unveils The National Drone Policy, 2018 - Transport - India." Mondaq, September 9, 2018, https://www.mondaq.com/india/aviation/733820/flying-drones-in-india-legal-from-1-december-2018-indian-aviation-ministry-unveils-the-national-drone-policy-2018 (last visited on June 25,2022).

[20] Tavawalla, H., & Pundir, A., "Here is how restrictive laws will stifle drone industrys" Business Standard, January 21, 2018, https://www.business-standard.com/article/companies/here-is-why-restrictive-laws-will-stifle-drone-industry-118012100007_1.html (last visited on June 25, 2022).

Code,1860, the local police would be authorized to charge the UAS owner and operator for such individual violations.

The Government of India further issued AIP Supplement 164 of 2018 issued by the Airports Authority of India (Airports Authority of India, 2018) and the DGCA RPAS Guidance Manual issued on 3 June 2019. In its consultative approach, the government of India released the draft Unmanned Aircraft Systems (UAS) Rules. After receiving industry recommendations and comments from stakeholders, the government notified the UAS Rules, 2021.[21]

The UAS Rules 2021 carried the same rules for weight categorization as CAR 1.0 but allowed the classification of nano drones into higher weight categories if their flight characteristics matched heavy drones. The UAS were categorized based on flight characteristics starting with a) Aeroplane, a UAS which is power-driven deriving lift primarily from an aerodynamic reaction, b) rotorcraft, a UAS which depends on power-driven motors to derive sufficient lift, c) Hybrid UAS, UAS having flight capabilities using engine power, with ability to carry out vertical take-off, vertical landing, and slow speed flight. The rules further allowed UAS to be categorized as on control system starting with a) Remotely piloted aircraft system (RPAS), a UAS controlled by the remote pilot, b) Model remotely piloted aircraft system, a UAS with a maximum weight of 25 kilograms used on designated premises as VLOS flight for educational purposes, c) Autonomous System, UAS which do not require the remote intervention of pilot for flight management and performance.[22]

The process for registration under UAS Rules 2021 allowed body corporates and associations registered in India and will need to have a principal place of business within India. The rules further allowed DGCA to ask companies to secure security authorization from the central government on a case-to-case basis. The registration paved the way to obtain a unique authorization number (UIN) for

[21] Ministry of Civil Aviation, Home, Directorate General of Civil Aviation, https://www.dgca.gov.in/digigov-portal/?page=jsp/dgca/InventoryList/RegulationGuidance/Rules/The%20Unmanned%20Aircraft%20System%20Rules/UAS%20Rules,%202021.pdf (last visited on June 25, 2022).

[22] Kukade, T., Majumdar, A., & Tavawalla, H., "Drone regime in India significantly liberalised: Entry of foreign players permitted", Nishith Desai Associates, https://www.nishithdesai.com/NewsDetails/4815 (last visited on June 25, 2022).

UAS owner importer, manufacturer, and operator valid for up to ten years. The manufacture and import of the UAS prototype also required prior permission of DGCA. The regulator was allowed to impose additional technical and safety standards for importing UAS. The DGCA would also issue a special unique prototype identification number to track and monitor all categories of prototypes.

The manufacturing quality and airworthiness protocol was introduced in UAS Rules, 2021. DGCA would issue the certificate of Airworthiness to manufacturers or importers who fulfill the technical and safety requirements. The DGCA is also empowered to designate labs to carry out such testing based on parameters. The DGCA would also monitor the oversight mechanism to ensure safety parameters for the entire UAS ecosystem. The UAS operators must adhere to rigorous maintenance and repair protocols. There was an additional requirement of keeping a detailed record of all the maintenance carried out on UAS based on which certificate will be issued for resumption of UAS after repair and overhaul. The rules also specified No Permission-No Takeoff (NPNT), geo-fencing, anti-collision system, GNSS as standard equipment to UAS operational requirements. The area of restricted operation of UAS was established and enlarged with a specific mandate of creating a no-fly zone of 5 kilometers in major airports of metropolitan cities. The no-flight restriction for all other airports and military installations was specified at 3 kilometers. Additionally, a 25-kilometer buffer zone was created from all border areas, LAC, LOC, AGPL included as a point of reference. The ministry of home affairs, India, has been bestowed with powers to notify a no-fly zone of 2 kilometers around an area of strategic importance as notified from time to time.[23]

