Market Assessment

Of Drones

Ecosystem In India

Final Report

March 2023

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GLOBAL TRENDS FOR EVOLVING DRONE MARKET

INTRODUCTION OF A NEW TECHNOLOGY - *DRONES*

According to **The Drone Rules 2021**, a drone is defined as:

"an aircraft that can operate autonomously or, can be operated remotely without a pilot on board"

Weight (including payload)

- Nano (less than or equal to 0.25kg)
- Mirco (0.25-2kg)
- Small (2-25kg)
- Medium (25-150kg)
- Large (more than 150kg)

As per Drone Rules 2021

Wing Type

- Single Rotor
- Fixed Wing
- Multi-Rotor
- Fixed-Wing Hybrid VTOL

Power Source

- Battery-powered
- Gasoline-powered
- Solar-powered
- Hydrogen fuel cell powered

Range

- Very close-range (less than 5 km)
- Close-range (5-50km)
- Short-range (50-150km)
- Mid-range (150-644km)
- Long-range (more than 644km)

Size (Diameter)

- Very small drones (less than 51mm)
- Small drones (76-152mm)
- Medium drones (150-640mm)
- Large drones (more than 640mm)

GLOBAL SCENARIO OF COMMERCIAL DRONE MARKET

In the past few years, drone technology has experienced an unprecedented rise in popularity across the globe.

Global Potential Forecast for Commercial Drone Market

CAGR: 28.5%

Chart (USD Billion):
- 2021: 6.51
- 2029: 47.38
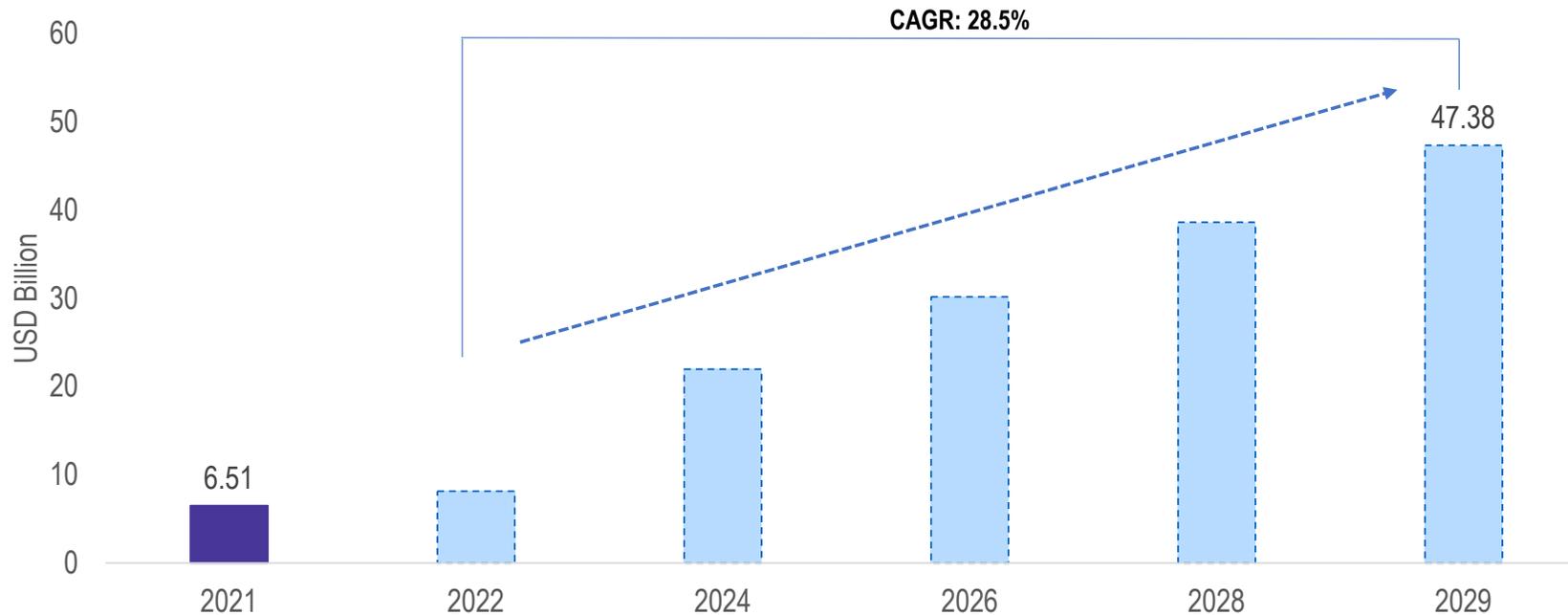
The AI-enabled completely autonomous drone market is expected to grow faster than semi-autonomous and remote-controlled drones since they can fly beyond visual line of sight (BVLOS).

PRESENT GLOBAL SCENARIO OF COMMERCIAL DRONE MARKET

Commercial Drone Market – By Regions (2021)

APAC, 31%

Europe, 22%

North America, 40%

LAMEA, 7%
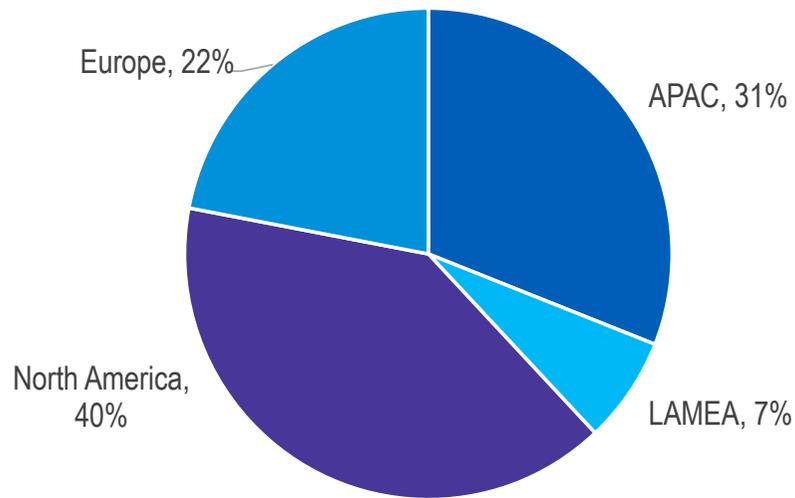
With 40.07% of the market share in 2021, North America dominated the regional market by a wide margin.

Market Outlook based on Products (2021)

Rotary Blade, 80.12%

Hybrid, 6.51%

Fixed-wing, 13.37%
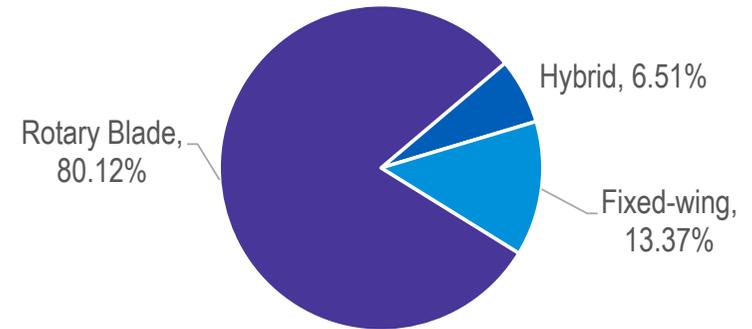
According to product prognosis, rotary blade sector kept top market position with 80.12% revenue share in 2021.

Commercial Drone Market – By Weight

25 Kg - 150 Kg

2 Kg - 25 Kg

<2Kg

0%   10%   20%   30%   40%   50%   60%
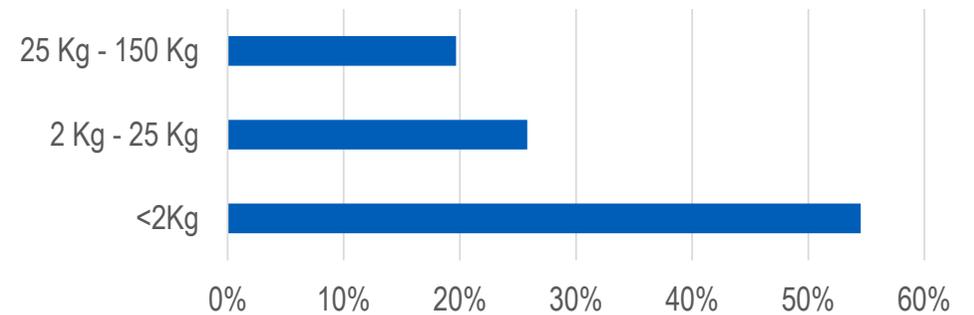
Source: Strategic Market Research, Grand View Research

PRESENT GLOBAL SCENARIO OF COMMERCIAL DRONE MARKET

Market Outlook based on Applications (2021)

Others*, 4%
Mapping & Surveying, 15%
Filming & Photography, 32%
Precision Agriculture, 20%
Surveillance & Monitoring, 13%
Inspection & Maintenance, 16%

Market Outlook based on End Users (2021)

Media & Entertainment
Real Estate & Construction
Energy
Security & Law Enforcement
Agriculture
Others
Delivery & Logistics

