INDIA'S DRONE REGULATIONS-1.0: PROGRESS, POLICY GAPS AND FUTURE TRAJECTORY

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INTRODUCTION

Unmanned Aircraft (UA) are the future of aviation, and global aviation leaders have been developing enabling technologies and experimenting with regulatory options to facilitate integration of unmanned-manned aircraft operations. In the absence of International Civil Aviation Organisation (ICAO) standards for Remotely Piloted Aircraft Systems (RPAS) operations, many countries have formulated interim regulations to promote innovation and develop their civil-military applications. The Director General of Civil Aviation (DGCA), a regulatory body of India, published its first Civil Aviation Requirement (CAR) for the operation of civil RPAS on August 27, 2018, which is to become effective from December 1, 2018.[1] It also published the Do's and Don'ts[2] and Frequently Asked Questions (FAQs)[3] to provide a ready reckoner to potential pilots, operators, users and the industry.

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1. "Requirements for Operation of Civil Remotely Piloted Aircraft Systems (RPAS)", Director General of Civil Aviation, Government of India, August 27, 2018, http://dgca.nic.in/cars/D3X-X1.pdf. Accessed on September 8, 2018.
2. "Do's and Don'ts Regarding Operations of RPAS", Director General of Civil Aviation, Government of India, August 27, 2018, http://dgca.nic.in/cars/RPAS-Do's%20and%20Don'ts.pdf. Accessed on September 8, 2018.
3. "FAQs Regarding Operations of RPAS", Director General of Civil Aviation, Government of India, August 27, 2018, http://dgca.nic.in/cars/RPS-FAQs.pdf. Accessed on September 8, 2018.

India has been late in initiating the formulation of the regulatory framework as many countries have already put in place empowering domestic regulations. The USA led the development of Unmanned Aerial Vehicles (UAVs) since World War II and took several policy initiatives.

The Minister of Civil Aviation of India, Shri Suresh Prabhu termed it as the Drone Regulations 1.0. A high-level task force set up in April 2018 has been studying various aspects of the formulation of the Drone Regulations and preparing a roadmap for optimum exploitation of UA technology. It is also tasked to formulate the next level of regulations, i.e. Drone Regulations 2:0.[4] The follow-up CAR is expected to be a comprehensive one covering several complex issues that could not be included in the present CAR.

India has been late in initiating the formulation of the regulatory framework as many countries have already put in place empowering domestic regulations. The USA led the development of Unmanned Aerial Vehicles (UAVs) since World War II and took several policy initiatives, including the 'Vision-100 Century of Aviation Reauthorisation Act' in 2003, a policy on operations of Unmanned Aerial Systems (UAS) in July 2013[5] and small UAS operations Rule (Part-107) in June 2016.[6] Some of the other countries that formulated regulations for the operation of RPAS include Australia in 2002,[7] European Union [Regulation (EC) No 216] in 2008[8], and China, which formulated the Interim Provision for Light and Small

4. "Government Announces Regulations for Drones", Press Information Bureau, Government of India, August 27, 2018, http://pib.nic.in/newsite/PrintRelease.aspx?relid=183093. Accessed on September 21, 2018.
5. "Unmanned Aircraft Systems (UAS) Operational Approval", July 30, 2013, http://www.faa.gov/documentlibrary/media/notice/n_89 00.227.pdf. Accessed on July 9, 2016.
6. "Operations and Certification of Unmanned Systems, Part-107 to Title-14 of Code of Federal Regulations (CFR-14)", https://www.faa.gov/uas/media/RIN_2120-AJ60_Clean_Signed.pdf. Accessed on September 19, 2018.
7. "Regulations of Drones: Australia", Library of Congress, https://www.loc.gov/law/help/regulation-of-drones/australia.php. Accessed on September 19, 2018.
8. Regulation (EC) No 216/2008 of the European Parliament and of the Council, dated February 20, 2008, http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:02008R0216-20130129. Accessed on June 10, 2016.

Unmanned Aircraft Operations in 2015[9] and Regulations on Real-name Registration of Civil Unmanned Aerial Vehicles in May 2017.[10] Most of these countries had allowed research and development activities well before they formally published their RPAS regulations.

The Indian RPAS manufacturing industry was led by defence research and manufacturing organisations, which initially struggled to find suitable partners in the civil industry. However, the situation changed in the last decade or so as several innovators and drone start-ups started manufacturing as well as providing RPAS service to military and industrial customers. On the regulatory front, the Indian industry was closely following the development of RPAS regulations in other countries and looking forward to this CAR with an expectation that it would encourage research, development and manufacturing by the Indian industry, and enhance the commercial exploitation of UAVs in India. Also, the CAR was expected to provide technological solutions to expedite approvals and prevent corruption by having a single window online application and approval system.[11] One of the major apprehensions of the DGCA in allowing operation of RPAS in India was the near absence of research programmes to develop enabling

One of the major apprehensions of the DGCA in allowing operation of RPAS in India was the near absence of research programmes to develop enabling capabilities, non-availability of ground-based RPAS detection, identification and monitoring systems, airborne detect and avoid systems and counter RPAS systems to facilitate their safe operation in the Indian air space.

9. "Regulations of Drones: People's Republic of China", https://www.loc.gov/law/help/regulation-of- drones/china.php. Accessed on December 4, 2016.
10. Regulations on Real-name Registration of Civil Unmanned Aerial Vehicles Formally Issued by CAAC, Civil Aviation Administration of China, May 24, 2017, http://www.caac.gov.cn/en/XWZX/201705/t20170524_44222.html. Accessed on September 19, 2018.
11. There are different agencies for granting clearances for the issue of aviation licenses and flying permissions in India and the entire process of approvals lacked transparency. The approvals were delayed or denied on frivolous grounds, which was the major reason for corruption. There was hope that the proposed regulations would address these challenges by making all the approvals online through a single window.

