Civil Drone Certification and Atmanirbharta Challenges in India

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India's goal of becoming an atmanirbhar (self-reliant) global drone hub by 2030 could face certification and atmanirbharta challenges. The certification challenges of civil drones emerge from anomalies in the Digital Sky portal, high cost, ambiguities, lack of formats, increasing inroads of consultants, etc. The lack of policy on operation and certification of Unmanned Aerial Systems (UAS) heavier than 500 kilogram (kg) indicates limitations of the current Directorate General of Civil Aviation (DGCA) policy on Certification Scheme for Unmanned Aircraft Systems (CSUAS). The atmanirbharta challenges are due to limitations of existing ecosystem as well as lack of ownership of civil drone technology. The non-availability of civil drone atmanirbharta policy, research and development structures and technology development initiatives in the Ministry of Civil Aviation, as well as absence of policies on certification and acquisition of indigenously designed drones, create challenges in India becoming atmanirbhar and a global drone hub by 2030. The article examines the certification and atmanirbharta challenges and proposes a way forward to overcome these limitations, anomalies and challenges, as well as build a high-technology, high-value globally competitive drone industry in India.

Keywords: *CUAS, atmanirbharbharat, dronehub2030, civil drone certification*

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Introduction

The Indian government launched several initiatives after the promulgation of the Drone Rules, 2021 to encourage manufacturing and adoption of drones in India. The country has set the goal of becoming a global drone hub by 2030[1] and *atmanirbhar* in critical technologies, including drones.[2] However, it faces certain challenges that need to be addressed to achieve these goals. The certification and *atmanirbharta* are the critical pillars on which the trajectory of drone hub 2030 would be decided.

The Indian Ministry of Civil Aviation (MoCA) notified the Certification Scheme for Unmanned Aircraft Systems (CSUAS) on 26 January 2022. The MoCA is the nodal ministry that is responsible for the formulation of rules and regulations related to the manufacturing, operation, training and certification of unmanned aircraft in India. The Directorate General of Civil Aviation (DGCA), an attached aviation regulatory body of the MoCA, is the authority for the issuance of type certification of the Unmanned Aerial Systems (UAS), while the Quality Council of India (QCI) is the CSUAS owner that owns the certification mark. The QCI has set up a multi-stakeholder committee, a technical committee and certification committees, and provides secretariats to them.[3] In addition, the QCI appoints certification bodies (CBs) to undertake certification of civil UAS. Some global companies have also set up their CBs and registered companies in India to exploit the opportunities provided by the emerging drone industry.[4]

The current civil CSUAS policy is aimed at certification of performance and safety of the UAS. The Digital Sky portal has been created to provide a single-window platform for information and approvals for drones, including certification. The number of 'non-type certified' UAS on this platform are significantly higher than the 'type certified' UAS. The ambiguities on the certification of UAS weighing more than 500 kilogram (kg) could impact indigenous development of large UAS for Urban Air Mobility (UAM),[5] Advanced Air Mobility (AAM)[6] and other applications. The increasing cost, complexities, ambiguities, opaqueness and delays in the process of certification and enlisting of non-type certified UAS are the emerging concerns of Indian UAS and UAS components' manufacturers.

The emphasis of the civil UAS policies has been largely on local manufacturing and operations and not so much on indigenous design and *atmanirbharta*. The increase in disbursement of money through Production Linked Incentive (PLI) scheme in the last two years indicates significant increase in local manufacturing. However, at the same time, Indian UAS

industry's reliance on import of critical drone components, sensors and payloads has increased. This can create vulnerabilities and adversely impact *atmanirbharta* in critical technologies.

The lack of ownership, absence of research and development (R&D) structures to support indigenous design and development of civil UAS and lack of initiatives for the development and timely adoption of enabling technologies are major concerns. India lacks technology development and validation initiatives to develop and adopt real-time tracking, No-Permission–No Take-off (NPNT), geofencing and collision avoidance systems, as proposed in the Drone Rules, 2021. There are delays in promulgation of Beyond Visual Line of Sight (BVLOS) operations and certification policies, as well as absence of trial-based certification of emerging drone technologies, UAM, AAM, Unmanned Traffic Management (UTM) and validation initiatives. The absence of technology development initiatives and minimal efforts in preventing employment of illegal drones for commercial and other operations indicate the requirement of policy and structural reforms. Therefore, this article endeavours to answer the following questions:

1. Has the Digital Sky been successful in providing a transparent, efficient and user-friendly environment to Indian drone manufacturers; and what are its anomalies?
2. Is the process of UAS type certification cost-effective, user-friendly and future-ready?
3. Does the CSUAS policy support Indigenous Design Certification?
4. Does India have enabling policies and structures for *atmanirbharta* in civil UAS to evolve into a leader in critical and emerging technologies to make the country a global drone hub by 2030?

There is a need to find answers to these questions to undertake course corrections. However, before examining these anomalies, let us take a look at the policies, structures and entities dealing with civil drone certification.

Civil Drone Certification Policies, Structures and Entities

The certification of drones is mandated in the Drone Rules, 2021, promulgated on 25 August 2021. These rules lay down basic definitions and act as a guiding document for laying down certification standards, process of certification and designated bodies for testing of UAS.[7] The Indian government has created Digital Sky platform to provide all digital processes

for registration of drones. The platform also has details of various policies related to the issue of Unique Identification Number (UIN), establishing of remote pilot training organisations (RPTOs), details of remote pilots, digital maps and associated links.[8]

Initially, the DGCA signed a memorandum of understanding with the QCI to develop and operate the CSUAS. The QCI, in turn, designed the UAS scheme comprising governance structure, CBs, certification process, etc.[9] The QCI website has details of the CBs, National Accreditation Board for Testing and Calibration Laboratories (NABL)-accredited laboratories, certification applicants, various guidelines and application forms related to civil drone certification.[10] These measures have led to the creation of formal certification process, which streamlines the process of testing and certification. However, the experience of the last two-and-half years indicates certain gaps in these policies as well as in their implementation. These gaps and their exploitation by various entities has created anomalies. The anomalies of the Digital Sky portal are deliberated next.

Digital Sky Portal Anomalies

The Digital Sky is the online platform hosted by the DGCA for various activities related to the management of UAS activities in India. The portal has information related to operations, manufacturing, training and certification of the UAS.[11] The UAS models type certificate details listed on the Digital Sky platform of the DGCA are divided into three categories: type certified; non-type certified (enlisted); and non-type certified (nano and model UAS). The breakdown of the UAS models displayed at the Digital Sky portal is given in Table 1.