The government for structured growth of UAS ecosystem also introduced Unmanned Aircraft System Traffic Management (UTM). The government would allow organizations to apply and receive a license subject to successfully submitting all the manuals, technical requirements, and checks to function as UTM for ten years. The UAS Rules also facilitate the establishment of Drone Ports. These ports will be designated for landing, take-off, repair, service, and

[23] PSL Release, *The Unmanned Aircraft System Rules, 2021*, PSL Advocates and Solicitors, https://www.pslchambers.com/wp-content/uploads/2021/07/The-Unmanned-Aircraft-System-Rules-2021.pdf (last visited on June 23, 2022).

commercial operations. The rules also opened the research and development arena for selected Startups, authorized UAS manufacturers, higher education institutions in the realms of Science and Technology, and government-backed R&D organizations.

The UAS Rules, 2021 has brought measures to penalize both individuals and organizations for violating provisions UAS Rules, 2021. The penalties under the rules were in the range of ten thousand Indian rupees to one lakh Indian rupees for individuals. Based on their size, the organizations will be penalized two hundred to four hundred percent of the fines levied on the individual for the same violation. The UAS Rules 2021 also allow for the compounding of offenses at a rate of a hundred percent to five hundred percent of the amount so specified for an individual. The amount levied compounding of offenses in matters of organization are based on the number of employees and can be up to four hundred percent of the amount so specified for an individual for the same violation. The fines under UAS Rules 2021 for large organizations would amount to heavy penalties for each infringement.[24]

III. Drone Rules, 2021 – A Liberalized New Era for UAS Ecosystem

The UAS Rules, 2021, was perceived by industry stakeholders as restrictive, with a considerable burden of procedure and paperwork that would affect the UAS ecosystem's growth. The Government of India notified drone Rules, 2021[25] as a liberalized regulatory framework to make India a global drone hub by 2030. The rules make mention of the UAS Promotion Council, which will create a network ecosystem that will promote incubators for the development of UAS, create a business-friendly environment, and engage policymakers and academia. The Ministry of civil aviation, India, reiterated that the digital sky platform would act as a single-window clearance without any other clearance requirement from other governmental departments.

[24]T Deol, *No drones around international airports, Rs 5 lakh fine - Govt's new rules for flying UAVs*, THE PRINT, March 13, 2021, https://theprint.in/india/no-drones-around-international-airports-rs-5-lakh-fine-govts-new-rules-for-flying-uavs/621191/ (last visited on June 25,2022).

[25] PIB Delhi, *Ministry of Civil Aviation notifies liberalised Drone Rules*, 2021, Aug. 26, 2021, https://pib.gov.in/PressReleseDetailm.aspx?PRID=1749154 (last visited on June 23,2022).

The drone rules 2021 retained the classification of UAS by weight methodology but increased the coverage of the maximum weight limit for large UAS now increased up to 500 kilograms. Any UAS above 500 kilograms will be subject to the provisions and mandate of the Aircraft Act 1934. The restrictions imposed on the classification of nano drones were also removed, restoring classification only based on weight rather than flight characteristics. The new regulation sallowed foreign companies to own and operate drones in India, retracting the blanket restrictions as part of rules since 2018. Further, the import of UAS will be regulated by the director-general of foreign trade (DGFT), and import clearance from DGCA has been omitted. The process of receiving type certification for a specific drone was simplified for the manufacturer, with the timeline for the issue of such certificate fixed to a maximum of 75 days from the time of submission of application. The micro or small UAS drone pilot operation has been exempted from licensing formalities under present rules.