0% 5% 10% 15% 20% 25% 30%
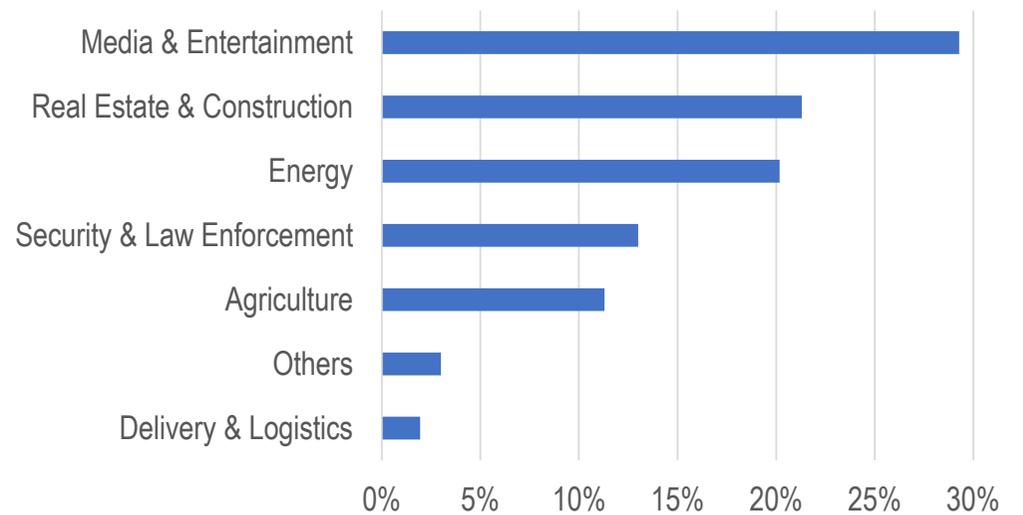
With 29.28% end-user market share in 2021, the media and entertainment sector achieved its highest market position.

With a 32.35% market share in 2021, the filmmaking and photography application dominated all others by application.

* Includes entertainment, disaster management, logistics & transportation, research & development, relief & rescue operations, and construction

Source: *Strategic Market Research, Grand View Research*

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2 MARKET TRENDS FOR INDIAN DRONE ECOSYSTEM

Booming Drone Market Potential in India

Indian Drone Market Potential Forecast (in INR Crores) and Distribution across End-Use Applications

CAGR: 35%

CAGR: 80%

295,000

81,600

2,900

Upto 2020

2025 Forecast

2030 Forecast

Legend:
- Defense (Army, Navy and Air Force)
- Homeland Security (State Police & Paramilitary Forces)
- Commercial (Retail, Infrastructure & Agriculture)
- Exports
- Counter-UAS

Source: FICCI

INR 81,600 Crs.
- 25%
- 5%
- 16%
- 7%
- 47%

INR 2,95,000 Crs.
- 17%
- 16%
- 25%
- 8%
- 34%
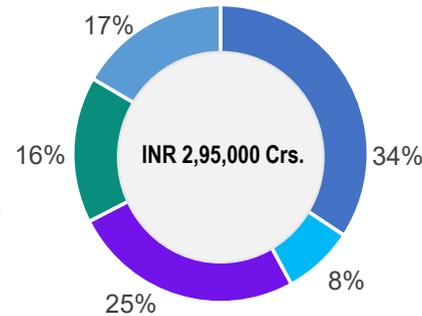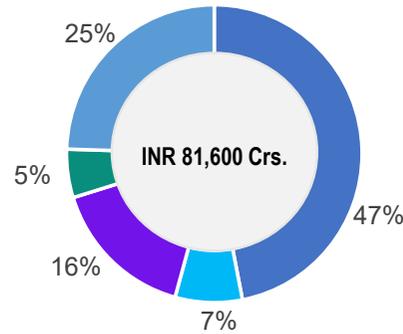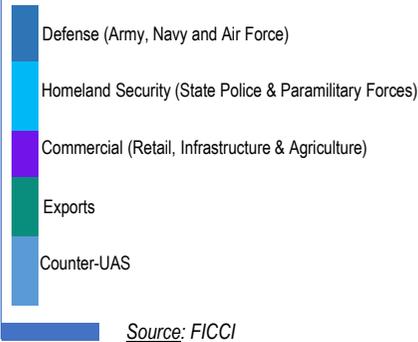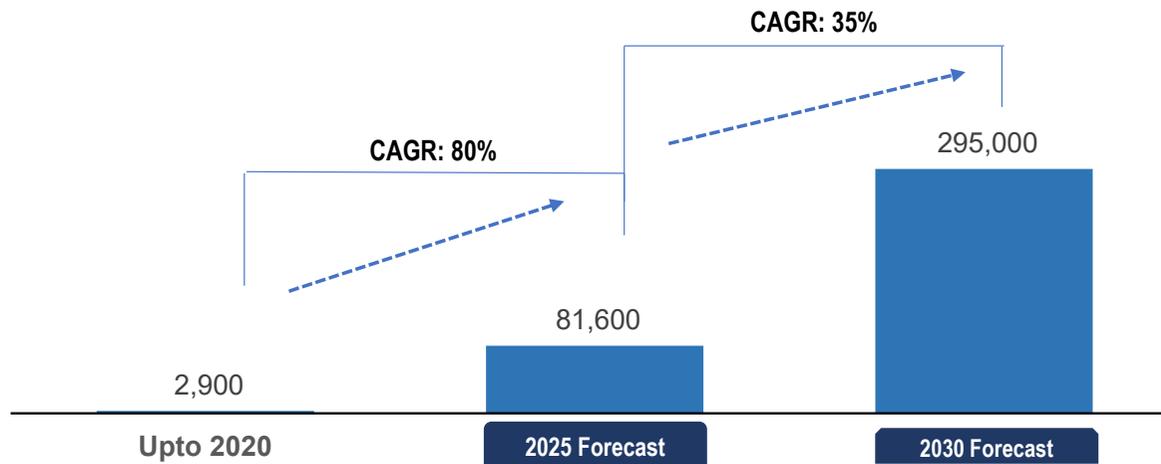
Growth Drivers

- Favourable governmental policies and regulations (such as Drone Rules 2021, Drone Import Policy 2022 and Production Linked Incentive Scheme)

- Rising demand from various end-use applications (especially agriculture and logistics)

- Increasing investments and number of start-ups in the drone manufacturing ecosystem

Growth Inhibitors

- India's underdeveloped drone manufacturing capabilities in the form of R&D centers and testing sites

- Less sophisticated technical know-how and skillset (when compared to established markets such as the US and Japan) to support design- and security-related elements

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KEY TECHNOLOGY TRENDS

Drone solutions are becoming increasingly popular and expanding their capabilities thanks to **several significant technology advancements**.