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The formulation of the CAR for the operation of civil RPAS by DGCA was a difficult task amid multiple views and technological challenges. This CAR provides the right beginning, even though it covers only operational aspects. It is the first, yet a significant step in providing much-needed legitimacy to civil RPAS operations in India, which remained banned since October 2014. However, whether this CAR meets the expectations of various stakeholders needs to be studied; therefore, this paper would deliberate on the following:

- To understand the process and challenges in the formulation of the policy (CAR).
- To examine its salient features, especially concerning registration, certification and operations.
- To examine the proposed regulatory provisions from the point of view of promoting manufacturing by the Indian companies.
- To examine the regulatory provisions for promoting research, design and development of futuristic unmanned aircraft technologies in India.
- To identify the challenges and expectations from Drone Regulations 2.0.

POLICY FORMULATION: PROCESS AND CHALLENGES

Indian companies were predominantly supplying RPAS and providing associated services mainly to the military, paramilitary forces and government agencies since the operation of civil RPAS had been banned by the DGCA in October 2014. The decision to ban the operation of civil RPAS was necessitated due to the threat of drone attacks by terrorists and RPAS collision with manned aircraft.[12] At that time, India did not possess the essential enabling technologies and regulatory mechanisms to allow RPAS operations in the country with the desired degree of safety. The DGCA was initially reluctant to formulate regulations for RPAS operations

12. Use of Unmanned Aerial Vehicle (UAV)/ Unmanned Aircraft Systems (UAS) for Civil Applications, DGCA, GoI, October 7, 2014, http://dgca.nic.in/public_notice/PN_UAS.pdf, Accessed on September 8, 2018.

due to non-availability of International Civil Aviation Organisation (ICAO) Standards and Recommended Practices (SARPs). However, the SARPs were primarily meant to facilitate operations of RPAS in the international air space and ICAO had entrusted the responsibility of formulating regulations for RPAS operations in domestic air spaces of the member states to their civil aviation authorities. The reluctance was also due to the fact that the DGCA, unlike Federal Aviation Authority (FAA) of the USA and European Aviation Safety Agency (EASA) of the European Union, had not initiated research and development programmes to develop enabling technologies like RPAS detection, traffic monitoring and airborne detect and avoid systems, which were essential for safe operations of RPAS. However, the increasing demand of the Indian RPAS industry and unregulated operations of RPAS necessitated that the DGCA initiate the process of formulation of RPAS regulations.

The formulation of regulations for operations of RPAS was a complex process as the views and concerns of multiple agencies, including those placed under different ministries, had to be factored in, viz. Ministry of Home Affairs (MHA) for providing security clearance, Ministry of Defence (MoD) for air defence clearance, Airports Authority of India (AAI) for operations in the civil air space, Wireless Planning & Coordination (WPC) Wing of the Ministry of Communications for the allocation of frequency for RPA operations, Department of Industrial Policy and Promotion (DIPP) of the Ministry of Commerce and Industry for granting industrial licences to the manufacturers, and Directorate General of Foreign Trade (DGFT) for the import and export of drones.

After extensive deliberations, the first draft of the regulations was published in April 2016 for seeking inputs from the public.[13] The inputs provided by the public comprised identification of deficiencies as well as suggestions for improving the draft regulations. After due deliberations and consultations with the relevant stakeholders, the DGCA published the

13. Guidelines for Obtaining Unique Identification Number (UIN) & Operation of Civil Unmanned Aircraft System (UAS), Director General of Civil Aviation, Government of India, April 20, 2016, http://www.dgca.nic.in/misc/draft%20circular/AT_Circular%20-%20Civil_UAS(Draft%20April%202016).pdf. Accessed on September 8, 2018.

second draft of the regulations in November 2017.[14] This draft had progressive provisions like earmarking of testing centres, etc. to promote indigenous Research and Development (R&D) of RPAS. However, it did not dwell on issues related to airworthiness certification of indigenously designed and manufactured RPAS, industrial licences to drone manufacturers in India and single window clearance for the UA pilot and Unmanned Aircraft Operator Permit (UAOP) licence. The draft received an overwhelming response from the public, RPAS manufacturers and operators. The Minister of State for Civil Aviation, Shri Jayant Sinha and his team in the Ministry of Civil Aviation took an active interest in seeking the feedback on the policy and conducted several workshops to take inputs from various stakeholders, including aviation experts, academia, drone manufacturers, digitisation experts, etc. As a result, several pertinent issues were flagged during the consultation process.

TASK FORCE ON DRONE REGULATIONS

The Ministry of Civil Aviation's (MoCA's) consultation with various stakeholders as well as feedback from the public highlighted some of the critical deficiencies that were left unattended in the draft RPAS regulations of November 2017. These interactions also brought to the fore the lack of expertise and preparedness of MoCA to deal with more serious issues like airworthiness certification of RPAS, the absence of research programmes to develop futuristic air traffic control systems, detect and avoid systems and other enabling technologies to propose a futuristic Unmanned Traffic Management (UTM) system. Also, a need was felt for including provisions that would support the 'Make in India' initiative of the government. Therefore, MoCA formed a 13-member Task Force under the chairpersonship of the minister of state for civil aviation in April 2018. The high-powered committee had members from the relevant ministries, R&D organisations, academia, etc. It also included 20 special invitees comprising representatives from

14. Requirements for Operation of Civil Remotely Piloted Aircraft System (RPAS), Director General of Civil Aviation, Government of India, November 1, 2017, http://www.dgca.nic.in/misc/draft%20cars/CAR%20-%20UAS%20(Draft_Nov2017).pdf. Accessed on September 8, 2018.

domestic and international industry experts, academia and individuals. The terms of references of the task force covered a wide variety of issues, including some of the critical ones that were often overlooked in the past. These included:

- research and development;
- acquisition and commercialisation;
- regulatory framework;
- development of the industry;
- preference for 'Make in India'; and
- potential impact on the industry, job creation, investments, contribution to the economy, exports, technology infusion, integration with value chains, etc.