The airspace under Drone Rules 2021 was segregated into three zones marked as red, yellow, and green.[26] The Government of India is authorized to change, reduce or increase the airspace under each of the above zones. The classification starts with a) Green zone, which is a zone within the territorial expanse of India with a vertical distance of 400 feet, not designated as the yellow or red zone, and in the case of the operational airport, a reduced vertical distance of 200 feet with 8km and 12km lateral distance b) Yellow Zone, which is a zone within the territorial expanse of India above 400 feet in the green zone and vertical distance of 200 feet with 8km and 12km lateral distance in green zone which will require prior flight authorization for UAS operation from designated controlling authority c) Red Zone, which is a zone within the territorial expanse of India where flight operations are authorized only with permission of Central Government. The UAS operators will require prior permission to fly in the yellow and red zone, but no authorization is needed for green zone flights. The government will publish all

[26] Sarkar, D. (2021, September 27). *India now has an airspace map for drones: Here's how to check where you can fly your drone*. Times of India. Retrieved February 5, 2022, from https://timesofindia.indiatimes.com/gadgets-news/india-now-has-an-airspace-map-for-drones-heres-how-to-check-where-you-can-fly-your-drone/articleshow/86558519.cms (last visited on June 17, 2022).

the air space maps accessible to all individuals.[27] The central government will evaluate and reclassify the extent and boundaries of each zone as per requirement. Under challenging circumstances, it can classify certain areas as a red zone for ninety-six hours. In addition to this drone, corridors will be carved out by the regulator UAS operation in the cargo delivery domain.

The Drone Rules 2021 allow for the testing of UAS cargo operations under the supervision of DGCA. The rules expressly prohibit the carrying of arms and ammunition. Further, the rules mandate specific adherence to Aircraft (Carriage of Dangerous Goods) Rules, 2003, and operators must verify that none of UAS carry any dangerous goods. The operator of UAS is further bestowed upon the duty to report an incident and accident within forty-eight hours of such event on the digital sky platform. The liberalized aspect of Drone Rules, 2021, is also focused on the UAS research and development arena. The rules have exempted type certification, UIN, and remote license requirements for recognized research organizations within the controlled facility in the green zone. The Drone Rules, 2021, have specified safety features, namely NPNT, geo-fencing, strobes but has not made it mandatory for the time being. The government may notify the provisions in the future. In the matter of Insurance coverage, the rules require third-party insurance for UAS operations to cover the potential damage to life and liberty. The Drone Rules, 2021 refer to the Motor vehicles Act,1989, and rules made thereunder for UAS insurance policy and claims.[28]

IV. Impact of Regulations and Challenges Ahead

The new Drone rules 2021, along with the PLI scheme of 2021, will help in the growth of the UAS ecosystem. The new liberalized rules have eased compliance

[27] Mukul, P, "Airspace map of India: How drone operators can check the flying zones", The Indian Express, September 28, 2021, https://indianexpress.com/article/explained/explained-drone-airspace-map-india-7536736/ (last visited on June 25,2022).

[28] DAS, K., & Arshad, M. "As drones take off under fresh rules, insuring their flight still has a host of teething troubles", THE ECONOMIC TIMES, https://economictimes.indiatimes.com/prime/fintech-and-bfsi/as-drones-take-off-under-fresh-rules-insuring-their-flight-still-has-a-host-of-teething-troubles/primearticleshow/87288034 cms (last visited on July 11,2022).

and procedural hurdles of UAS Rules 2021, but the challenges posed by increased UAS will affect UAS operations.

The provisions related to UAS operational safety, namely NPNT, geo-fencing, strobe lights, have not been made mandatory yet under Drone Rules 2021. The rules have not mentioned a timeframe for implementation but mention a six-month compliance window once the central government notifies the safety provisions. In addition to that, UAS, like any other system, is prone to cybersecurity risk. The UAS are vulnerable to hacking, unauthorized access, spoofing, and jamming.[29] The design and manufacturer must account for such contingencies to eliminate the risks. The Quality Council of India must mandate audits to ensure the integrity of components and systems before granting certificates. The airspace safety and security protocols are also of prime importance as the same helps in securing safe passage of both manned and unmanned aircraft within the regulated airspace. The government has issued a National Unmanned Aircraft System Traffic Management Policy Framework for secure drone traffic management.[30]

The Supreme Court of India recognized has the right to privacy of individuals. The court's judgment allows the assertion of one right to private space devoid of any intrusion. The operation of UAS with sophisticated payloads can capture data which may include audio, video, picture, a pattern of movement, and biometric information. The privacy bill of 2011 was last the legislative attempt that discussed the right of individuals against the capture of personal data. Rule 27(h) of UAS Rules 2021 had introduced the element of privacy protection. The provision mentioned that it should be the duty of the UAS operator to ensure the privacy of persons and property. Further, Rule 38(2) of UAS Rules 2021 restricted