Manufacturing Trends

Application Trends

Edge and Fog Computing

Integration with other technologies

Autonomous Drones

Alternative Power Sources

Extended Flight Time Range

Superior Positioning and Navigation

Hybrid Drones

Enhanced Payload
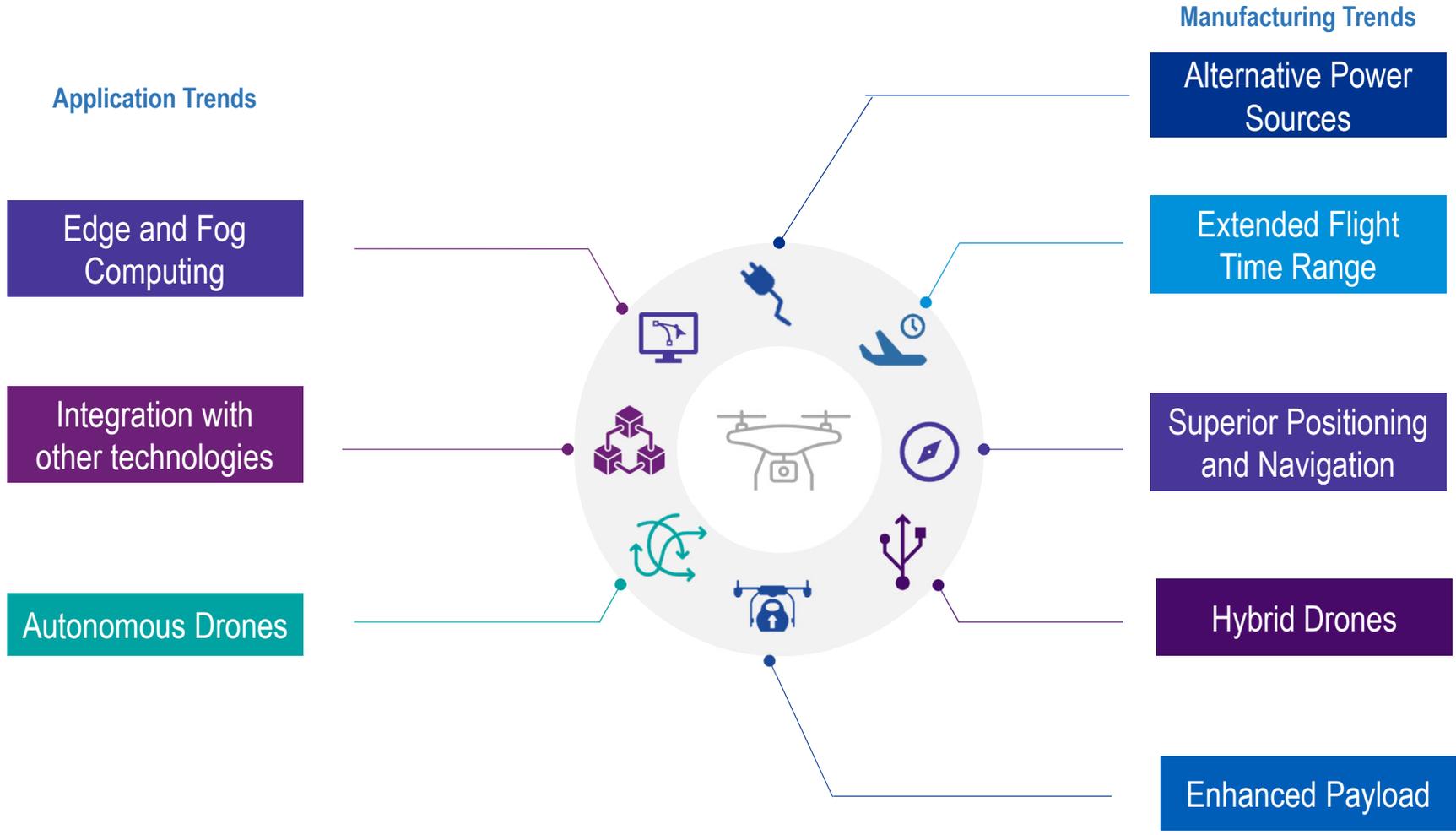
KEY TECHNOLOGY TRENDS

Alternative Power Sources

Drone manufacturers are exploring alternatives to conventional battery technology, such as hydrogen cells, gasoline-powered systems, solar batteries, gas-electric hybrid systems, and laser systems, because of the rising demand for longer flight times and more carrying capacity.

China has successfully tested its **first solar-powered UAV, known as the Qimingxing-50**. This UAV can fly for months, even act as a satellite if necessary, and has successfully completed its inaugural flight. It has a wingspan of 50 m and is a high-altitude long-endurance drone.

Extended Flight Time Range

Longer flight durations for drones are being developed by manufacturers and researchers, enabling them to hover for longer periods of time. For applications like long-range surveillance and package delivery, this is especially crucial.

With a maximum flight time of 42 hours, the **unmanned MQ-C Gray Eagle Extended Range is the longest-flying military drone**. It is employed for long-duration surveillance and target acquisition, and its maximum takeoff weight is 4,200 lbs. The Gray Eagle's GTOW is 3,600 pounds with a 160HP diesel engine, while the GE-Max ER's Gross Takeoff Weight (MGTOW) is 4,200 pounds and has a high-performance 180HP diesel engine.

KEY TECHNOLOGY TRENDS

Superior Positioning And Navigation

With the capacity to fly in hazardous locations and hold exact positions even when exposed to unfavorable conditions like strong winds, drones are getting more sophisticated in terms of their navigation and positioning skills.

The **Zephyr S drone** from Airbus is the largest, **lightest, and most durable unmanned aircraft** to ever fly, and its success might lead to new capabilities for marine surveillance and GPS-like location. It weighs 150 pounds and flies at 80,000 feet, distant from commercial traffic and unaffected by weather changes. It can fly at a graceful 30 knots for weeks because of its 80-foot wingspan and solar-cell power.

Hybrid Drones

Hybrid drones, which can fly horizontally like an aeroplane and take off and land vertically like a helicopter, are currently being developed. These drones have the potential to be more effective and maneuverable than conventional fixed-wing drones.

The **'Vertiplane-X3'** was unveiled by TechEagle, a private start-up firm that specializes in drone-based logistics and was marketed as the **fastest hybrid e-VTOL (vertical takeoff and landing) indigenous unmanned aerial vehicle in the world**. The Vertiplane-X3 can go up to 120 km/h while carrying a 3 kg load across rough terrain at 4500 meters above sea level. This H-UAV combines the speed and aerodynamics of a fixed-wing aircraft with the ability to land and take off from a small (5 m2) area of ground.

KEY TECHNOLOGY TRENDS

Enhanced Payload

In order to carry greater loads and do a wider variety of activities, drones are being built to carry larger payloads. This is crucial for industries like construction and agriculture, where drones can deliver equipment and supplies to inaccessible locations.

The **Rhaegal is a new type of vertical takeoff and vertical landing (VTOL) regional freight UAV that promises high efficiency, all-weather operation**. With a cruising speed of 370 kph, it can transport a VTOL payload of up to 2,455 kg across 1850 km. The Rhaegal is a cutting-edge, adaptable, and effective air cargo solution since the cargo bay is readily accessed from the nose and can transport LD-1, LD-2, or LD-3 cargo containers or bulk goods utilizing a convertible roller floor.

Edge and Fog Computing

Fog computing allows data to be gathered to be analyzed inside the drone before interacting with the main point of control. Drone operators will be able to minimize latency and the amount of data that needs to be transmitted from the drone to the controlling application by using fog computing.

Now, the technology is still in the research and development stage for drones.

Source: The Rhaegal

KEY TECHNOLOGY TRENDS

Autonomous Drones

The autonomy of drones, which can fly and carry out tasks without direct human input, is rising. Artificial intelligence (AI) and machine learning advancements have made this feasible by enabling drones to make wise judgements based on information from sensors and other onboard systems.

Exyn Technologies rates its current degree of drone autonomy, which it calls autonomy level 4A, as the highest ever. Although it falls two steps short of complete autonomy, this does allow for advanced transport, distribution, security, inspection, and research duties as well as brand-new cooperative modes with other drones and ground-based robots. Without a pilot in the loop, **Exyn's LiDAR drones can map and explore intricate subterranean mines on their own**.

Integration with other technologies

In order to create new capabilities and applications, drones are being merged with other technologies like AI and machine learning. Drone manufacturers are also integrating AR functionality in order to improve user experience, increase the effectiveness of drone technology applications and offer better anti-collision protection.

First responders are assisted in their rescue operations by Firefighter Drones, which are dispatched to fire spots as scouts and use cameras with thermal imaging technology.

Source: Exyn Technologies Autonomous Drone

VARIOUS ADVANTAGES DRIVING WIDESPREAD APPLICATIONS

Various **advantages are offered** by the drones over various other technologies across sectors. These advantages are **supporting widespread applications** of the drones globally with the global industries striving to incorporate its use cases within their strategy.

Cost Reduction

Drones often provide a convenient and affordable way to acquire aerial photos with high-quality geospatial data.
E.g.: For inspections, a drone is less expensive to purchase, and maintain than an aero plane

Precision and Accuracy

Drones can be programmed and accurately steered to specified areas since their software integrates GPS.
E.g.: Precision Agriculture - spraying pesticides, identifying weeds, monitoring crop health, crop damage, crop evaluation, field soil analysis, and monitoring irrigation.

Quality Improvement

Drones can capture amazing aerial photographs, and aerial films, and gather huge amounts of precise data thanks to their high-resolution cameras equipped with top-notch sensors.
E.g.: The collected data from drones can be converted into detailed 3D maps and 3D models.

Flexibility and Agility

Drones have a wider range of motion, fly lower in all directions, and are adept at navigating. Drone-control technology enables users to swiftly deploy and control drones even with only a very basic understanding of technology.
E.g.: Midair Reconfigurable Quadcopter

Easy Accessibility

Drones make it simple to collect effective data from difficult-to-reach regions. It is the best substitute for overcoming the drawbacks of conventional techniques in terms of worker safety.
E.g.: Drones can be used in risky circumstances like radiation monitoring and high-voltage line inspection.

KEY APPLICATIONS AND USE CASES ACROSS SECTORS

DEFENSE

- Border Security & Surveillance
- Strikes & Combats
- Threat Assessment
- Swarm attack
- Counter drone

Use Cases

1. The Indian start-up Sagar Defense Engineering has created "Varuna," India's first people-carrying platform, a VTOL UAV without a pilot. One person can fit inside the drone at a time. It has been specially made for the Indian Navy which will be initially used for transferring materials.

2. The Archer-NG armed drone has a 300 kg armament capacity, including anti-tank guided missiles and smart anti-airfield weapons (SAAWs).

ENERGY & UTILITIES

- Monitoring & Maintenance
- Surveillance & Incidence Response
- Transmission power patrolling
- Powerplant & Transmission corridor mapping
- Pipeline and other asset monitoring
- Surveillance and incidence response
- Construction monitoring
- Assist in predictive maintenance
- Inspection of offshore platforms

Use Case

Maharashtra State Electricity Transmission Company Limited has utilized drones for EHV Line Patrolling. These drones include high-resolution cameras with normal vision, thermo-vision, and GPS capabilities. The drones, which are being used for a variety of duties including preventative maintenance, have been providing swift and precise surveys of lines and substations.