The committee was required to submit its recommendations within six months.[15]

DRONE REGULATIONS 1.0: PROGRESS AND POLICY GAPS

The Ministry of Civil Aviation published the regulations for operations of civil RPAS (Drone Regulations 1.0) on August 27, 2018, even though the final report of the task force for formulating the drone regulations was awaited.[16] The Drone Regulations 1.0 supersedes the DGCA notification of October 2014, which imposed the ban on the operation of civil RPAS.[17] The new policy stipulates one-time registration of drones, pilots and owners and allows individual Indian citizens, companies or registered bodies to fly RPAS for civil applications. Some of the key features and limitations

15. Constitution of task force for formulating a roadmap with implementable recommendations for the government, industry and research institutions to leverage the Unmanned Aerial Vehicle (UAV) technology. Ministry of Civil Aviation, Government of India, April 11, 2018, http://www.civilaviation.gov.in/sites/default/files/Constitution%20of%20Task%20Force%20for%20UAVs_1.pdf.
16. Requirements for Operation of Civil Remotely Piloted Aircraft System (RPAS), Director General of Civil Aviation, Government of India, August 27, 2018, http://dgca.nic.in/cars/D3X-X1.pdf. Accessed on September 8, 2018.
17. Use of Unmanned Aerial Vehicle (UAV)/ Unmanned Aircraft Systems (UAS) for Civil Applications, DGCA, GoI, October 7, 2014, http://dgca.nic.in/public_notice/PN_UAS.pdf, Accessed on September 8, 2018.

The introduction of the automatic app-based permission through the Digital Sky platform is the first – and a progressive – step towards developing a futuristic unmanned air traffic control system in India, which needs to be developed further. The digitisation of the approval process and nomination of colour zones would simplify the process of approvals as well as reduce the workload of air traffic control centres.

of Drone Regulations 1.0 are deliberated on below.

DIGITAL SKY: NOT YET A SINGLE WINDOW APPROVAL SYSTEM

One of the major challenges faced by the unmanned aircraft industry had been the difficulty in obtaining clearances from multiple agencies and their lack of transparency and accountability in granting approvals and clearances. The Digital Sky programme announced in November 2017 aims to digitise approvals, the filing of the flight plan and provide a technological solution for establishing connectivity between the low flying RPA, air traffic controllers and ground radars for real-time monitoring of the RPAS flights.[18] The Digital Sky platform has app-based permission software with a 'No Permission, No Take-Off' option as a safety feature. A Subscriber Identity Module (SIM) would be installed on each RPA, and no RPA would be able to take off unless app-based permission is uploaded on it.

Another feature of the digital sky platform is earmarking of the three colour zones, with the 'red zone' being the area in which flying is not permitted, the 'yellow zone' for controlled air space in which permission is required for flying and the 'green zone' for uncontrolled air space in which no permission would be required for operation. The introduction of the automatic app-based permission through the Digital Sky platform is the first – and a progressive – step towards developing a futuristic unmanned air traffic control system in India, which needs to be developed further. The digitisation

18. "Jayant Sinha Pitches for 'Digital Sky' for Drones", *The Economic Times*, November 22, 2017, https://economictimes.indiatimes.com/industry/transportation/airlines-/-aviation/jayant-sinha-pitches-for-digital-sky-for-drones/articleshow/61755831.cms.

of the approval process and nomination of colour zones would simplify the process of approvals as well as reduce the workload of air traffic control centres. A cue could be taken from China where its Civil Aviation Administration is exploring the feasibility of using a cloud-based system for real-time monitoring of RPA movements. It published a study in January 2018 about the feasibility and effectiveness of utilising cellular networks for the supervision of drones.[19] MoCA could study the system and identify relevant aspects for incorporation in its Digital Sky platform.

The introduction of the 'Digital Sky' platform for drone operations has raised the hope that it would provide all the registrations, approvals and permissions through a single window.

UIN and UAOP Approvals: The Indian Foreign Service's passport department was earlier known to have a cumbersome, non-transparent and corrupt system in issuing passports. However, it overcame these ills through digitisation and demonstrated the efficacy of having a single window clearance system requiring approvals from multiple departments within the same ministry as well as from multiple ministries. The introduction of the 'Digital Sky' platform for drone operations has raised the hope that it would provide all the registrations, approvals and permissions through a single window. The Digital Sky platform has made a promising start with the introduction of the online system for the filing of the application for obtaining the Unique Identification Number (UIN) and Unmanned Aircraft Operator (UAOP) (para 6.2.3, para 6.3 and para 7.3). The laying down of timelines for the issue of UIN and UAOP in two and seven days respectively is another forward-looking step, which would bring accountability among the issuing departments. This platform would also ease the workload of civil RPA operators as they would not be required to physically file the flight plans. On the other hand, digitisation of the process would relieve the air traffic controllers from physically ascertaining the correctness of the routing

19. Low Altitude Connected Drone Flight Safety Test Report, Civil Aviation Administration of China, January 31, 2018, http://www.caac.gov.cn/en/HYYJ/NDBG/201802/P020180227616856973062.pdf. Accessed on September 23, 2018.

and avoidance of restricted and prohibited areas during the proposed RPAS operation, which would reduce the chances of mistakes due to human error as well as the time required for granting approvals. The Digital Sky platform, however, does not provide single window clearance for UIN and UAOP as the applicant is required to submit Equipment Type Approval (ETA) from the Wireless Planning and Coordination (WPC) wing of the Ministry of Telecommunication for operating in the de-licensed frequency band (s), security clearance from the MHA and security programme by the Bureau of Civil Aviation Security (BCAS), which is a department in the Ministry of Civil Aviation.