Table 1 Details of UIN, TC & Non TC Drones on Digital Sky

	Total UIN Issued	Total No. of TC Issued	Non-Type Certified (Enlisted)	Non-Type Certified (Nano & Model UAS)
UAS	21,206	55	646	2,495

Note: UIN: unique identification number; TC = type certified.

The details of the UINs,[12] type certified issued,[13] non-type certified (enlisted),[14] non-type certified (nano and model) UAS,[15] as shown in Table 1, were analysed and some of the observations related to certification of the drones are discussed next.

Low Rate of Type Certification

The total number of type certified UAS are only 55 against the 21,206 UINs; 646 non-type certified (enlisted) and 2,495 non-type certified (nano and model) UAS are listed on the Digital Sky portal.[16] The low rate of issue of type certified points towards challenges in the certification process (discussed later).

Implementation Anomalies

There are deviations and arbitrariness in the process followed for the implementation of the Drone Rules, 2021 and the CSUAS, including through Digital Sky. The subjective interpretation of the UAS certification governance is witnessed in the way workflows are issued and changed at the implementation level.[17]

Non-Type Certified (Enlisted) Anomalies

There are 646 non-type certified (enlisted) UAS on the Digital Sky website. The enlisted UAS include imported UAS from foreign countries, including China. There are no details of the UAS other than the model name and the class of the UAS.[18] There is lack of clarity on the reason for creating non-type certified (enlisted) UAS list and the criteria for listing them. The lack of critical performance details of imported non-type certified (enlisted) UAS on the Digital Sky platform creates opaqueness and provides opportunities for misuse. Some of the questions that emerge from the examination of this UAS list are as follows:

1. Are there transparent criteria for admission and display of the UAS under the non-type certified (enlisted) category on the Digital Sky portal?
2. Why have the non-certified UAS from foreign original equipment manufacturers (OEMs) been listed on the Digital Sky portal?
3. Does the non-certified category include UAS imported after the ban on import of drones imposed by the Government of India in 2022?
4. Why are the country of origin of the drones, OEMs and other details of non-type certified drones (enlisted) not reflected on the Digital Sky portal?

Non-Type Certified (Nano and Model) UAS Anomalies

The model RPA, with an all-up weight (AUW) of 25 kg, can be used for education, research, design, testing or recreational purposes only and has to be operated within the visual line of sight (VLOS). No type certification is required for manufacturing or importing a nano UAS and model RPA

system.[19] There are 2,495 non-type certified nano and model UAS on the Digital Sky portal (Table 1). About 70–80 per cent drones in non-type certified UAS are of foreign origin, whose import is banned in India.[20] The current process of registration, listing, utilisation of non-type certified (nano and model) UAS seems to be ambiguous and has the following anomalies:

1. *Manufacturers/Importer*: The manufacturer and importer columns have been clubbed together and written as 'Manufacturer/Importer' on the Digital Sky portal. Only one name is cryptically written under this heading, which makes identity of the OEM and the Indian importer unclear.
2. *Import Enlisting*: The import of drones was banned on 9 February 2022, while the import of drone components was eased.[21] The ban was aimed at supporting indigenous manufacturers while allowing R&D, testing and innovation. However, the UAS from foreign OEMs, including Da-Jiang Innovations (DJI),[22] China, are prominently present in the non-type certified (enlisted) and non-type certified (nano and model) UAS.[23] Though imported UAS are not allowed for legal use,[24] yet there have been cases of employment of banned UAS for commercial activities. In some cases, banned UAS were also listed on the Government e-Marketplace (GeM) website. The policy, process and implementation gaps are sometimes being misused to sell and employ model UAS for commercial use, which adversely impacts domestic manufacturing. This listing of banned UAS on the Digital Sky platform, without displaying the restrictions of their use, could be misused.
3. *Recreational UAS*: The provision in the Drone Rules, 2021 that allows import of drones up to 25 kg as model UAS for recreational purposes does not support indigenous industry. The import of drones for recreational purposes may have been a necessity in the past, however, with the increasing focus on domestic manufacturing, the need for retaining the import provision in this clause may be re-examined.
4. *UAS for R&D listing*: The import of UAS for R&D was allowed with an aim to help Indian designers learn and develop indigenous UAS and sub-systems. The unqualified listing as a model UAS for R&D, without any transparent guidelines and restrictions, can be misused for commercial purposes.
5. *AUW and maximum height*: Some of the UAS under the non-type certified (nano and model) UAS category are shown to have 'zero' maximum height attainable[25] and 'zero' AUW,[26] which is not possible for a flying

UAS. The display of zero maximum height and zero AUW for non-type certified (nano and model) UAS on the Digital Sky portal indicates that inadequate effort has been made to ascertain these performance parameters prior to admitting them. This also indicates arbitrariness in their listing on the portal.

6. *Educational, research, design, testing and recreational UAS criteria*: There are ambiguities on the criteria and guidelines on the utilisation of educational, research, design, testing and recreational (nano and model) UAS. The posting of details of these UAS on the website, without clear criteria and guidelines, creates policy gaps which can be misused for business.

UAS Operation Exemptions Anomalies

There is an absence of structures to use research, technology development and trials methodology to formulate drone policies for emerging applications. India still does not have a policy on BVLOS operations. As a result, drone operation exemptions are being used for BVLOS delivery, medical supply, logistics supply and other applications.[27]

Table 2 Details of Exemptions for Drone Operations by MoCA

	2021	2022#	2023	2024
Total	59	2	-	-

Note: #Data available up to 15 May 2023.[28]

Source: 'Archive Orders', MoCA, available at https://civilaviation.gov.in/ministry-documents/orders-documents/archive-document?page=0, accessed on 16 April 2024.

Missing Exemption Details

The details of MoCA orders granting exemptions for drone operations are available only till 15 May 2023. The number of exemptions for drone operations uploaded on the portal were 59 in 2021, however, the numbers uploaded on the portal were reduced to two in 2022 and no details of exemptions were uploaded in 2023 and 2024 (see Table 2). It is a known fact that some entities were granted exemption to undertake BVLOS operations in 2023 and 2024. However, they have not been shown on the Digital Sky portal.[29] The discontinuation of uploading of orders granting exemptions and extensions for UAS by the Drone Directorate on the MoCA website brings in opaqueness.