Source: Varuna – India's first people-carrying platform, Archer – NG , MSETCL - Drone Usage

KEY APPLICATIONS AND USE CASES ACROSS SECTORS

MINING

- Monitoring and Inspection
- Stockpile and Quarry Management
- Hazard Identification
- Haulage road optimization

Use Case

MCL, a subsidiary of Coal India, has implemented drone technology in coal mines for volume measurement, environmental monitoring, and photogrammetric mapping of mines to digitalize the mining process. Through the VIHANGAM portal, the technology allows for the real-time transmission of aerial footage of mining operations from mines to an online platform.

HOUSING AND URBAN AFFAIRS

- Monitoring and Inspection
- Incident reporting
- Planning/ Digital Elevation Model
- Land Mapping Surveys

Use Case

On September 30, 2022, the Supreme Court ordered the Central Government to employ drones to undertake geospatial mapping of the whole city and digitize land records to prevent encroachments and widespread residential property misuse.

Source: Vihangam, Mapping illegal constructions using drones

KEY APPLICATIONS AND USE CASES ACROSS SECTORS

AGRICULTURE

- Soil & Crop Health Scans
- Irrigation and Aerial Seeding
- Fertilizer & Pesticide Spraying
- Plant size, and crop health monitoring
- Farm output estimates
- Vegetation indices, plot statistics
- River erosion/restoration tracking
- Insurance claim surveys
- Agri data exchange for drones

FOREST & WILDLIFE CONSERVATION

- Hazardous Activity Monitoring
- Pollution-level Assessment and Source Tracking
- Anti-poaching Monitoring
- Migratory behaviors of wildlife
- Tree health monitoring
- Forest Mapping

Use Case

The Anna University-supported drone manufacturing business has created an Agrigator drone, the only certified petrol engine-based hybrid drone that doesn't need its batteries changed frequently. The drone has been developed by Dhaksha Unmanned Systems Pvt Ltd.

Use Case

The government of Madhya Pradesh's Forest Department intends to employ drones to monitor the eight wild cheetahs it obtained from Namibia at Kuno National Park.

Source: The Agrigator Drone, Drone monitoring by Forest Department

KEY APPLICATIONS AND USE CASES ACROSS SECTORS

HEALTHCARE & DISASTER MANAGEMENT

- Essential & Healthcare Items Delivery
- Sample collection from remote or epidemic/ pandemic affected areas
- Impact assessment during disasters
- Transport medicines, food, and essentials in disaster-affected areas
- Search and Rescue
- Patrolling in remote areas

INFORMATION AND BROADCASTING

- Hazardous Activity Monitoring
- Pollution-level Assessment and Source Tracking
- Anti-poaching Monitoring
- Migratory behaviors of wildlife
- Tree health monitoring
- Forest Mapping

Use Case

The Arunachal Pradesh government launched "Medicine from the Sky," a drone-based healthcare network, on August 15, 2022, from Seppa to Chayang Tajo in the East Kameng district. On the basis of the project's clear image of operational challenges, financial viability, and regulatory concerns, the government will develop a policy and act to gradually accept this developing technology.

Use Case

When the country has been blocked off to outsiders and is under lockdown, remote-controlled UAVs have permitted media organizations to film or take pictures of different parts of the lockdown and cover them.

***Source**: Medicine from the Sky, UAVs for Monitoring*

KEY APPLICATIONS AND USE CASES ACROSS SECTORS

RAILWAYS

- Surveillance and Incidence Response
- Visual Inspections and Maintenance
- Construction Monitoring
- Equipment Monitoring

Use Case

In order to monitor its assets and guarantee passenger safety, the Railways has purchased Ninja unmanned aerial drones with real-time tracking, video streaming, and automatic failsafe mode.

HIGHWAYS & WATERWAYS

- Visual Inspections
- Incident Response
- Construction monitoring
- Dynamic monitoring utilizing sensors for water quality

Use Case

1. NHAI has made the use of drones for monthly video recording of National Highway projects during all stages of development, construction, operation, and maintenance mandatory in order to increase transparency and uniformity.

2. The Ministry of Road Transport and Highways unveiled Skye UTM, a cutting-edge drone air traffic management system, with a capacity of around 4,000 planes per hour and 96,000 flights per day. It combines human aviation space with an unmanned aerial traffic control system that operates in the cloud.

Source: Ninja UAVs, NHAI makes drone surveys mandatory, Skye UTM

3 POLICY TRENDS IN INDIA SUPPORTING THE EVOLVING DRONE MARKET

CENTRAL POLICY AND REGULATORY FRAMEWORK

November 2022
Guidelines for PLI scheme for manufacturing of drone & drone components
Notified by the Ministry of Commerce and Industry

February 2022
Drone Import Policy
Notified by the Ministry of Commerce and Industry
Drone (Amendment) Rules
Issued by the Ministry of Civil Aviation

January 2022
Certification Scheme for Unmanned Aircraft Systems
Notified by the Ministry of Civil Aviation

Second Tranche of Policy and Initiatives

October 2021
National Unmanned Aircraft System Traffic Management Policy Framework
Issued by the Ministry of Civil Aviation

September 2021
Drone Airspace Map
Published by the Ministry of Civil Aviation
PLI Scheme for manufacturing of drone & drone components
Notified by the Ministry of Civil Aviation

August 2021
Drone Rules
Issued by the Ministry of Civil Aviation

January 2019
Drone Ecosystem Policy Roadmap
Issued by the Ministry of Civil Aviation

August 2018
Civil Aviation Regulations 1.0
Issued by the Ministry of Civil Aviation

First Tranche of Policy and Initiatives

October 2014
Ban on commercial use of drones
Issued by the Director General of Civil Aviation

Source: Use of Drones (PIB, MoCA, 2015), A series of reform measures undertaken to promote India's upcoming drone industry (PIB, MoCA, 2022)

DYNAMICALLY CHANGING POLICY & REGULATORY LANDSCAPE

- The Government of India aims to capture this sunrise opportunity presented by the industry and has set a vision to make India a **'global drone hub' by 2030**.

- In this context, Indian drone ecosystem has observed enactment of various policies and launching of several initiatives and schemes by the Government of India.

01 Liberalization of ecosystem

02 Encouraging uptake of applications

03 Boosting domestic manufacturing
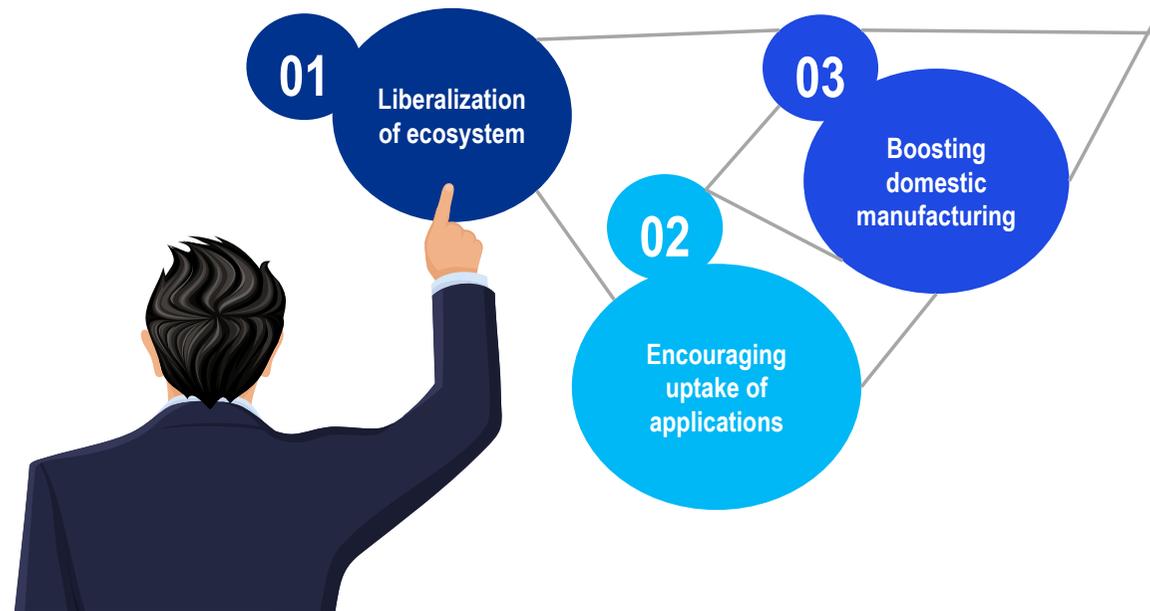
Source: Union Minister Jyotiraditya Scindia Launches NITI Aayog's Experience Studio on Drones (PIB, NITI Aayog, 2022)