Permission for Operations: Another aspect in which the Digital Sky platform does not achieve its purpose of single window clearances is the obtaining of permission for flying operations. The operator is required to obtain permission through the "Digital Sky" platform (as per para 12.4 of the CAR) as well as file the flight plan at least 24 hours before actual operations. Also, he would be required to obtain a separate Air Traffic Control (ATC) briefing, meteorological briefing and ATC clearance from the nearest ATC unit, Air Defence Clearance (ADC) from the nearest Indian Air Force (IAF) unit and flight information clearance from the Flight Information Centre (FIC) concerned (as per para 12.5 of the CAR). As discussed earlier, the Digital Sky platform would provide online clearance for operations in different colour zones. It is understood that clearances from all the above agencies would also be needed for operations in the yellow zone; however, it is not clear whether RPAS operating in the green zone would also need to take briefings/approvals from all these agencies. The need for the manual filing of the flight plan and a minimum period of 24 hours before the actual flight could restrict the operators from undertaking operations at short notice or make changes to the planned route due to operational necessity despite having a Digital Sky platform. This could become a hindrance in optimally exploiting the potential of RPAS. It should be feasible to do away with the requirement of physical filing of the flight plan, obtaining of ADC and FIC with the operationalisation of the Digital Sky platform.

DOES THE POLICY FAVOUR DOMESTIC RPAS MANUFACTURERS?

Shri Suresh Prabhu made an ambitious statement on August 27, 2018, when he said, "Today, we start an exciting new chapter in India's aviation history by allowing commercial use of drones. I am sure that many new and exciting applications will emerge that will propel India's economy forward. Our progressive regulations will encourage a vast 'Make in India' drone industry."[20] Before we understand the implications for the 'Make in India' initiative, it is pertinent to understand various stakeholders and their significance in bringing technology, job creation and strengthening the economy in the long run under this scheme. The 'Make in India' initiative in the drone industry has two significant elements, viz. 'Make in India' by foreign Original Equipment Manufacturers (OEMs) and 'Make in India' by Indian manufacturers. It is the second category, which invariably loses out if the 'Make in India' initiative is not implemented correctly. Indian drone manufacturers or drone service providers either procure complete drone or major assemblies, predominantly from Chinese or Taiwanese manufacturers. Also, India does not produce critical parts like batteries, chips, propellers and semi-conductors. In the last decade, Indian companies have gained enough expertise in the integration of drones and the opening up of the civil RPA industry provides a golden opportunity for the Indian RPA manufacturing entities to expand their business and move towards increasing the indigenised contents during their manufacturing in India. Indian UAV manufacturing companies are small when compared to the Chinese, American and Israeli civil UAV manufacturing companies and they would not be able to compete with them if the regulatory mechanism does not support them. The growth of the domestic manufacturing industry in any part of the world has always been made possible due to the hand-holding of the government and through enabling regulatory policies. This is a critical juncture in the history of the RPAS manufacturing industry of India and if enabling regulatory provisions are formulated, Indian manufacturing

20. "Government Announces Regulations for Drones", Press Information Bureau, Government of India, August 27, 2018, http://pib.nic.in/newsite/PrintRelease.aspx?relid=183093. Accessed on September 21, 2018.

companies would soon be able to manufacture critical components within India, reduce dependence on imports, and create jobs.

The CAR, in its present form, favours Indian operators by allowing operations of imported, domestically purchased (and not produced as per para 5.2 of the CAR) and leased RPAS; however, it does not have enabling, provisions to promote manufacturing by Indian companies. The 'Make in India' initiative in the defence and military aviation domains has not strengthened the domestic aviation manufacturing industry. Most 'Make in India' initiatives by the foreign OEMs became 'Assemble in India' with little or negligible transfer of technology, which directly or indirectly has had an adverse impact on the indigenous aviation manufacturing industry, especially the ones involved in the core technology sectors. Indian drone manufacturers too could face the same fate. There is a need to draw a line between participating in the 'Make in India' initiative by foreign companies and manufacturing by Indian companies and thereby provide an incentive to Indian manufacturers. The job creation by foreign companies, by and large, is akin to the creation of the services sector with a low level of technological gains in manufacturing technologies.

The silver lining for the Indian civil aviation manufacturing industry lies in the terms of reference of the high powered committee which includes "Preference for 'Make in India', development of the industry and the potential impact on industry, job creation, investments, contribution to economy, exports, technology infusion, integration with value chains, etc." The need for 'Make in India' is understood, but care must be taken to ensure that Indian manufacturers are given preference, and in no case, should they be at a disadvantage vis-à-vis foreign OEMs.

The drone manufacturing industry has provided India with an opportunity to make a course correction by supporting Indian manufacturers, which India missed out in the civil aviation manufacturing sector. India never pursued civil aviation manufacturing aggressively, citing lack of economic viability for such endeavours. However, no nation can reduce imports and increase the indigenous manufacturing capability by this argument. China

did not buy this argument, and it has started reaping the benefits and, thus, is emerging as a leading manufacturer in aviation and other technologies. It is also argued that the ability of China to promote domestic manufacturing and acquire technology is attributed to the Communist form of government, firm political control and coherent policies, which cannot be replicated by India. However, this argument also does not stand scrutiny when we compare India's achievements in the space and atomic energy sectors in which India has succeeded despite having limitations of a democratic government. It has been seen that whenever the Indian leadership decided to pursue 'Make in India' wholeheartedly, it was able to find ways and means of making it happen. India should grab the opportunity offered by Indian start-ups and RPA manufacturers so that they get preference where feasible or at least a level playing field to promote manufacturing in India.