The exemption is becoming an acceptable norm for BVLOS operations. Even though BVLOS trials were completed by the end of 2021, the policy on BVLOS has not been formulated yet. The policy would have introduced safety norms as well as testing mechanism for certifying UAS for BVLOS operations.

Challenges and Anomalies of Type Certification

The type certification of UAS is evolving in India. The CSUAS policy and its implementation has witnessed a number of challenges and anomalies, including issue of fewer type certificates, delays in certification, ambiguities in policies and processes, high rate of rejection, complexities of documentation, etc. Some of these are deliberated next.

1. *Ambiguous terms*: Ambiguous terms, such as sufficient, relevant and suitable, have been used in the CSUAS, 2022. The lack of quantification of testing procedures, values, test conditions, etc., also creates ambiguities.
2. *Non-availability of formats*: Many details that are required to be submitted in various testing reports and certification documents are undefined, unclear and ambiguous. The existing information on the formats for certification is incomplete and inadequate. Therefore, innovators, start-ups, micro, small and medium enterprises (MSMEs) and other manufacturers face challenges in undertaking certification on their own even if they have the technical knowledge and ability.
3. *Number of drones for testing*: The number of drones required for certification are not clearly defined. It is seen that an average number of drones required for testing may vary from two to four but this number is not fixed, which creates ambiguities that can be exploited. The high cost of drones and lack of standardisation on the number of drones to be submitted for trials brings in discretion and subjectivity.
4. *Absence of standards and standardisation*: There are no standards for testing of systems, sub-systems, components, sensors and payloads. In addition, there is a lack of standardisation of testing process, testing machines, test points, test limits of equipment in terms of figures, duration, operating conditions and other parameters. These gaps create room for subjectivity in testing procedures and submission of test results.
5. *Country of origin and date of application enlisting*: The information on the country of origin of imported drone and date of application for non-type certified UAS is not displayed on the Digital Sky platform.

6. *Motor testing standards*: Indian companies are developing indigenous drone motors; however, absence of standards, test protocols and mechanism for testing and certification of drone motors becomes a challenge for Indian companies developing them.
7. *Emerging battery technologies standards*: The drone batteries in India are certified as per Bureau of Indian Standards (BIS) certification: IS 16046 (Part 2): 2018[30]/IEC 62133-2: 2017 for lithium and IS 16046 (Part 1): 2018[31] for nickel batteries. New and innovative technologies, such as graphene, sodium and aluminium-based drone batteries, are being developed worldwide; and a few of these technologies are also being developed by Indian companies. However, the current system does not have testing and trials-based mechanism to certify these emerging battery technologies.
8. *Standards for programmable technologies*: The drone space cannot move ahead without indigenous speed controllers, Inertial Navigation System (INS), autopilots and collision avoidance sensors. Also, Basic Input/ Output System (BIOS)-level system integrity is important when operating under controlled or restricted environment. There is a need to formulate standards to develop and certify these technologies in India.[32]
9. *Multiple simultaneous applications*: The DGCA does not accept multiple applications for type certification of different UAS models simultaneously from a manufacturer. This poses a challenge for the Indian innovators, who may be developing multiple UAS models, of different size and design, to field in the market for different applications. As the certification process may vary from a few months to years, these delays become a hurdle in seeking certification of multiple UAV designs. One by one certification of the UAS delays entry of different UAV models in the market. Such delays become an impediment and are detrimental to the growth of the Indian UAS industry.[33]
10. *Number of payloads*: The manufacturers are discouraged to seek type certification on large number of payloads on a UAS. There is an effort to keep an artificial limit on the number of payload (say three to five payloads) that are certified on a UAS. This becomes a hurdle for the manufacturer to offer multiple payload options to customers.[34]
11. *Rejections/delays*: There is subjectivity in interpretation of the Drone Rules, 2021 and the CSUAS by different stakeholders in the DGCA, the QCI and the CBs. There are differences in the formats for recording of information, testing or documentation sought by different CBs,

stakeholders in DGCA and QCI based on their subjective interpretation of the CSUAS rules. This is due to lack of standardisation on several accounts. The applications are accordingly delayed or rejected due to these inconsistencies and anomalies (discussed later).

The stated ambiguities, gaps and challenges create scope for subjectivity. In addition, post-submission questioning, delays and rejections create avoidable complexities and can be misused by middlemen, consultants and others. These gaps need to be addressed by formulating appropriate qualitative requirements, formats, standards, standardisation, as well as instituting policy corrections.

Type Certification Anomalies

In early 2022, India became one of the leading countries to formulate a UAS certification policy and mechanism. The certification of UAS is an ongoing process in which learnings are being leveraged to improve the certification process. In all, there are five CBs and a total of 360 applications have been received for the grant of type certification. The breakdown of grant of type certification, rejection of applications, etc., is given in Table 3.

Table 3 Details of Drone Certification by CBs

	No. of Applicants	TC Granted	TC in Progress	Rejected	Data Updated
TQ Cert	217	24	36	157	8 April 2024
UL India	134	8	27	99	8 April 2024
BVIL	5	1	4	Nil	8 April 2024
SGS	3	Nil	3	Nil	8 April 2024
MSCERT	1	Nil	Nil	1	8 April 2024
Total	**360**	**33**	**70**	**257**	

Note: TC = type certification.

Source: TQ Cert;[35] UL India;[36] BVIL;[37] SGS;[38] NTH (NR);[39] and MSCERT.[40]

As per the Digital Sky portal, a total of 55 TCs have been granted so far.[41] However, breakdown of only 33 type certifications undertaken by five CBs is available. The observations from the analysis of the data given in Table 3 are deliberated next.

Low Rate of Certification by CBs

Against a total of 360 applications, only 33 type certifications have been granted by the CBs; 70 applications are under process; and 257 applications have been rejected. This less than 10 per cent success rate in certification is extremely low and there is a need to examine the reasons for it.