[29] Madan, B. M., Banik, M., & Bein, D, *Securing unmanned autonomous systems from cyber threats*, Vol. 16(2), JOURNAL OF DEFENSE MODELING AND SIMULATION: APPLICATIONS, METHODOLOGY, TECHNOLOGY, 119-136,2016, https://doi.org/10.1177%2F1548512916628335 (last visited on June 16,2022).

[30] Kundu, R., "Govt notifies drone traffic management policy", Mint, Oct. 26, 2021 https://www.livemint.com/news/india/india-notifies-traffic-management-policy-for-drones-11635254607202.ht ml (last visited on June 16, 2022).

imagery and data capture. The Drone Rules 2021 have omitted both provisions leaving a complete void in the regulatory framework.[31]

The right to privacy is sacrosanct, and data collected by UAS might conflict with the same. The rules have no mention regulating the collection use, transfer, and deletion of data collected by UAS. The Indian Parliament is deliberating and discussing the draft Data Protection Bill in line with the European Data Protection Regulation to secure data.[32] The Personal Data Protection Bill, 2019 (PDP Bill) was returned to the parliamentary committee, which has suggested amendments and renamed the bill The Data protection Bill 2021.[33] The suggestion includes the inclusion of personal and non-personal data. The UAS regulatory framework must note the same for preparing the stakeholders to adhere to its implication on UAS operations. The issue of data localization and cross-border data transfer also needs clarity with financial regulatory body RBI mandating the same for all the financial data.[34]

The UAS operation also brings forth the surveillance capabilities employed by law enforcement authorities.[35] The Indian law enforcement authorities have also

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[31] D. Somayajula, *Eye in the Sky'- India's Drone Operations and Privacy Concerns*, Vidhi Centre for Legal Policy, July 31,2021, https://vidhilegalpolicy.in/blog/eye-in-the-sky-indias-drone-operations-and-privacy-concerns/ (last visited on June 17, 2022).

[32] A. Konert, & M. S Baryla, *The Impact of the GDPR on the Unmanned Aircraft Sector*, *Air and Space Law*, *46*(4), 517-544, 2021, https://kluwerlawonline.com/journalarticle/Air+and+Space+Law/46.4/AILA2021030 (last visited on June 25,2022).

[33] N. Dhavate, & R. Mohapatra, *A look at proposed changes to India's (Personal) Data Protection Bill*, International Association of Privacy Professionals, January 5,2022, https://iapp.org/news/a/a-look-at-proposed-changes-to-indias-personal-data-protection-bill/ (last visited on July 02,2022).

[34] FE Online, RBI reiterates its stand on data localisation; says, payment data of Indian customers to remain in India, THE FINANCIAL EXPRESS https://www.financialexpress.com/economy/rbi-reiterates-its-stand-on-data-localisation-says-payment-data-of-indian-customers-to-remain-in-india/1619933/ (last visited on June 18,2022).

[35] Bentley, J. M. "Policing the Police: Balancing the Right to Privacy Against the Beneficial Use of Drone Technology", Vol 70(1), HASTINGS LAW JOURNAL, 249-296,(December,2018) https://repository.uchastings.edu/hastings_law_journal/vol70/iss1/6/ (last visited on July 15,2022).

started deploying UAS for surveillance operations.[36] The Drone Rules 2021 empower the Central Government to exempt certain UAS operations from safeguards of UAS regulations. The measures for privacy are presently non-existent in the present regulatory framework. The UAS, with its unique ability to hover, extend endurance, and low atmosphere flying capabilities, may also be employed in the future for persistence surveillance. If surveillance is necessary, the question arises whether there is a need for a warrant from a judicial authority, as in the case of a search warrant.[37] The use of UAS may be justified as an urgent measure or under challenging circumstances to bypass the permission needed to initiate surveillance. The autonomous UAS is carrying out surveillance and capturing data also pose a grave risk to the privacy and data of the individual.[38] The protocol to access, review, transfer, and delete also need to be established to reduce the risk of misuse and tampering.