Licensing for Indian Manufacturers: UAVs, RPAS and autonomous, programmable aerial vehicles fall under the defence items, which require permission from the Department of Defence Production, Ministry of Defence, for obtaining an industrial licence from the Department of Industrial Policy and Promotion (DIPP). The security guidelines stipulated by the Ministry of Defence[21] impose an additional financial burden on Indian UAV manufacturers while Indian companies importing UAVs from foreign vendors do not have to comply with such security guidelines, which adversely impacts the economic viability of UAVs manufactured by Indian companies in India.[22] Also, RPAS manufactured by foreign OEMs may have inbuilt cyber vulnerabilities, which could be exploited by manufacturers, criminals and terrorists. In one such move, the US military banned the use of Chinese DJI RPAS in 2017, citing increased awareness of cyber vulnerabilities.[23] Therefore, imported RPAS could

21. Industrial Licensing Policy in Defence Sector, Make in India, Indian Army, https://indianarmy.nic.in/MakeInIndia/Site/FormTemplete/frmTempSimpleMII.aspx?MnId=06r6xXCLx5QiT+hi2lHCpA==&ParentID=7x+DFbjiq9eyTNbY2WJq7w==. Accessed on September 23, 2018.
22. List of defence items requiring industrial licence, Department of Industrial Policy and Promotion, Government of India, June 26, 2014, http://dipp.nic.in/sites/default/files/pn3_2014_0.pdf. Accessed on September 23, 2018.
23. Jeff Daniels, "US Army Reportedly Bans Chinese-Made Drone, Citing 'Cyber Vulnerabilities'@", *CNBC*, August 4, 2017, https://www.cnbc.com/2017/08/04/us-army-bans-chinese-made-drone-citing-cyber-vulnerabilities.html. Accessed on November 10, 2018.

In recent years, it has been observed that Indian start-ups and manufacturers have reached a level of expertise in several domains, and if given additional time and opportunity, their products could match and compete with global rivals.

be brought under the defence items category and corresponding security guidelines could be applied to them to place both of them on a common platform. Alternatively, a separate licensing criterion or simplified mechanism for the issue of the industrial licence to civil RPA manufacturers could be laid down. Also, special security measures could be instituted to counter the cyber vulnerabilities posed by imported RPAS.

Empowering Domestic Manufacturers: The Indian RPAS manufacturing industry is at a disadvantage while competing with international companies when Indian government agencies procure RPAS through global tenders. The Indian RPA manufacturing industry is still evolving and has a small market. It also has to face the uncertainty of the demand-supply mechanism in India. When a Request for Proposal (RFP) is issued by the MoD, para-military forces, government departments or ministries, there is hardly any time for the Indian start-ups and RPA manufacturing companies to develop, optimise, modify or upgrade their products to meet the standards or capabilities being offered by established global players. In recent years, it has been observed that Indian start-ups and manufacturers have reached a level of expertise in several domains, and if given additional time and opportunity, their products could match and compete with global rivals.

Balance the GST and Import Taxes: Another impediment in promoting manufacturing by Indian companies has been incoherence in our tax structure, which directly or indirectly favours import or assembly of products by foreign manufacturers. A case in point is the Indian aviation (manned aircraft) Maintenance and Repair Organisation (MRO) industry, which pays 18 percent Goods and Services Tax (GST) on services and spare parts for services rendered in India, while foreign MRO service providers directly

import replacement engines and spare parts under Chapter 88 of the Central Board of Indirect Taxes (CBIT), which are charged at 5 percent GST. The situation for the RPAS manufacturers and importers is likely to be similar as soon as Indian manufacturers start paying GST on indigenously produced RPAS and their MRO services vis-à-vis assembled RPAS or foreign MROs. The task force should look into the aspect of balancing the GST and import tax to provide a level playing field to Indian RPAS manufacturers.

A study by the Civil Aviation Administration of China highlighted that civil RPAS were vulnerable to tampering of Global Positioning System (GPS) data, simulation of false GPS signals, disruption of the data-link between RPAS and the ground control station and interference in the drone operating software.

AIRWORTHINESS CERTIFICATION: A MUST FOR SAFE OPERATIONS

The increasing employment of RPAS for various civil-industrial applications necessitates that standards are set for airworthiness[24] to ensure that RPAS are reliable, their command and control links are secure and they do not pose a danger to other manned and unmanned aircraft. A study by the Civil Aviation Administration of China highlighted that civil RPAS were vulnerable to tampering of Global Positioning System (GPS) data, simulation of false GPS signals, disruption of the data-link between RPAS and the ground control station and interference in the drone operating software (similar to the digital sky platform, thereby making it deviate from the intended path). These breaches in datalinks and GPS signals, being crucial for the safe operation of RPAS, pose greater security hazards than manned aircraft. Therefore, the datalinks and GPS being employed for civil RPAS need to have a higher level of security regarding encryption and redundancy. The study also highlighted the *modus operandi* of some of the dubious companies in selling anti-fence features to enable the drone to bypass the electronic

24. P-13, Remotely Piloted Aircraft Systems (RAS) Concept of Operations (CONOPS) for International IFR Operations, International Civil Aviation Organisation (ICAO), https://www.icao.int/safety/UA/Documents/RPAS%20CONOPS.pdf. Accessed on September 25, 2018.

fence to deviate from the approved route. The anti-fence features could help criminals, terrorists and adversaries breach or bypass the electronic security fence, which could facilitate intrusion of rogue RPAS into prohibited and restricted areas or create a collision hazard for the civil aviation traffic without showing the breach on the RPAS traffic monitoring system. The RPA manufacturers, on the other hand, upgraded GPS with added security features at an additional cost.[25] The study highlighted the need for finding technological solutions, strengthening the drone regulations and setting up a drone standards system for safe operation of RPAS.