Certification Timelines

The timelines and figures shown on the Digital Sky portal do not indicate the delays in the certification of drones and other anomalies. The portal only shows the timelines between the last submission of Form D-1 and issue of certification by the DGCA, unless it is cleared in the first attempt, which is rare. The exceeding of timelines, number of rejections and other anomalies and inefficiencies of the certification process are not shown on the Digital Sky platform. Some of these anomalies are:

1. *Number of rejections of Form D-1*: Form D-1 is sometimes rejected and manufacturers are asked to reapply. The manufactures do not have objection to reapplying due to low fee of Rs 100 for Form D-1; however, associated delays in certification increase the cost of the whole process. This process is repeated several times as there are number of rejections of Form D-1. Every time a new Form D-1 is raised, the timelines for certification starts afresh. The number of rejections of Form D-1 are not recorded in the certification timelines, and thus are not shown on the Digital Sky platform, which gives an incorrect understanding of the time involved in obtaining certification for drones.
2. *Date of rejection*: The date of rejection is not shown on the Digital Sky platform, which sometimes is closer to the 60-day time period. The delays and inefficiencies of the CB in processing and rejecting an application go unnoticed.
3. *Quotations from CBs*: The quotations from CBs, in some cases, are received after the submission of Form D-1, further adding to delays.
4. *Total timelines*: The time lapse between the first submission of Form D-1 and the final issue of the certificate varies from a few months to more than a year, which is significantly more than the timelines shown on the Digital Sky platform. For instance, it took one of the drone manufacturers seven rejections and more than a year to obtain certificate of compliance by the DGCA. However, only the date of submission of the last Form D-1 and issue of certificate was shown on the Digital Sky,

which is misleading.[42] These certification timelines are so high that they can make or break a start-up living on the thin edge of funding.

Reasons for Delays in Certification

The drone manufacturers face a number of rejections of their type certification applications. In most cases, the reasons and detailed observations for rejection of type certification application by the CB are either not given, or not recorded in writing, or are given late. Additionally, the reasons for rejection keep changing at different stages of certification. Some of the reasons for rejection and delays are as follows:

1. *Multiple layers of questioning*: There are multiple layers of questioning by the evaluators, domain experts and personnel of the CB, the QCI and the DGCA to create proof of verification. In addition to the CB, the involvement of the QCI and the DGCA in the questioning leads to duplication, delays and complexities in certification.
2. *Lack of domain experience*: Some domain experts lack experience on UAS and have limited understanding about the peculiarities of the UAS development and operations. This leads to avoidable questioning and associated delays in certification.
3. *Paucity of qualified manpower*: The paucity of technical manpower and their limited availability adversely impacts the functioning of the CB. This often leads to delays in receiving response from the CBs or action on the application.
4. *Lack of standardisation*: The lack of standardisation in documentation, procedures, processes and questioning by the CBs, the QCI, the DGCA and domain experts make preparation for the certification challenging and uncertain. The adoption of global standards in certification processes could overcome some of these challenges.
5. *Repetitions/duplications*: There is duplication in certain tests that are required to be conducted and submitted for the certification, especially in the case of drone components, even if:
   (*i*) component of similar parameters is used in another drone; and
   (*ii*) same component is used across different drones.

   An example of such duplications is the need for submission of test reports from the NABL for the fire retardant ID plate, even if the plate is made from the same material and made by the same company. Such repetitions are avoidable with the formation of standards for sub-systems.

Lack of Penalising Mechanism

The DGCA and its Drone Directorate continue to view themselves as regulators and not as owners and protectors of indigenous drone technology and industry. There are several provisions under the Drone Rules, 2021, the CSUAS policy, the drone import ban by Director General of Foreign Trade, the exemptions from certification for R&D, etc., that have the potential for violation and exploitation by motivated people and entities. There is no entity that has formulated a policy or created a reporting and redressal mechanism to implement drone policies and penalise defaulters and violators. As a result, the import bans, prohibitions or restrictions articulated in the policies remain ineffective. The misuse of imported, banned or R&D drones for business and commercial activities go unreported. The lack of penalising mechanism for drone-related policy violations is creating space for defaulters to get away unquestioned and unaccounted.

The avoidable delays lead to significant increase in cost. Thus, the designing, development and manufacturing by Indian drone companies becomes an expensive, unattractive, uncertain and challenging proposition. These challenges encourage the Indian drone manufacturers to use imported components, rather than using those that are indigenously designed, developed and manufactured. The increase in cost and timelines for development, as well as easy terms for the import and use of imported components in drone manufacturing, makes indigenous development and manufacturing a lesser attractive option. The significant import of drone equipment and listing of banned drones in non-type certified UAS are indicative of the trend of using imported components.

Cost of Drone Certification

The Indian government has made a concerted effort to reduce the cost of certification of drones by charging a meagre fee of Rs 100 for the certification application (Form D-1). However, the cost of certification of drone has several layers of expenditure that are less known and understood. The basic measurements by the NABL laboratories, which include temperature, weight, multimeter, tachometer, measuring tape, anemometer, vernier callipers, etc., cost between Rs 1,00,000–Rs 1,50,000.[43] These other tests significantly increase the cost of certification. The details of some of the expenditure involved in the certification of the drones are enumerated in Tables 4 and 5.

Table 4 Cost of Certification of Drones

S. No.	Description of the Test/Activity	Minimum Cost (Rs)	Maximum Cost (Rs)
1.	Cost of Form D-1 as per UAS certification policy (manufacturer may have to apply up to 10 times)	100	1,000
Cost of Testing of Drone			
2.	Cost of drone	8,00,000	16,00,000
3.	Cost of basic measurements by the NABL laboratories (temperature, weight, multimeter, tachometer, measuring tape, anemometer, vernier callipers, etc.)	20,000	1,50,000
4.	EMI/EMC test	1,00,000	2,00,000
5.	Fire retardant ID plate	10,000	20,000
	Total cost of testing	9,30,000	19,71,000
Cost of Certification by CBs			
6.	Certification fee by CBs	1,50,000	6,00,000
7.	Cost of man days of the CBs (approximately 15–40 man days @ Rs 10,000 per man day)	90,000	2,00,000
8.	Cost of travel and accommodation for representatives of CBs	50,000	2,00,000
	Total	2,90,000	10,00,000
Cost of Consultancy for Drone Certification			
9.	Cost of initial consultancy on information on testing, filling of forms, approvals, etc.	2,00,000	10,00,000
10.	Additional cost of consultancy on active support during testing and certification	0	4,00,000
	Total	**2,00,000**	**14,00,000**
	Grand Total	**14,20,000**	**43,71,000**

Note: Costing is calculated by the author based on information from quotations, interaction with drone companies, individuals and others involved in the certification of drones.

Table 5 Cost of Certification of Drone Battery

S. No.	Description of the Test/Activity	Minimum Cost (Rs)	Maximum Cost (Rs)
1.	Cost of 22 batteries	8,00,000	12,00,000
2.	Cost to testing of batteries	2,00,000	5,00,000
3.	Cost of consultation for certification of drone batteries	50,000	1,00,000
4.	**Total**	**10,50,000**	**18,00,000**

Note: Costing is calculated by the author based on information from quotations, interaction with drone companies, individuals and others involved in the certification of drones.