LIBERALIZING DRONE ECOSYSTEM

Timeline (top to bottom):
- Drone (Amendment) Rules, 2022
- Certification Scheme for Unmanned Aircraft Systems, 2022
- Drone Rules, 2021
- Drone Ecosystem Policy Roadmap, 2019
- Civil Aviation Regulations 1.0, 2018
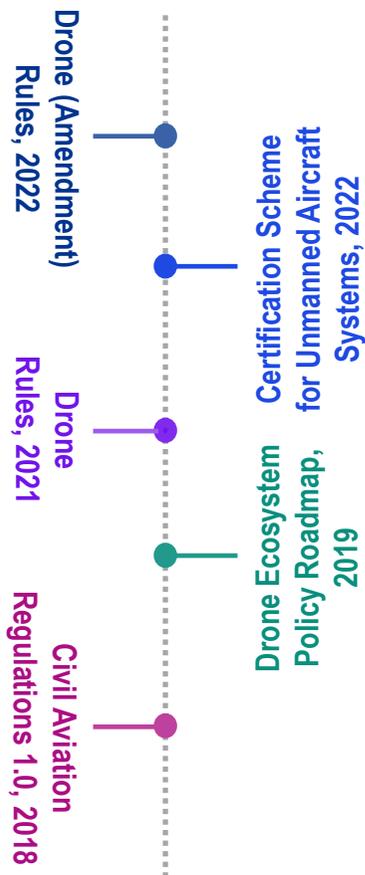
- In **August 2018**, the drone ecosystem observed a complete overhaul with notification of **Civil Aviation Regulations (CAR) 1.0**. The regulations enabled civil operations of drones of *first-of-its-kind national unmanned traffic management (UTM) platform*, i.e., **Digital Sky Platform**. The platform will facilitate **one-time registration** of the drones, pilots, and owners as well as implementing the **"no permission, no takeoff" (NPNT)** compliance of drones.

- To assist in the drafting of CAR 2.0, the MoCA released the **Drone Ecosystem Policy Roadmap (DEPR)** in **January 2019**. Some pivotal recommendations were proposed, such as setting up a **drone directorate within the DGCA** as well as developing **favorable infrastructure for beyond visual line of sight** (BVLOS) operations like unmanned aircraft system traffic management (UTM), drone corridors, and ports.

- Since **August 2021**, through the notification of **Drone Rules**, India's regulatory landscape has begun to give room to the industries to experiment and contribute meaningfully to the ecosystem. The Rules drastically changed the ecosystem by reducing the number of **permissions from 25 to 5** and types of **fees from 72 to 4**.

- The Rules further added to the growth by laying down criteria for **classification and categorization of drones**, **application and procedure** for the **type certificate, remote pilot license,** and **remote pilot training organization**, as well as the need for **insurance** and **mandatory safety features**.

- Continuous progress is being made with the notification of **Certification Scheme for Unmanned Aircraft Systems** in **January 2022** to **streamline the process and timeline** of receiving the drone type certificate with an aim to ensure a minimum airworthiness standard as well as announcement of the **Drone (Amendment) Rules** in **February 2022** to **remove the requirement of a remote pilot license**.

Refer to Annexures: CAR1.0 (2018), DEPR (2019), Drone Rules 2021

**Drone (Amendment) Rules, 2022**

National Unmanned Aircraft System Traffic Management Policy Framework, 2021

Drone Airspace Map, 2021

Drone Rules, 2021

Civil Aviation Regulations 1.0, 2018

- With the notification of **CAR 1.0 (2018)**, the **outright ban imposed was lifted** that impacted the uptake of drone applications for commercial use and, thus, provide the necessary boost to the emerging ecosystem.

- To be ready to cater to the growing market while preventing unauthorized flights and ensuring public safety, the CAR 1.0 regulations laid out the implementation of **"no permission, no takeoff" (NPNT)** compliance through the **Digital Sky Platform**. Under the compliance, any drone without a digital permit to fly will simply not be able to takeoff. The regulations also defined and **categorized the airspace** into **different zones (namely, red, yellow and green)** with different permission requirements as well as **defining "No Drone" zones**.

- The notification of **Drone Rules 2021** further added to the cause and provided the necessary regulatory framework for commercial use of drones. They have **increased the permissible payload to 500 kg** and **allowed the development of drone corridors** for cargo deliveries. The Rules have **reduced formalities** including **forms, fees, permissions, and licenses**, which were **further reduced by Drone (Amendment) Rules 2022**.

- Up to **90% of Indian airspace has been opened** for drone applications with **airspace up to 400 feet** being designated as **green zone** on the interactive **drone airspace map** published in **September 2021**. Furthermore, a **revamped Digital Sky platform was launched in January 2022**, with digitalized forms, permissions, and updated information.

- To enable complex operations of drones and increase the overall safety in the airspace, the **National UAS Traffic Management (UTM) Policy Framework**, published in **October 2021**, defined the **architecture and mechanism for traffic management** of unmanned aircraft in Very Low Level (VLL) airspace up to 1000 feet above ground level. It further laid down the **UTM stakeholders' services** as well as **guidelines for real-time identification, tracking and security**.

Refer to Annexures: CAR1.0 (2018), Drone Rules 2021, Drone Airspace Map (2021)

BOOSTING DOMESTIC MANUFACTURING

Guidelines for PLI scheme for manufacturing of drone & drone components, 2022

Drone Import Policy, 2022

Certification Scheme for Unmanned Aircraft Systems, 2022

PLI Scheme for manufacturing of drone & drone components, 2021
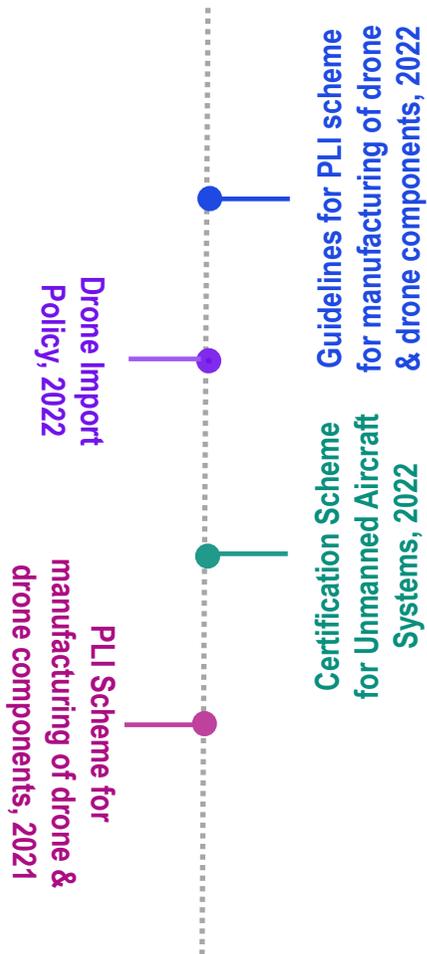
- In the last decade, the opening of the civil drone industry provides a **golden opportunity for the expansion** of the Indian drone manufacturing ecosystem and **move towards increasing the share of indigenization** in the overall supply chain.

- Follow-through of the liberalization of drone ecosystem via notification of Drone Rules 2021, the Government of India introduced the **Production Linked Incentive (PLI) Scheme for Manufacturing of Drone and Drone Components** in **September 2021**. The PLI Scheme is intended to **catalyze the growth** in the upcoming drone sector **with indigenous production**.

- The Scheme allocates **INR 120 Crores spread over a period of 3 financial years** for drone and drone component manufacturing, **nearly doubling the combined turnover of FY 2020-21** of all domestic drone manufacturers. With **exceptional treatment provided** to the drone industry, the Scheme provides a **cascading estimated incentives** on a yearly basis for **drone** and a **wide variety of its components** as well as **drone-related IT products**.

- The **Certification Scheme for Drones** along with **Drone Import Policy** introduced in the months of **January and February 2022**, respectively, aim to **support** the local ecosystem and provide the necessary **boost for domestic manufacturing**. While the Certification Scheme making it **easier to obtain type certificate** by drone manufacturers, the Drone Import Policy **restricts the import of foreign drones** but frees up the import of drone components.

- For the effective operation and smooth implementation, the operational **Guidelines for PLI Scheme** were formulated and notified in **November 2022**. The guidelines covered **qualification & eligibility**, **application & online portal** as well as **defined** the Project Management Agency (PMA), Empowered Group of Secretaries (EGoS), & Competent Authority and their **roles in the approval mechanism for the PLI calculations and disbursement**.