India has its challenges in formulating RPA standards and their certification. Within the MoCA, DGCA views itself as the agency responsible for facilitating the operations of RPAS and would not like to pursue the formulation of CAR on airworthiness certification of RPAS, which fall within the purview of the airworthiness directorate of MoCA. There is a gap in the competence of the airworthiness officers of the airworthiness directorate of the DGCA vis-a-vis those of the FAA and EASA[26] and there was reluctance in the DGCA to proactively certify RPAS manufactured in India, which is still an evolving technology. Drone Regulations 1.0 has steered away from the aspect of airworthiness certification of RPAS; however, it has stipulated certain minimum standards for RPAS for issuing the UIN. The formulation of standards would bring some sort of standardisation in the locally purchased as well as imported RPAS. Also, standards, like detect and avoid systems, appear to be difficult to implement considering the current level of technology and research being undertaken within the country and at global levels. Therefore, there is a need to review existing standards, broaden the scope and include airworthiness certification of RPAS in the Drone Regulations 2.0 to promote RPAS manufacturing and ensure their safe operations in India.

25. Low Altitude Connected Drone Flight Safety Test Report, Civil Aviation Administration of China, January 31, 2018, http://www.caac.gov.cn/en/HYYJ/NDBG/201802/P020180227616856973062.pdf. Accessed on September 23, 2018.
26. One Hundred Sixty-Eighth Report of the Parliamentary Standing Committee on Transport, Tourism and Culture on the Director General of Civil Aviation (DGCA), Issues and Challenges, May 2011, http://164.100.47.5/newcommittee/reports/EnglishCommittees/Committee%20on%20Transport,%20Tourism%20and%20Culture/168.pdf. Accessed on October 1, 2018.

RESEARCH AND DEVELOPMENT

The world is witnessing the emergence of futuristic unmanned aircraft technologies (e.g. artificial intelligence, automation in UAVs, UAV swarms) which are going to transform the trajectory of the aviation business in the future. Some of these technologies are being developed in our neighbourhood (especially China) almost in similar timelines as global leaders, which would make it challenging for the Indian companies to compete in the international market. Also, India has lagged in initiating measures to integrate unmanned aircraft in the civil air space. The DGCA has not involved itself in the research and development of air traffic management technologies and other enabling technologies to facilitate the integration of RPAS operations in the civil airspace.

The DGCA CAR as of now, limits operations of RPAS to the line of sight distances by day only while many countries have formulated regulations to promote the development of new capabilities and applications of the RPAS. Australia has formulated regulations for allowing night operations by RPAS,[27] China allowed testing of swarms of over 1,000 UAVs in February 2017[28] and passenger taxi Ehang-184 in February 2018,[29] while Canada initiated beyond the line of sight operation trials in June 2018.[30]

The futuristic Universal Transverse Mercator (UTM) systems are moving from accommodating RPAS in the segregated air space to integrating their operations in the non-segregated air space.[31] Their procedure and regulation should enable operation of RPAS in Instrument Flight Rules (IFR), Beyond Visual Line of Sight (BVLOS), logistics supply and passenger carrier

27. "Operation of RPAS by Night", Civil Aviation and Safety Authority of Australia, https://www.casa.gov.au/standard-page/operation-rpa-night. Accessed on September 22, 2018.
28. "First Test Footage Revealed of Ehang 184 Manned Passenger Drone, *Ehang"* February 11, 2017, http://www.ehang.com/formation/. Accessed on September 22, 2018.
29. Ibid.
30. "Transport Canada Selects Four Organizations for BVLOS Drone Trials, Inside Unmanned Systems", June 18, 2018, http://insideunmannedsystems.com/transport-canada-selects-four-organizations-for-bvlos-drone-trials/, September 22, 2018.
31. "ICAO Secretary General Stresses Safe and Harmonized Airspace Management Priorities for Unmanned Aircraft and Drones", International Civil Aviation Organisation (ICAO), September 18, 2018, https://www.icao.int/Newsroom/Pages/ICAO-Secretary-General-stresses-safe-and-harmonized-airspace-management-priorities-for-unmanned-aircraft-and-drones.aspx. Accessed on September 25, 2018.

The operation of civil RPAS would increase the air traffic and make the civil air space congested. Therefore, reliable traffic detection, identification and traffic management systems are needed to ensure the seamless operation of the manned and unmanned aircraft.

operations by day as well as by night.[32] If India wants to evolve the culture of innovation and technology development, it would need to incorporate enabling regulatory provisions in its next drone regulations (Drone Regulations 2.0), which facilitate research, development, testing and manufacturing of futuristic technologies in India.

Flight Testing Sites: Flight testing facilities are essential for promoting indigenous research and development of cutting-edge technologies in the country. The US has earmarked six UAS testing sites[33] and similar facilities are provided by other nations developing innovative unmanned aircraft and associated technologies. In India, for the first time in the history of aviation regulatory mechanisms, the earmarking of the flight-testing sites was proposed in the draft CAR of November 2017 to promote participation of the private sector and individuals in developing innovative unmanned aircraft technologies. However, these were not included in the final circular. Section 6.4 of this CAR exempts RPAS flying in enclosed premises for research and development from obtaining UIN; however, there is no provision for allowing testing of innovative UAVs outside closed premises, which is essential for developing futuristic capabilities and long-range RPAS. The proposed provision can hardly be an encouragement for the Indian RPA companies involved in R&D. MoCA needs to earmark research and testing sites and formulate enabling regulations to promote R&D and encourage the design and development of aviation technologies in the country.

Developing Enabling Technologies and Capabilities: Section 11.2 of the CAR mandates that RPAS above the category of micro RPAS flying up to

32. Remotely Piloted Aircraft Systems (RAS) Concept of Operations (CONOPS) for International IFR Operations, International Civil Aviation Organisation (ICAO), https://www.icao.int/safety/UA/Documents/RPAS%20CONOPS.pdf. Accessed on September 25, 2018.
33. "UAS Test Sites", Federal Aviation Authority, United States Department of Transportation, https://www.faa.gov/uas/research/test_sites/. Accessed on September 21, 2018.