Cost of Certification

The cost of testing and certification of drone by the CB varies between Rs 12,20,200 and Rs 29,71,000 (Table 4) provided that the OEM does not engage consultants, which is rare considering the complexities and ambiguities of the process. If the cost of consultants is added, the consolidated cost varies between Rs 14,20,000 and Rs 43,71,000. In addition, if the OEM decides to manufacture its own battery, its testing, certification and consultation cost varies from Rs 10,50,000 to Rs 18,00,000 (Table 5). Therefore, the whole process becomes expensive for start-ups and MSMEs that are mostly dependent on loans. Further, the ambiguities and delays make their survival impossible.

Understanding of cost of certification is essential to understand the challenges and limitations of Indian drone and drone components manufacturers *vis-à-vis* their global counterparts. This cost would increase as the Indian civil drone manufacturers start developing larger drones and critical drone components. The Indian civil drone components manufacturers face challenges in convincing Indian drone OEMs. The drone OEMs in turn face challenges in convincing consumers, who are either not aware of nuances or are unwilling to seek drones with indigenous systems and sub-systems in the request for proposal (RFP) due to increase in workload and challenges associated with validation. This adversely impacts the cost competitiveness of Indian products *vis-à-vis* established global OEMs.

Cost of Consultations

The efforts of the DGCA, the QCI, drone bodies and other organisations to reach out to drone manufacturers in the last two years has not led to simplification of the certification process. In fact, increasing complexities,

subjectivity and ambiguities have created the necessity of hiring consultants. The details of some of the types of consultations are deliberated next.

1. *Paid seminars*: The paid seminars being conducted by the QCI to educate potential drone manufactures on drone certification remain inadequate as they do not obviate the need for hiring consultants or consulting agencies due to non-availability of formats, templates, policy and procedural ambiguities, etc.
2. *Certification consultants*: The complexities of testing, documentation, ambiguities, non-availability of formats and enormity of the process have created the necessity of hiring individual consultants, or consulting organisations or industry bodies, without which obtaining certification has become challenging. The repeated observations raised by the CBs, the QCI or the DGCA, and the need for multiple design, testing and documentation iterations due to various ambiguities, create delays and increase costs. As a result, it becomes prohibitive for innovators or start-ups to obtain certification of drones without consultants. The certification consultants divide the certification into various parts and charge them for various phases of certification. This adds to the cost of development for Indian companies, especially the start-ups and the MSMEs, who often struggle to maintain their cash flow to survive as new entrepreneurs.
3. *Paid certification classes*: The consultancy firms and individuals conduct paid classes on the certification process. The aim of such classes varies from organisation to organisation, but often their effort is focused on providing basic information while holding back critical information. This information helps in understanding the chronology of tests and commence testing. However, the start-ups have to again come back to consultants for documentation and other details for which there are no templates for reference.

The requirement of consultants indicates not only complexities but also the lack of transparency, ambiguities and non-availability of formats, standards and standardisation. Some of the problems can be resolved by using technology; improving policies and their implementation, processes and structures; and bringing transparency and objectivity.

Civil UAS Atmanirbharta Challenges

Atmanirbharta and becoming a drone hub by 2030 are highly aspirational goals that intend to change the trajectory of drone technology development and its

exploitation in India. The terms, such as 'Make in India', local manufacturing, atmanirbharta and indigenous design, sometimes create confusion, but despite appearing similar, these terms have significant differences. Make in India and local manufacturing relate to local manufacturing by foreign OEM itself or offloading local manufacturing of non-critical systems to Indian entities while retaining control over Intellectual Property (IP) and critical technologies. These create low-value industry in India, in which Indian entities have to go back to global OEMs for upgrades, modifications and developing future variants. Meanwhile, atmanirbharta and indigenous relate to Indian entities having control over all phases of design and development, especially in critical technologies.

Atmanirbharta in UAS has been largely achieved due to R&D initiatives taken by the Indian Ministry of Defence (MoD) and the defence forces. The Mehar Baba UAS Swarm Drone Competition of the Indian Air Force,[44] the UAS development programmes of Aeronautical Development Establishment (ADE),[45] the Combat Aerial Teaming System (CATS) by Hindustan Aeronautics Limited (HAL)[46] and other defence UAS development by the private industry are examples of defence UAS R&D programmes. India's goal of becoming a research and innovation-led high-technology, high-value atmanirbhar global drone hub by 2030 would require equally vibrant and robust civil UAS atmanirbharta structures and initiatives. The issues that impact atmanirbharta are as follows:

1. civil UAS technology ownership;
2. civil UAS atmanirbharta policy;
3. indigenous design, development and trials of civil UAS and enabling technologies;
4. structures and framework to assess technology-based indigenous content (IC) of UAS;
5. standards and certification; and
6. procurement.

Civil UAS Technology Ownership

There is no body or organisation that accepts the ownership of drone technology and takes proactive measures to develop niche and emerging drone technologies to fill technology gaps and develop enabling technologies to integrate drones in the Indian airspace. This observation comes from the fact that the Drone Directorate is placed under the DGCA, which views itself only as the regulator of operations and not as the owner of civil drone technology. India has not launched any civil drone technology development

and adoption initiative to support atmanirbharta. This could dilute the mission of building high-value drone hub by 2030.

Civil UAS Atmanirbharta Policy

The MoCA does not have an atmanirbharta policy, including on civil UAS. The National Civil Aviation Policy, 2016 does not have any provision for atmanirbharta in civil aviation that focuses on design and development of civil aircraft, civil UAS, ground, air navigation, air traffic, fire safety and other systems.[47] This is a limitation in the indigenous development of niche, innovative and futuristic civil UAS technologies, as well as in integration of civil UAS in the Indian airspace.

Civil UAS R&D Initiatives

India does not have civil UAS R&D initiatives, unlike the Federal Aviation Administration (FAA) of the United States (US) and the European Union Aviation Safety Agency (EASA).[48] The absence of civil UAS R&D initiatives has been a major challenge for the growth of Indian drone design and manufacturing industry.