Refer to Annexures: PLI Scheme (2021), Guidelines for PLI Scheme (2022)

CLOSER LOOK TO MOMENTOUS PUSH IN FY 2022-23
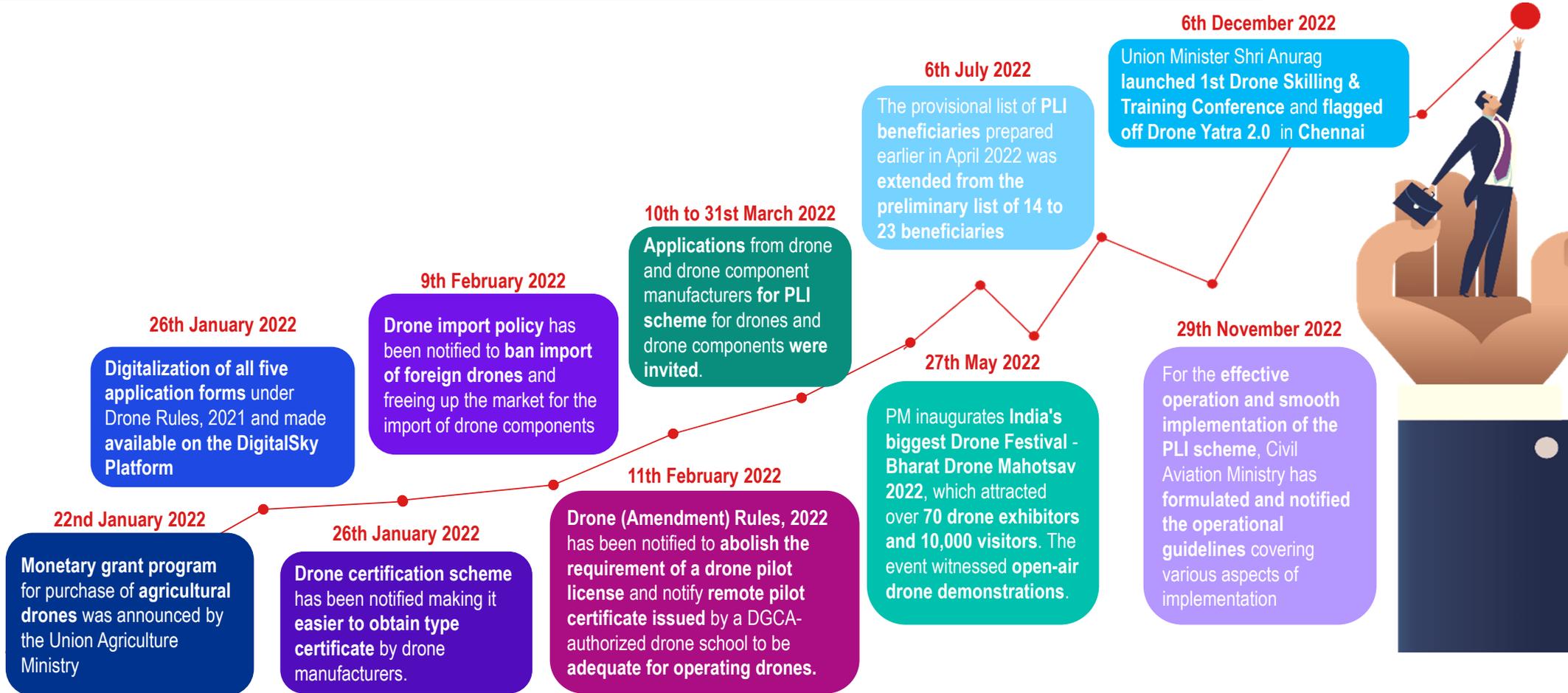
6th December 2022

Union Minister Shri Anurag **launched 1st Drone Skilling & Training Conference** and **flagged off Drone Yatra 2.0** in **Chennai**

6th July 2022

The provisional list of **PLI beneficiaries** prepared earlier in April 2022 was **extended from the preliminary list of 14 to 23 beneficiaries**

10th to 31st March 2022

Applications from drone and drone component manufacturers **for PLI scheme** for drones and drone components **were invited**.

9th February 2022

Drone import policy has been notified to **ban import of foreign drones** and freeing up the market for the import of drone components

26th January 2022

Digitalization of all five application forms under Drone Rules, 2021 and made **available on the DigitalSky Platform**

29th November 2022

For the **effective operation and smooth implementation of the PLI scheme**, Civil Aviation Ministry has **formulated and notified the operational guidelines** covering various aspects of implementation

27th May 2022

PM inaugurates **India's biggest Drone Festival - Bharat Drone Mahotsav 2022**, which attracted over **70 drone exhibitors and 10,000 visitors**. The event witnessed **open-air drone demonstrations**.

22nd January 2022

Monetary grant program for purchase of **agricultural drones** was announced by the Union Agriculture Ministry

26th January 2022

Drone certification scheme has been notified making it **easier to obtain type certificate** by drone manufacturers.

11th February 2022

Drone (Amendment) Rules, 2022 has been notified to **abolish the requirement of a drone pilot license** and notify **remote pilot certificate issued** by a DGCA-authorized drone school to be **adequate for operating drones.**

INITIATIVES BY GoI TO PROMOTE DRONE APPLICATIONS

Fight against COVID-19[1]

- Deliver COVID-19 vaccines with pilot project in Manipur, Nagaland and Andamans & Nicobar
- Surveillance of COVID-19 containment zones to ensure compliance of lockdown guidelines; demonstrated by Chandigarh Police

SVAMITVA Scheme[3]

- Provide 'Record of Rights' to village household owners possessing houses in inhabited areas
- Provide an integrated property validation solution for rural India; Survey of India to use drones for mapping of inhabited areas of villages

Surveys of Infrastructure Projects[4]

- Indian Railways (IR) introduced drones for security surveillance; Mumbai division procured 2 drones for the same
- Coal India Ltd. (CIL) introduced drones for real-time videography for surveying and mapping of mines
- NHAI made mandatory use of drones for monthly video recording of all projects during all stages and make comparative analysis videos

Strengthening Defense Sector[2]

- India's DRDO, under its Drone Program, aims to develop a domestic arsenal of drones; some of them being DRDO Lakshya, DRDO Nishant, DRDO Rustom
- Army launched 'Him Drone-a-thon' programme, along with Drone Federation of India to catalyze ecosystem

Promotion via "Drone Shakti" & Drone Melas[5]

- 2022-23 Budget outlines startups to promote and facilitate 'Drone Shakti' through varied applications and for Drone-As-A-Service (DrAAS)
- PM inaugurated India's biggest drone festival, i.e., Bharat Drone Mahotsav 2022

Kisan Drones and Sub-Mission on Agricultural Mechanization[6]

- PM Launched Kisan Drones at 100 places across the country
- SOPs to provide instructions for effective & safe drone operations for pesticide and nutrient application
- Monetary grant to facilitate "kisan drones" in agriculture sector with funds for disbursement amounting to INR 52.5 crores to ICAR and INR 70.88 Crores to state governments

Source: 1: India deploys drones to deliver COVID-19 vaccines, Drone Based Surveillance System; 2: The growing market for drone technologies in India, Indian Army Launches 'Him Drone-a-thon'; 3: SVAMITVA Scheme; 4: Indian Railways introduces Drone based surveillance system for Railway Security, Innovative RPAS Inaugurated at MCL of Coal India Ltd, NHAI Makes Drone Survey Mandatory for All National Highways Projects; 5: Summary of Union Budget 2022-23, PM inaugurates India's biggest Drone Festival - Bharat Drone Mahotsav 2022; 6: Kisan Drones, Use of Drones in Agriculture Sector

STATE POLICY AND REGULATORY FRAMEWORK
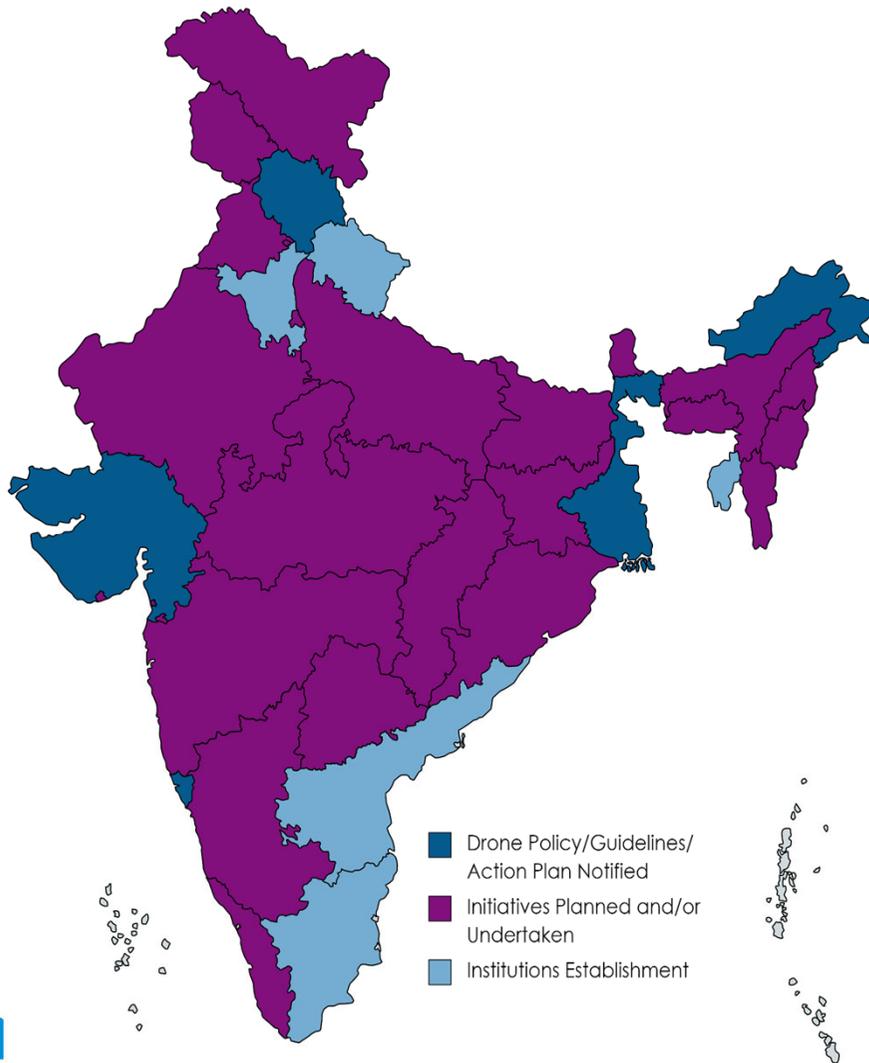
Drone Policy/ Guidelines/ Action Plan Notified

- Govt. of **Himachal Pradesh, Gujarat, Goa** and **West Bengal** notified **Drone Policy/ Guidelines** for their respective states in 2022

- Govt. of **Arunachal Pradesh** formulated Arunachal Pradesh **Drone Framework and Action Plan Roadmap** in 2022

Institutions Establishment

- Various states have **constituted dedicated institutions for the promotion and adoption of drone applications** within the state. These include **Andhra Pradesh, Haryana, Tamil Nadu, Uttarakhand, Tripura**.