400 ft be equipped with the SSR transponder or ADS-B and detect and avoid capability. However, there is no known programme to develop airborne detect and avoid systems in India. Also, most of the equipment being developed globally is in the testing and validation phase and it would be difficult to find lightweight miniaturised versions, especially for the micro and mini category of RPAS, which will make it difficult to comply with these requirements. Another aspect, which needs attention is the non-availability of the voice and data recording system in the RPA, which would make it difficult to carry out post-accident analysis, as is being done in manned aircraft. Such a system would be essential for RPAS placed in the large category.

The Indian police and internal security agencies are concerned that operation of civil RPAS would create new law and order challenges for them as RPAS with an ability to carry different payloads could intrude into the private space of citizens and enable anti-social elements and criminals to execute crimes.

The operation of civil RPAS would increase the air traffic and make the civil air space congested. Therefore, reliable traffic detection, identification and traffic management systems are needed to ensure the seamless operation of the manned and unmanned aircraft. However, there is no known programme, other than Digital Sky platform, to develop ground radars and futuristic unmanned air traffic management systems in India; this would make the job of traffic monitoring and ensuring the simultaneous operation of RPAS and manned aircraft in the non-segregated air space extremely difficult.

SECURITY THREATS AND COUNTER-MEASURES

Law and Order Issues: The Indian police and internal security agencies are concerned that operation of civil RPAS would create new law and order challenges for them as RPAS with an ability to carry different payloads could intrude into the private space of citizens and enable anti-social elements

and criminals to execute crimes. The US government witnessed increasing employment of drones to supply phones, SIM cards, sharp weapons, drugs into prisons, jails and juvenile homes, which forced it to pass legislation in September 2018 to deter and punish people for unauthorised transportation of drugs, weapons, other contraband items. The utilisation of commercial drones for criminal activities necessitated that the police department hire drone pilots and procure anti-drone systems to prevent such activities.[34]

Security Threats: The security agencies are also concerned about the possibility of terrorists employing civil RPAS for executing terror attacks. There was a mass attack by armed UAVs on two Russian military positions in Syria, which consisted of an attack by three small armed UAVs on the Tartus Naval Station and by 10 UAVs at the Khmeimim Air Base on the night of January 5-6, 2018. It was the first mass attack on military installations.[35] In another incident, an unsuccessful attempt was made to assassinate Venezuelan President Nicolas Maduro during a military parade when he was attacked by Improvised Explosive Device (IED) equipped quadcopter drones on August 4, 2018.[36] The capability to undertake collaborative operations took a giant leap with the successful trials of UAV swarms in the US and China, which indicates a substantial enhancement in the potential and scope of such attacks in the future.

Counter UAV Systems: The non-availability of systems to detect, identify, track and neutralise UAVs has been a major concern for the security agencies. It is feasible to launch small UAVs from anywhere in varying numbers, which can fly at very low levels towards their intended target. Most of the existing surveillance systems are not suitable for detecting them, ascertaining their identity and numbers, or ensuring continuous tracking. Even if a rogue

34. "California Outlaws Drone Flights Over Prisons", *State Scoop,* September 12, 2018, https://statescoop.com/california-outlaws-drone-flights-over-prisons. Accessed on September 23, 2018.
35. Jeremy Binnie, "Russians Reveal Details of UAV Swarm Attacks on Syrian Bases", January 12, 2018, *Janes 360,* https://www.janes.com/article/77013/russians-reveal-details-of-uav-swarm-attacks-on-syrian-bases. Accessed on September 23, 2018.
36. Anna Vanessa Herrero and Nicholas Casey, "Venezuelan President Targeted by Drone Attack, Officials Say", *The New York Times,* August 4, 2018, https://www.nytimes.com/2018/08/04/world/americas/venezuelan-president-targeted-in-attack-attempt-minister-says.html. Accessed on September 23, 2018.

UAV is identified and tracked, the next challenge lies in finding a suitable system which is light, portable, can be launched at short notice and counter the threat of rogue UAVs with a reasonable level of certainty. This is a concern in the MoCA and it had invited companies developing counter UAV technologies for a demonstration of their capabilities in February 2018.[37] The DRDO has also developed a one KW anti-UAV laser system, which is carried on a truck and has a range of one kilometre. It has a plan for developing more powerful lasers.[38] There is a need to make counter UAV systems lightweight, enhance their range and increase their effectiveness for ease of employability. Many countries are experimenting with different systems, and most of such equipment is still in the development stage.

DRONE REGULATIONS-2.0: FUTURE TRAJECTORY OF DRONE REGULATIONS

India's civil aviation minister, while releasing the Drone Regulations 1.0, had stated, "We want to establish a world-leading drone ecosystem. These regulations firmly place us among the global leaders. Our policy roadmap will certainly provide a strong impetus to all players in the drone ecosystem. We hope that these initiatives will enable us to create a vibrant new industry."[39] The release of Drone Regulations 1.0, along with the formation of a high-level committee, has provided a perfect launching pad for developing futuristic drone regulations in the country. The development of the Digital Sky platform indicates an out-of-the-box approach and fresh thinking of the MoCA. India's nascent drone industry holds a lot of promise, which provides an opportunity to

37. "Assessment and Formulation of Requirements for Counter Drone Technologies for Surveillance, Detection and Neutralization of Drones/ UAVs in the Vicinity of Airports", Ministry of Civil Aviation, http://www.civilaviation.gov.in/sites/default/files/Public%20Notice%20reg%20live%20demo%20in%20March-extension.pdf. Accessed on September 22, 2018.
38. Shaurya Karanbir Gurung, "India Gets a Step Closer to Laser Weaponry as DRDO Successfully Tests Laser System", *The Economic Times*, July 14, 2018, https://economictimes.indiatimes.com/news/defence/india-gets-a-step-closer-to-laser-weaponry-as-drdo-successfully-tests-laser-system/articleshow/61954646.cms. Accessed on September 22, 2018.
39. "Government Announces Regulations for Drones", Press Information Bureau, Government of India, August 27, 2018, http://pib.nic.in/newsite/PrintRelease.aspx?relid=183093. Accessed on September 21, 2018.