Civil UAS Trials

The UAS is an emerging domain and a number of technologies need to be developed that include niche and futuristic systems as well as enabling technologies to integrate UAS in the Indian airspace. India has not exploited trial methodology for adoption of emerging technologies as well as for proactive formulation of policies in emerging sectors, including UAS. If technology validation initiatives are undertaken, Indian companies developing dual-use industrial technologies can modify and deploy them for UAS operations.

India launched its first proactive BVLOS trials initiative in the UAS segment in 2021. On 5 May 2021, the MoCA granted conditional exemption to 20 entities from Unmanned Aircraft Rules, 2021 to conduct BVLOS experimental flights of drones. These trials were launched with an aim to facilitate development of UAV rules pertaining to BVLOS drone operations. These trials also aimed at creating a framework for drone deliveries and other applications, as well as articulate a suitable certification mechanism.

The process of BVLOS trials was initiated on 13 May 2019 when an Expression of Interest (EOI) for BVLOS trials was invited by the DGCA. The promulgation of the BVLOS policy would have brought in standardisation

in BVLOS operations, safety features in manufacturing, expanded BVLOS operations envelop and increased business potential and the pace of growth of the Indian drone industry. Some companies had completed mandatory trials of 100 hours in October 2021.[49] However, five years after the initiation of the process of BVLOS trials, India is yet to have its BVLOS operation and certification policies. The non-promulgation of the policy on BVLOS operations five years after seeking the EOI for trials, and three years after the completion of BVLOS trials, is an indicator of the absence of proactive approach of the DGCA. There is a need to create mechanism for leveraging trials and validation of technologies for policy formation.

Production Linked Incentive (PLI) and Indigenous Design

India promulgated the PLI scheme in 2022 with an aim to provide incentives to manufacturing of drone in India. The scheme created a conducive environment for manufacturing, however, there was no incentive for indigenous design and development of drones and drone components. Despite the PLI scheme, the Indian drone industry remains largely dependent on import of critical systems, components, sub-systems, sensors, payloads, software, etc.

India's goal of becoming an atmanirbhar global drone hub requires building a high-technology, high-value and high-profit industry by leveraging own domestic demand and consumption to compete globally. This can be done by indigenous design and development and creation of IP. Therefore, incentives are needed for indigenous design and development of drones, components, sensors, payloads and other critical systems in India.

Limitations of Civil UAS Certification

The certification scheme for civil drones, dated 26 January 2022, has procedures and modalities for product and process certification of drones based on technical standards and regulations.[50] The QCI has been entrusted with the responsibility of certification of civil drones and the DGCA, upon receiving its results, issues the certificate to drones. Some of the limitations of the civil UAS certification are discussed next.

Certification of Drone Components

India has banned the import of drones, however, it is largely dependent on foreign OEMs for drone components, sensors, software and payloads. The current scheme of drone certification issued by the DGCA certifies complete drones and no separate standards are laid down for drone components,

sub-systems, sensors, software and payloads, except for the drone battery, which creates challenges for drone components manufacturing in India.

The drone components manufacturers require fresh certification when a component of a certified drone is used in another drone of similar class or the component is replaced with a component of similar technical parameters and performance manufactured by another OEM. The drone manufacturer, thus, has to do all tests again and submit them to obtain certification approvals from the QCI/DGCA. This duplication increases cost of development of drones and drone components, adversely impacting cost competitiveness.

Certification Challenges of Indian Developers

The Indian drone companies that resort to assembling of drones by predominantly using proven imported critical systems, sub-systems, components, sensors, payloads, software, etc., are in an advantageous position to obtain certification of their drones *vis-à-vis* those Indian companies which indigenously develop drones, components and systems. The Indian companies assembling drones with negligible or little indigenously developed critical systems do not have to spend money, face challenges and deal with uncertainties and complexities related to the development of drones. Their entire effort is focused solely on certification of proven products, which is less challenging.

Indian drone and drone component developers, on the other hand, have to hire design engineers, cater to failures, undergo prolonged development timelines, overcome funding challenges and procurement uncertainties, as well as face other struggles. The non-availability of development standards, lack of clarity on testing procedures, absence of standardisation in recording of testing parameters and certification ambiguities add to their challenges and become a stumbling block for Indian developers who are indigenously designing and developing the product from the ground up.

Additionally, the performance of indigenously developed products may not match a specific test point or performance parameter initially. If these parameters are not clearly spelled out or their standards have not been clearly articulated and ambiguous terms are used, the journey becomes hazardous. The high cost of consultations and complexities of certification are making indigenous design, development and manufacturing a less preferred choice for Indian start-ups and MSMEs. These entities often have insufficient funds and are unwilling to go through the struggle. This creates a challenging environment for Indian innovators, who end up working for global companies or shifting their operations to innovation-friendly countries. India needs to take course correction to prevent brain and technology drain.

Civil UAS Certification for Future

The Drone Rules, 2021 limit the certification of drones to below 500 kg AUW. The rules stipulate that drones with AUW of more than 500 kg shall be governed by the Aircraft Rules, 1937.[51] Some Indian companies are developing drones that have an AUW greater than 500 kg for UAM, AAM and other applications. However, they would not be able to pursue certification of the UAS due to limitations in the current UAS certification policy. The challenges in certification of UAS weighing more than 500 kg are as follows:

1. The ownership of certification of the UAS scheme for certification of UAS weighing less than 500 kg rests with the QCI. However, no agency has been entrusted with the ownership of certification of the UAS larger than 500 kg.
2. There are no Standard Operating Procedures (SOPs) for the certification of UAS weighing more than 500 kg.
3. The CB to undertake certification of drones more than 500 kg has not been designated.
4. The details of tests that are required to certify UAS more than 500 kg have not been formulated.

Without the policy, procedures, SOPs and entity with ownership of certification of UAS weighing more than 500 kg, the growth of Indian drone industry will remain slow. Differentiated mechanisms for the certification of drones weighing below and above 500 kg are needed.

Reciprocity in Foreign Certification Acceptance

Section 10 of the Drone Rules, 2021 allows the DGCA to issue type certification to a particular type of unmanned aircraft system based on the approval granted to that type of UAS by the regulators of foreign contracting states provided the Indian central government specifies it through an official gazette notification.[52] However, it is important that such acceptance of certification approval should not be one-sided that creates avenue for import and adversely impacts domestic manufacturing industry.

Procurement Challenges

The indigenous drone and drone components manufacturers face challenges in selling their products due to non-availability of provisions or non-exercising of provisions for procurement of indigenous drones and drones with indigenous components in the procurement policies. This makes survival of indigenous developers challenging.