- Apart from these institutions, IITs present across states have **dedicated research center and/or incubation centers** working to **support the startups** in the ecosystem.

Initiatives Planned and/ or Undertaken

- While majority of the states do not have any specific policy in place, the state governments have been working towards **implementing various initiatives/ projects** showcasing drone applications.
- Among the sectors, **agriculture and healthcare** have witnessed the **maximum number of use cases** with some applications in other sectors including **city surveillance, defense and security, land mapping, forest management, power sector** as well as **drone-based monitoring, surveillance and delivery**. Some states have also been **actively working on the skill development** aspects to promote drone adoption.

Legend:
- Drone Policy/Guidelines/ Action Plan Notified
- Initiatives Planned and/or Undertaken
- Institutions Establishment

Refer to Annexures: Policy and Regulations by States, Initiative Undertaken by States, Institutions Established by States

4 INDUSTRY TRENDS AND VALUE CHAIN ASSESSMENT

DRONE VALUE-CHAIN IN INDIA

Aircraft Hardware		Operations			Services	
Components	**OEMs**	**Physical Infrastructure**	**Navigation/ Traffic**	**Operators**	**Support Services**	**Data Management**
Components and subcomponents used on drones • Batteries • Payloads • Sensors • Motors	Assembler or manufacturer of drone • Consumer • Commercial	Physical infrastructure for drone takeoff, landing, and recharging • Landing pads • Stations • Vertiports • Chargers	Systems designed to navigate airspace • Artificial intelligence • Route planning • GPS devices	Professional Service providers of drone • Photography • Mapping • Inspections	Services supporting the drone ecosystem • Pilot marketplace • Repair services • Consulting • Training • Testing infrastructure	Software and analytics to digitize the information collected by drone • Data processing • Image processing software

Select Indian Players

DRONE COMPONENTS ARE MOSTLY IMPORTED

Most sensitive purchases and use cases related to drone components are still being imported by the government and commercial agencies in India.

Import* (%)

Component	Import* (%)
Airframe	25% (China, EU)
Sensor Payloads – DSLR, LIDAR, Thermal, Zoom Lens	75% (China, Taiwan, US, Japan, Israel)
GCS & Communication Device	50% (China, US, EU, Philippines)
Power Plants/ Battery/ Engine	75% (China, Taiwan, US, EU, Israel, Australia)
Servos	75% (China, Taiwan, US)
Electronic Speed Controls	75% (China, Taiwan, US, EU)
Propellers	75% (China, Taiwan, US, EU)

Select shortlisted companies by Government of India under PLI incentives scheme for drone components

- Absolute Composites (Airframe)
- Adani-Elbit Advanced Systems India (Assembly)
- Adroitec Information Systems (Data Management)
- Alpha Design Technologies (Assembly and Communication)
- Dynamake Engineering (Design)
- Imaginarium Rapid (Design)
- SASMOS HET Technologies (CS : Control System)
- Servocontrols Aerospace India (Servos)
- Valdel Advanced Technologies (CS)
- ZMotion Autonomous Systems (CS)
- Zuppa Geo Navigation Technologies (Navigation)

*Source: *FICCI Report*

FOUR KEY COMPONENTS CONTRIBUTES TO 75% OF TOTAL COST

Motors — 25
Camera payloads — 20

Top 2, motors & camera alone contribute to **approximately 45% of the total manufacturing cost**

Communication module — 15
Batteries — 15

Top 4, which also includes communication module & batteries comprise a total **~75% of total manufacturing cost**

Propellers — 10
Navigation — 10
Airframe — 5
Total — 100
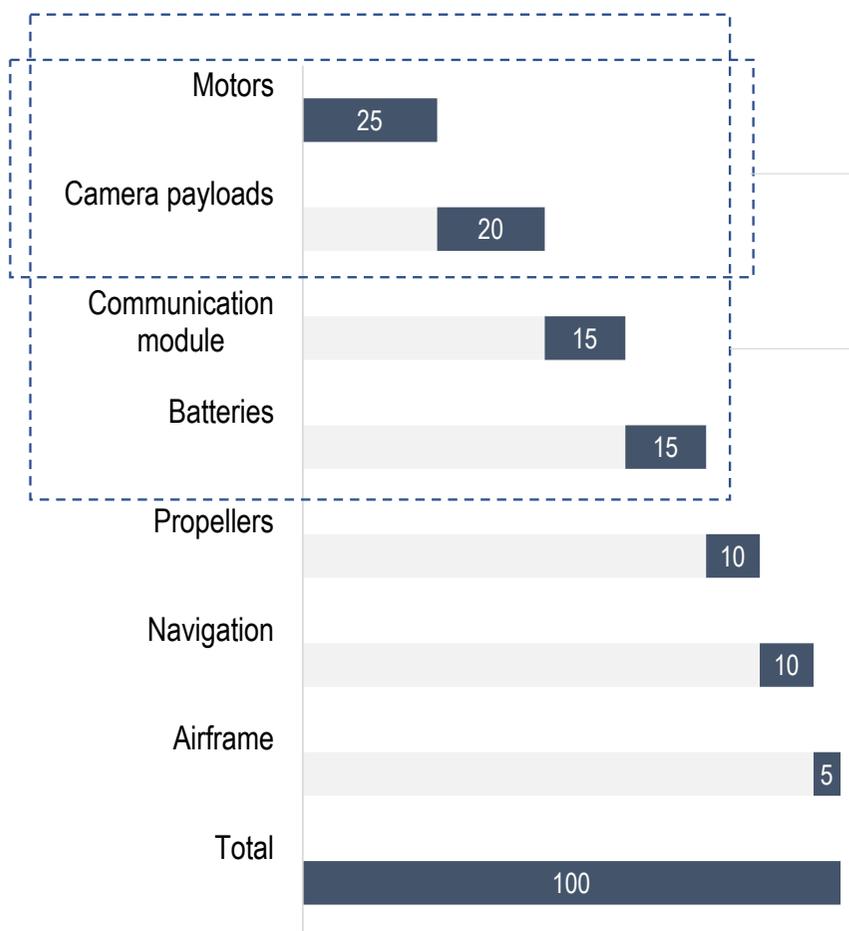
Component cost in percentages

- ✓ More than **50% of the top 4 components are imported** and not manufactured locally in India
- ✓ These parts are imported mainly from China. The Indian government aims to make India a drone manufacturing hub by 2030
- ✓ China poses a stiff competition to drone manufacturers of India because of the price point advantage combined with limited demand in India (growing eventually). These factors combined makes reaching economies of scale in manufacturing a difficult task

❖ Equipment cost which can be broadly classified as manufacturing, is only **~20% of the overall cost in application of drones**

❖ The most significant **cost is that for data management which accounts for more than 60% share of the overall cost**

❖ **55% of the global investment** in the drone sector is made **towards manufacturing side** of the business, while it is evident that the data management is the most expensive and may require more focus pertaining to efficiency improvement

❖ **The service side of the drone application roughly constitute ~75% of the overall cost** and is far more commercially significant than providing the equipment. In future, digitization & diverse application may lead to further increase in costs related to data management