In matters of the right to peaceful enjoyment of property, individuals are protected from unlawful interference in the form of trespass. The UAS with size, horizontal and vertical flight envelope, endurance, payload, ease of launch, and recovery makes it a contentious issue in matters of trespass.[39] The aspect of minimum reasonable vertical height for operating UAS without encroaching or disturbing the peace of individuals on the ground needs further clarity. The manner of flight, recurrence, and place of UAS use will also play an essential role in deciding the appropriate thresholds for trespass. In addition to that overlap between public and

[36] S. Das, & N Chandra, *Drones come in handy for police in enforcing lockdown,* Mint, April 6, 2020 https://www.livemint.com/news/india/drones-come-in-handy-for-police-in-enforcing-lockdown-11586196187231.html (last visited on July 09,2022)

[37] G. S. McNeal, W Goodwin,., & S.Jones, *Warrantless Operations of Public Use Drones: Considerations for Government Agencies,* FORDHAM URBAN LAW JOURNAL, *44*(3), 703-723,2017 https://ir.lawnet.fordham.edu/ulj/vol44/iss3/4 (last visited on June 16,2022).

[38] Finn, R. L., & Wright, D, "Privacy, data protection and ethics for civil drone practice: A survey of industry, regulators and civil society organisations", *Computer Law & Security Review*, *32*(4), 577-586,: https://doi.org/10.1016/j.clsr.2016.05.010 (last visited on June 18,2022).

[39] H. B. Farber, *Keep Out! The Efficacy Of Trespass, Nuisance And Privacy Torts As Applied To Drones*, GEORGIA STATE UNIVERSITY LAW REV, *33*(2), 359-409, 2017 https://readingroom.law.gsu.edu/gsulr/vol33/iss2/3 (last visited on June 18, 2022).

private property, flight time, right of passage, the intent of the UAS operator will also be necessary for determining the charge of trespass.[40]

The UAS operations moving towards heavy cargo trails will bring the operator's liability to the forefront. The Drone Rules, 2021 has significantly reduced the penalties and liability imposed by UAS Rules 2021. Further, the insurance principles to the UAS ecosystem have been aligned to the Motor vehicles Act 1989, which might be inadequate considering the aerial operations and dangers posed by life and property on the ground.[41] If contested in a court of law, the cases in the future may bring the dimension of applicability of strict liability principle and penal liability of the operator. The UAS operations will also be open to offenses under the Indian Penal Code, 1860. The incident reporting to DGCA and local law enforcement inquiry may create bottlenecks with multiple investigations initiated simultaneously.

V. Global Developments in UAS Regulation

The UAS operations worldwide have accelerated, especially after the covid 19 pandemic, with countries revising the regulatory framework to cope with the ever-increasing diverse UAS ecosystem.

The European Union (EU) has introduced a common regulatory framework for all its member from January 1st, 2021, with a two-year transition period to adopt regulations.[42] The new framework operates on classification based on risk profile, namely a) open, b) specific c) certified. All drones will fall into the limited open category till the finalization of the regulatory framework in the interim period. The registration formalities also provide scope for synchronization of UAS

[40] T. A. Rule, *Airspace in an age of drones*, BOSTON UNIVERSITY LAW REV, *95*(1), 195-208, 2015, https://www.bu.edu/bulawreview/files/2015/02/RULE.pdf (last visited on June 17,2022).

[41] K. DAS, & M. Arshad, *As drones take off under fresh rules, insuring their flight still has a host of teething troubles*, THE ECONOMIC TIMES, https://economictimes.indiatimes.com/prime/fintech-and-bfsi/as-drones-take-off-under-fresh-rules-insuring-their-flight-still-has-a-host-of-teething-troubles/primearticleshow/87288034 .cms (last visited on July 11,2022).

[42] Group One Air, *New EASA Drone Regulations | 2021 Updated*, https://www.grupooneair.com/new-easa-drone-regulations/ (last visited on June 12, 2022).

operation in member states, even if the drone is registered in another member state or outside EU member states.