Need for Reforms in MoCA

According to a recent article, India's aspirational goals of becoming a high-technology, high-value global drone hub by 2030 and atmanirbhar in drone technology need a strong foundation of research, technology development and an enabling ecosystem. India's MoCA, like the FAA and EASA, is the pillar of civil aviation and civil UAS development and its integration in the Indian airspace. However, India lacks the R&D structures, initiatives and ecosystem possessed by the global aviation and unmanned aviation leaders, which could become an impediment in achieving its goals.[53] The following developments further corroborate these observations and indicate non-availability of policies and structures for research, development, testing and trials-based development of civil drone technologies and capabilities:

1. The process of certification has remained stagnant and limited to certification of UAS below 500 kg, which is a limitation for the growth of Indian UAS manufacturing industry.
2. The BVLOS policy for operations and certification of UAS has not been formulated despite initiation of the trials in 2019.
3. No decision has been taken on the installation of mandatory safety systems on drones, such as NPNT hardware and firmware, real-time tracking beacon and geofencing, as proposed in the Drone Rules, 2021.
4. There is no initiative to develop and validate UTM technologies.
5. The critical components, sub-systems, payloads and sensors for manufacturing of UAS continue to be imported in the absence of R&D initiatives and lack of mechanism for their certification.
6. The Centres of Excellence (CoEs) established in premier academic institutions, including the Indian Institutes of Technology (IITs), have been unable to fill most technology gaps in sub-systems, sensors and payloads.
7. No initiatives have been taken by the MoCA/DGCA to undertake trials for UAM, AAM and integration of UAS in the Indian airspace.

Thus, in summary, the absence of atmanirbharta policy and lack of structures for research, innovation, technology development and trial-based certification initiatives by the MoCA, the DGCA and its Drone Directorate are creating challenges for the growth of the Indian civil UAS industry. These challenges slow down the development of advanced civil UAS, enabling technologies for integration of drones in the Indian airspace and their certification. Therefore, there is an urgent need for reforms in the MoCA.

Indigenous Design Challenges

India has taken several initiatives to support the manufacturing of UAS; however, inadequate effort has been given to incentivising indigenous design. This section discusses key issues that impact indigenous design of UAS, such as indigenous design certification of UAS and the need for creating a robust mechanism for IC calculation of defence UAS.

The indigenous design certification would help the users in identifying UAS and critical components that have been designed, developed and manufactured by Indian entities. The IC, on the other hand, is a calculation in percentage based on indigenous components, materials and software, which could be used for giving preference to the procurement of indigenously designed, developed and manufactured drones and components. However, the calculation of IC percentage would be challenging and a technically sound expert body would be needed to articulate these percentages.

Indigenous Design Certification

In the defence aviation sector, Centre for Military Airworthiness and Certification (CEMILAC) is responsible for providing airworthiness certification to flying platforms, including UAVs.[54] The CEMILAC carries out analysis of documentation, test reports, design drawings, innovations and physical trials for according airworthiness certification. The CEMILAC, by virtue of its vast experience of certification of indigenously designed aircraft, has gained significant expertise that could be leveraged to provide indigenous design certification to the UAS. However, it does not have mandate to provide indigenous design certification to defence equipment, including drones.

In the civil UAV segment, the DGCA has the authority for the issuance of type certification of the civil UAS, while the QCI is the CSUAS owner and CBs undertake certification of civil UAS.[55] The current civil CSUAS policy is aimed at certification of the performance and safety of UAS and it does not have policy, mandate and mechanism for certification of indigenous design in the civil UAS.

Standards and Standardisation

India does not have a history of proactive formulation of aeronautics standards as it has been a follower of aeronautics technology. It has been adopting global standards promulgated by the US and European aviation bodies. The rapid evolution of drones in the last decade and lack of Indian standards for drones and its systems could bring in vulnerabilities,

non-standardisation and interoperability challenges. The increasing capability of Indian drone manufacturers also necessitates that India take initiative to formulate standards for UAVs.

Indigenous Content (IC) Certification

In the defence sector, the MoD policy on IC in the Defence Acquisition Procedure (DAP) has been changed from cost-based IC calculation to materials, components and software-based IC calculation. However, there are no standards or a technical body that defines/allocates percentage of IC content for various materials, components and software for each category or type of drone/defence equipment. The formulation of a mechanism for IC calculation based on materials, components and software, without a nodal technical agency having technical and domain experts, could lead to inconsistencies, incoherences, non-standardisation and subjectivity in the application of this policy.

In the civil UAS sector too, there are no standards for IC calculation and no entity has been entrusted with the responsibility to define percentage of IC content for various materials, components and software of the civil drones.

Indigenously Developed Products Vertical on GeM

The GeM is a national public procurement portal set up for online procurement of common use goods and services required by government organisations/departments and the public sector undertakings (PSUs). The purchases through GeM by government users has been authorised and made mandatory by the Ministry of Finance by addition of a new rule (No. 149) in the General Financial Rules, 2017.[56] This portal is a single point of procurement by the government users, however, it does not indicate whether products are indigenously developed, or assembled or imported.

The GeM does not have a vertical for indigenously designed products and indigenously designed products-based services. On a few occasions, banned imported drones have been listed on the GeM and were removed when objections were raised.

Indigenous Products Procurement by All Ministries

The procurements are the lifeline of indigenous products and atmanirbharta. There are about 55 ministries and 90 plus departments in the Indian central government. Out of these ministries, most initiatives to procure indigenously designed products have been taken by the MoD. As similar initiatives are lacking from other ministries, it adversely impacts Indian manufacturers

designing and developing indigenous drones or Indian services companies from using indigenous drones for various services.

Way Forward

India's goals of becoming a global drone hub by 2030 and atmanirbhar in critical technologies, including UAS, in the true sense are going to be challenging unless necessary structural reforms are instituted in the MoCA, the DGCA and the Drone Directorate. These entities need to be empowered to undertake research, development and trial-based certification of UAS and enabling technologies. This would require creating enabling structures, recruiting and skilling suitable technical manpower and bringing in reforms in policies and processes. The following is recommended to overcome the challenges.

MoCA Reforms

1. Designate a nodal ministry (MoCA) to take ownership of civil drone technologies.
2. Formulate a civil UAS atmanirbharta policy to support indigenously designed UAVs.
3. Create technology development structures in the MoCA, the DGCA and the Drone Directorate; and introduce R&D initiatives to facilitate development of niche, cutting-edge and emerging UAS and enabling technologies.