The tax structure should be favourable for Indian manufacturers as well as Indian entities providing Maintenance, Repair and Overhaul (MRO) services in India and at no stage, should it be unfavourable to Indian entities.

correct the past mistakes of ignoring the civil aviation manufacturing sector. The response of the industry and other stakeholders to the Drone Regulations 1.0 has been positive. Also, they are aware that the high-level task force on drone regulations headed by the minister of state for civil aviation is studying various options to develop a futuristic regulatory framework. This has also raised the expectations from the second edition of the drone regulations, which is expected to be released after the report of the task force and feedback on the CAR is received. The issues, which need to be addressed by the Drone Regulations 2.0 are summed up as follows:

- **Single Window Clearances:** Single window online application for the issue of UIN and UAOP involving approvals from all the stakeholders, including WPC, MHA, BCAS and DGCA.
- Single window application for granting permission from the Digital Sky platform, ATC and meteorology briefing, and for issuing ADC and FIC.
- **Standards and Airworthiness Certification:** Formulation of standards for the airworthiness of RPAS and UAVs and nomination of the agency to certify them. Efforts should be made to formulate standards that include measures to strengthen command and control data links, improve the reliability of RPAS, reduce the accident rate, lay down guidelines to prevent GPS failures as well as introduce alternate safety systems to cater to the eventuality of GPS failure. Also, the Indian Regional Navigation Satellite System (IRNSS) or Navic receiver could be made mandatory for RPAS operating in the Indian air space.
- **Voice and Data Recorders:** Making it mandatory for the larger UAVs (at least for RPAS weighing more than 150kg) to have onboard voice and data recording system for effective post-accident analysis.

- **Industrial Licence:** The conditions for the issue of the industrial licence for civil RPAS manufacturers need to be revised and, if required, issue of industrial licences to civil manufacturers to be removed from the list of defence items. This will ensure that Indian manufacturers are provided a level playing field vis-à-vis foreign companies as well as those Indian companies which import products from foreign OEMs.
- **Tax Structure:** A study of the GST and taxes levied by the Central Board of Indirect Taxes (CBIT) on imported products and spares. The tax structure should be favourable for Indian manufacturers as well as Indian entities providing Maintenance, Repair and Overhaul (MRO) services in India and at no stage, should it be unfavourable to Indian entities.

The Indian drone manufacturing industry holds a lot of promise; however, it needs the support of the government and an enabling regulatory mechanism to prosper. Indian drone manufacturers, innovators, and operators need to be provided incentives

- **Promoting Indigenous Manufacturing:** Indian companies should be provided the opportunity to develop products indigenously. This can be done by allowing Indian companies additional time after the RFI/RFP to develop, modify or upgrade their products before the field trials to match global players.
- **RPAS Testing Sites:** Indian private sector entities are raring to have a go at the civil-military RPAS technologies; however, they need an enabling regulatory and operational environment. Earmarking of the RPAS testing sites and transparent policy on utilisation can be a revolutionary measure, which will enable the private sector entities to compete with global players and help the nation in securing advanced and innovative equipment and associated technologies.
- **Research and Development:** The capabilities of RPAS are expanding into domains like beyond visual line of sight operations, night operations, unmanned taxies, logistics supplies, etc. However, RPAS operations

should not jeopardise the safety of people, vital installations and other aircraft in the air. This requires continuous research to design and develop enabling systems and capabilities. Therefore, RPAS regulations must have favourable provisions to promote research and development of cutting-edge and futuristic technologies.

- There is an urgent need to initiate research to develop enabling technologies like airborne detect and avoid systems, ground-based RPAS detection, identification, tracking and control systems to facilitate the integration of manned and unmanned aircraft operations, which need to be led by the MoCA.
- Research is also needed to develop counter RPAS technologies to provide protection against rogue RPAS.

CONCLUSION

The Drone Regulations 1.0 comprise a small but significant step towards facilitating the exploitation of drones for commercial applications. However, for creating a world-class drone eco-system, this CAR would need to be followed up by a comprehensive and robust regulatory and policy framework, which focusses on promoting research and development, promotes manufacturing by Indian drone companies and encourages foreign companies to collaborate with Indian entities to set up design and manufacturing facilities in India in such a way that it makes India a manufacturing hub and not an assembly point.

India's next generation drone regulations, i.e. Drone Regulations 2.0 must address critical issues like formulation of standards for airworthiness, setting up of processes, procedures and institutional mechanisms for certification of domestically designed and produced RPAS, providing single window clearances and approvals through digital platforms, providing enabling infrastructure and regulatory mechanism for research, design and innovation, having favourable taxation systems for encouraging design and manufacturing in India and discouraging import. The policies should

provide an edge to the products manufactured by Indian manufacturers over the ones imported from foreign OEMs.

The Indian drone manufacturing industry holds a lot of promise; however, it needs the support of the government and an enabling regulatory mechanism to prosper. Indian drone manufacturers, innovators, and operators need to be provided incentives on the lines of the ones provided under the regional connectivity scheme to develop airfields in smaller cities under the National Civil Aviation Policy 2016.[40] Indian RPAS manufacturers need hand-holding by the government to make India a UAV manufacturing hub.

The Indian civil aviation manufacturing industry is non-existent, as almost the entire fleet of civil aircraft being utilised by commercial airlines, air logistics and air charter services providers is imported or leased from foreign manufacturers. Will Drone Regulations 2.0 help the Indian RPAS manufacturing industry overcome the limitations of the civil aviation manufacturing industry? Will it be able to promote RPAS design, development and manufacturing in India.? The answer to all these questions will only be known after it is released and implemented.

40. National Civil Aviation Policy, 2016: Salient Features, Ministry of Civil Aviation, Government of India, June 15, 2016, http://pib.nic.in/newsite/PrintRelease.aspx?relid=146238.