In the United States of America, the Federal Aviation Administration (FAA) has introduced The Operation of Unmanned Aircraft Systems over People Final Rule, which became effective on April 21, 2021.[43] The rules allow the operation of UAS over people and in night conditions subject to restrictions. This is to effect liberalized framework to improve the UAS ecosystem. The FAA is also enforcing the Remote ID for UAS identification and location tracking from 2023 onwards

In Asia, The Civil Aviation Authority of Malaysia introduced three new civil aviation directives, which would be effective from March 1st, 2021, to meet the emerging challenges of the UAS operation.[44] The Malaysian Civil Aviation Regulator had introduced regulations in 2016 for Small unmanned aircraft, Small unmanned surveillance aircraft, Unmanned aircraft systems of more than 20 kilograms. Additionally, a permit is also required for commercial operations from the Director-General of Aviation. The first directive of March 2021, CAD 6011 Part (I), introduces the establishment, procedure, rules, and administration of the Remote Pilot Training Organization. The second directive, named Agricultural Unmanned Aircraft System Operations, focuses on a niche area of agriculture numbered CAD 6011 Part (II). The final directive Special Unmanned Aircraft System Project, numbered CAD 6011 Part (V), is a liberalized framework to encourage drone investors, innovators, production capacity to form a robust ecosystem and drone hub in Malaysia.[45]

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[43] FAA, *Operations Over People General Overview. Federal Aviation Administration*, https://www.faa.gov/uas/commercial_operators/operations_over_people/ (last visited on May 27, 2022).

[44]CAAM "UNMANNED AIRCRAFT SYSTEM", https://www.caam.gov.my/wp-content/uploads/2021/03/ CAD-6011-I-RPTO-1.pdf (last visited on July 17, 2022).

[45] Ministry of Transport Malaysia, Media Release Minister of Transport Malaysia, https://www.mot.gov.my/en/News/Media%20Release%20YBM%20MOT%2025%20February%202021-%20Launch%20of%20New%20Unmanned%20Aircraft%20Systems%20(UAS)%2025022021.pdf (last visited on June 25,2022).

VI. Conclusion

The Indian regulatory authorities, with notification of Drone Rules, 2021, have taken the appropriate path for encouraging investors and developing a robust UAS ecosystem. The Drone Rules, 2021, have clarified timelines and reduced the procedural hurdles under UAS Rules, 2021. The regulatory framework with the motto of the liberalized pathway has certain shortcomings. The Ministry of Civil Aviation, India, must provide a clear timeline for installing safety parameters such as NPNT, Geo-fencing, and strobe lights that have been presently not notified. The Drone Rules, 2021, have omitted the reference to privacy protection, which must be addressed. The UAS stakeholders must plan and carry out a suitable risk assessment analysis to understand how to manage the vast data collected by UAS operators, especially UAS operators working as commercial service providers. UAS use by law enforcement also brings important issues to the forefront. The risk for warrantless tracking and surveillance will lead to grave infringement of the fundamental right of individuals. The data protection authority of France enforced a ban in 2021 on UAS use by police, which highlights the risk and conflict yet to emerge in this domain. The issue of trespass and the right to peaceful enjoyment of the property will also be contentious, with Drone Rules 2021 only classifying air Zones and not the manner of UAS operation. The problems arising from UAS flights at low heights, especially in urban areas, are yet to be addressed. The Drone Rules, 2021, have mentioned the aspect of insurance for third-party liability. Still, the same must consider the additional risk arising from adverse incidents of large commercial UAS, which are being tested for commercial cargo operation. In case of trespass or unauthorized use of UAS, the aspect counter-drone protocol in civilian airspace also needs clarity about who is allowed to intercept and take down rogue drones. The past year has also seen the use of UAS for carrying out attacks on civilian and military installations. The risk of proliferation of such large UAS, which can be tampered with to carry out violent attacks, must also be investigated as presently counter-drone devices are deployed near strategic installations only. The Drone Rules, 2021 has simplified the digital sky platform under the aegis of DGCA. Still, there is a further need for a specialized division to track and monitor activities and incidents related to UAS within India. The UAS ecosystem will grow at a sustained rate with increased use within civilian airspace. The Drone Rules, 2021 is a positive step, but the challenges must be discussed and addressed in consensus with UAS stakeholders.