Certification, Standards and Digital Sky Listing Reforms

1. Thoroughly examine the factors contributing to high cost of testing and certification and introduce corrective measures to make certification affordable, transparent and a simple process for start-ups and MSMEs.
2. Examine the challenges and anomalies leading to low rate of certification and placing of high number of UAS in the 'in process' and 'rejected' categories.
3. Study ambiguities in testing and documentation, non-availability of formats, standards and standardisation, anomalies in timelines, inefficiencies and paucity of qualified manpower in CBs, duplications in testing and certification, etc.
4. Introduce autopilot testing, functioning integrity in terms of hardware-in-the-loop simulation testing and trials, along with their associated

individual sensors, to ascertain their failures, redundancies, robustness and longevity.
5. Examine the anomalies deliberated in non-type certified (enlisted) and non-type certified (nano and model) UAS certification listing on Digital Sky portal and UAS exemptions.
6. Appropriately review the policy of placing UAS under non-type certified (enlisted) and non-type certified (nano and model) to prevent import of banned UAS. Also, introduce a transparent online monitoring mechanism to prevent their misuse.
7. The DGCA should formulate a policy and guidelines for development, testing, certification and operation of BVLOS, real-time tracking, UTM, collision avoidance systems, UAM, AAM and UAS weighing more than 500 kg.
8. The DGCA/QCI should create standards for sub-systems, components, sensors, payloads, software, etc., and introduce mechanism for their certification.
9. The DGCA/QCI should make a list of approved sub-systems, components, sensors, software, payloads, etc. The repetitive submission of test reports of sub-systems should be prevented.
10. Re-examine the need for re-certification of drones for using sub-systems of similar category and performance from different manufactures.
11. Introduce time-bound trial and validation mechanisms for expeditious development and adoption of emerging and innovative technologies and formulation of policies.
12. Adoption of minimal manufacturing process standards as per NABL ISO 9001 2015, or similar standards, by the CBs, the QCI and the DGCA to reduce timelines and cost overruns.

Indigenously Designed Developed and Manufactured (IDDM) and Atmanirbharta Reforms

1. The DGCA should formulate indigenously designed certification mechanism for the civil UAS.
2. The DGCA should designate a nodal agency for indigenous design certification and IC calculation. The nodal agency should formulate criteria for IC percentage based on indigenous sub-systems, components, software, sensors and payloads.
3. Designate an agency for formulation of standards for drones, drone components, materials, sensors, payloads, software, etc.

4. Formulate 'Abhikalpa-Abhinav Protsaahan Yojna'[57] (Design-Innovation Incentive Scheme) for drones and drone components to offer financial incentives as well as infrastructural support across various stages of development, deployment, testing and certification, so as to stimulate indigenous design and IP creation in civil UAVs, materials, critical systems, sensors, payloads, software, etc.

Procurement Reforms

1. *Review GeM policies*: The following reforms in GeM are recommended to support indigenous design and atmanirbharta:
   (i) Create indigenously designed products vertical on the GeM portal.
   (ii) Annotate 'Indigenously Designed' on indigenous UAS, sub-systems, software, components, payloads and sensors.
   (iii) Give priority to procurement of indigenously designed products.
   (iv) Introduce technological, policy and procedural mechanisms to prevent inadvertent listing of banned UAS and sub-systems.
2. Formulate a robust structure and mechanism to implement the polices and penalise the violators.
3. All ministries to include Qualitative Requirement (QRs) for indigenously designed drones, drone components, sensors and payloads in request for proposals (RFPs) for the procurement of drones and indigenously designed drones-based services.
4. Include indigenously designed drones, drone components, software, materials, sensors and payloads in the positive indigenisation list of the MoD.
5. All ministries to adopt the positive indigenisation list of the MoD or create similar positive indigenisation list to support IDDM drones.

Academia and CoEs

The funding for drone CoEs by the Department of Science and Technology (DST), the MoD, the Ministry of Education and others needs to be restructured, streamlined with all stakeholders and made outcome oriented. The allocation of funds through the incubation centres, the CoEs and academia should be focused on filling specific drone technology gaps in a time-bound manner with well-defined technology milestones. The progress of technology development projects should be closely monitored and where required, funding should be discontinued and diverted to those projects making progress in drone and associated technology development.

1. An audit of funding to academic institutes, CoEs, incubation centres and others should be done to ascertain the causes of their inability to fill drone technology gaps.
2. The objectives, milestones and outcomes of all government-funded projects undertaken through all ministries, including Ministry of Electronics and Information Technology (MeitY), DST, academia, incubation centres, specially created independent bodies and other mechanisms should be published and placed on one portal to prevent duplication, ensure optimum utilisation of precious resources and bring in accountability.

Indigenous Design and IC in Defence UAS

1. Define the standards and mechanism for indigenous design certification of defence UAS.
2. Designate a nodal technical body to define IC content for defence UAS based on materials, components and software.

Conclusion

India's drone sector, due to the establishment of Digital Sky platform, launch of the Drone Rules, 2021, drone certification, RPTO and PLI schemes, etc., has been able to partially develop manufacturing and services sectors. These policies, after laying the foundation of the drone industry, are facing implementation challenges and anomalies. The anomalies related to enlisting of drones on Digital Sky, potential misuse of policy exemptions, high cost and complexities and ambiguities of certification need to be addressed on priority.

India's aim of becoming atmanirbhar in critical drone technologies would require corrective measures to reduce the overwhelming dependence on imports for critical systems, sensors, payloads, software and other components—despite launching PLI, establishing CoEs and providing significant funding to premier academic institutions, including IITs, by the DST, the MeitY and others. The failure of these initiatives in filling the gaps in drone technology and capability need to be examined, and accordingly these schemes have to be reorientated. The further growth of the drone sector would require reforms in the MoCA, the DGCA and the Drone Directorate; formulation of civil UAS atmanirbharta policy; creation of R&D structures; launching of technology development and validation initiatives; leveraging

trials for the formulation of policies; and formulating progressive certification mechanisms.

India has demonstrated its ability to take bold policy reforms by introducing single window scheme for issuing 'Passport', unified 'Goods and Services Tax' (GST), e-VISA and Unified Payment Interface (UPI). India's drone sector is at a crossroads, and requires leadership and ownership at the apex level to institute major policy, structural and procedural reforms to become research, innovation and IP-led high-technology, high-value atmanirbhar global drone hub by 2030.

Notes

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