Drone equipment 12%

Battery 8%

Maintenance 3%

Manpower 6%

Logistic 6%

Data management 65%
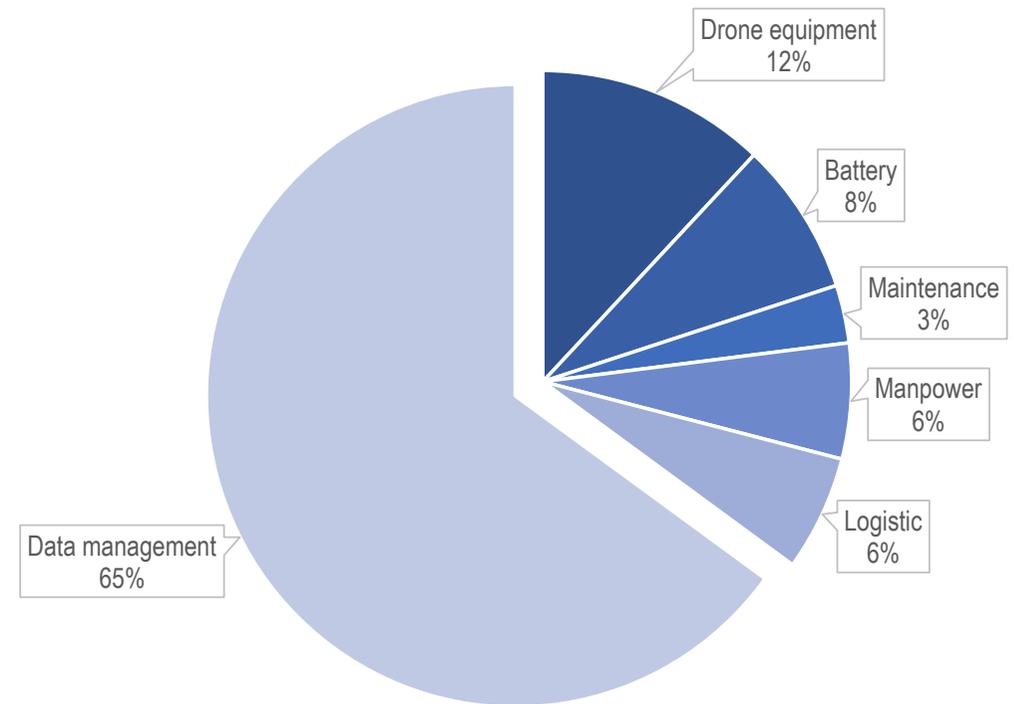
High level approximate cost break up in % across the value chain
(cost data is generic, may vary for different use cases)

MOST OF THE DRONE PLAYERS IN INDIA FOCUS ON MANUFACTURING OR SERVICES, ONLY A FEW PLAYERS OFFER INDIGENOUS DATA MANAGEMENT SERVICES

Some key players and their presence in the Indian market *(Source: Secondary Research)*

S.No.	Name of the company	Manufacturing / assembling	Support services	Data management
1	Iotechworld	✓	✗	✗
2	General Aeronautics	✓	✗	✓
3	Droneacharya	✗	✓	✓
4	Drone Destination	✓	✓	✓
5	ideaForge	✓	✓	✓
6	TROPOGO	✗	✓	✗
7	ZUPPA	✓	✗	✗
8	Datasol Innovative labs	✗	✓	✗
9	Marut Drones	✗	✓	✗
10	Dhaksha Unmanned System	✓	✗	✗
11	Aarav Unmanned system	✓	✓	✗
12	AOTOM technology	✗	✗	✓
13	BharatRohan	✗	✓	✓
14	UrbanMatrix	✓	✗	✓
15	Vecros	✓	✗	✓
16	Garuda Aerospace	✓	✗	✗
17	Optimized Electrotech	✗	✓	✓
18	Skylark Drones	✗	✓	✗
19	TechEagle Innovations	✓	✗	✗
20	Paras Aerospace	✓	✓	✗

FRAMEWORK FOR INFRASTRUCTURE ASSESSMENT FOR VERTICAL TAKE-OFF AND LANDING (VTOL)

The assessment would evaluate the power supply, charging rates and the number of charging stations required to suffice the current and future requirement.

eVTOLs require advanced communication systems to ensure safety and reliable operations. The assessment would evaluate the existing communications infrastructure and identify the upgrades required

Regulations plays and important role in development of any new technology and hence the assessment would evaluate the existing framework and identify the changes required to safe and efficient operations

01
Landing and take-off sites

02
Charging infrastructure

03
Airspace management

04
Communication infrastructure

05
Maintenance infrastructure

06
Regulatory framework
.

eVTOLs require dedicated landing and take-off sites. The assessment would identify suitable locations and evaluate the feasibility in terms of safety, access and environmental impact

Since eVTOLs operate in low altitude airspace which requires new air space management. The assessment would evaluate the current airspace management and the identify the changes required

Specialised maintenance facilities are required because of the difference in technology from regular aircraft. The assessment would evaluate the current state and future requirement to satisfy the increasing demand

Source: Our Analysis

Challenges for VTOLs in India

01

Constrained airspace

Majority of airspace is already taken up by commercial and business aircrafts. Current air traffic control not handle robust operations of VTOLs. Drones & VTOLs fly in low altitude areas in dense buildings making it further difficult to ensure safe air navigation

02

Utilization & load factors

Commercial aircraft business model is successful if it operates in cost efficient manner because of optimum utilization with load factors of their aircrafts, which remains a challenge in the case with VTOLs in the near future.

03

Landing sites & charging stations

Only developing the aircraft wont solve the problem, having proper landing spaces is an area where companies are focussing on too. Pre-existing heliports would have to undergo transition to vertiports which would have charging stations too.

04

Willingness to pay

In the initial period the price per trip is likely to remain higher than other modes of transport, the mass adoption in India is only possible with affordable per trip fare

Source: Our Analysis

DESPITE CHALLENGES, SEVERAL PLAYERS IN INDIA HAVE MANAGED TO DEVELOP SOME PROTOTYPES (VTOL)

Use Case

The Indian start-up Sagar Defense Engineering has created **"Varuna,"** the India's first people-carrying platform that is a drone without a pilot which can be classified as a VTOL. One person can fit inside the drone at a time. It has been specially made for the Indian Navy which will be initially used for transferring materials. Varuna can be operated remotely and on predefined paths

Range – 25 km: Payload – 130 Kg; Endurance – 25 – 33 min

Use Case

Abhiyaan _ENM800 is a VTOL two-seater air taxi version with all electric and hybrid propulsion system. This can be attached with additional payloads for services such as paramedics, rescue mission, disaster management and cargo drop etc.

Cruise speed – 50 m/s: Operational altitude – 2000 m : Endurance – 3.3 hours for hybrid and 1 hour for electric

Use Case

ideaForge has developed **Netra V4** as a lightweight UAV that uses quadcopters to provide lift and control giving it a VTOL capabilities.

Range – 4-5 km: Maximum operational altitude – 400M ; Endurance – 40-60 min

Source: Secondary Research

DATA MANAGEMENT SERVICES FOCUS ON 5 MAJOR COMPONENTS

Drone Based Image Capturing

Data Transmission

Base Station

Survey Area

Data analysis, data visualization, data storage and management forms the core of data management services which **accounts for 65% of drone operating cost**. Inspite of this, the software and technology in terms of platforms are not readily available which increases our dependency on foreign service providers .

Data Analysis

Data Visualization

Data Storage and Management

Data Centers

Data Optimization

Reporting

DESPITE OF INDIA HAVING BEST OF IT CAPABILITIES, NUMBER OF SERVICE PROVIDERS OPERATING IN THIS SEGMENT IS VERY LOW

Lack of Specialized Technology

- Drone data management service ecosystem in India is still in nascent stage and there is shortage of specialized technology solutions.
- Lack of funding and limited R&D are the root cause of this challenge. The same has been expressed by the stakeholders.

Infrastructure challenges

- Air traffic management systems and reliable communication networks are still being setup which poses as a challenge.
- Data centres with large capacity are required to store the huge amount of data that would be transmitting from the drone

Limited market size for now with an expected large growth in future

- Limited operators owing to limited adoption of drone ecosystem in India owing to the limited current market size

Gap in required and available skill

- Data management in drone requires range of skills and this being a developing industry, the number of people available for such roles are very few. Companies must invest in training and development of required skills in their employees.

DRONE TESTING ENTAILS DEVELOPMENT OF SPECIFIC GREENFIELD FACILITIES

01

Avionics testing facility

Avionics testing facility should be able to but not limited to following:

- Auto Pilot and Flight Control System
- Ground Control Systems
- Power Plant
- Electrical Power Subsystems
- Command and Control Link
- Performance of Payloads

02

Indoor testing room

Indoor testing facility should be able to but not limited to the following:

- Wind Tunnel Testing of Aerodynamic Structures
- Fatigue Evaluation
- Dynamic and Endurance Testing of Rotors, Drives & Controls
- Testing of Batteries
- Simulation Testing

03

Outdoor flight-testing zone

For ensuring air worthiness of drones, it should be tested under real operational scenarios and hence outdoor testing facility should have the following to undertake the testing :

- Airstrip
- Telemetry test equipment
- Drone monitoring centre
- Hangars
- Fire Stations

04

Safety & compliance related issue

Integrated testing facility should enable the following testing:

- Environmental Testing: Testing the mechanical stress in different climatic conditions
- Mechanical Safety Testing: Testing against mechanical failures of components / equipment
- Wireless Testing: Testing for compliance with the statutory codes and regulations
- Electrical Safety Testing: Testing of electrical systems and the capability to function satisfactorily in its electromagnetic environment

Source: *Secondary Research*

DRONE TESTING FACILITY IN INDIA

1

Prominent Drone Testing Sites in India

✓ Marut Drone Testing Site, Chitradurga – Outdoor testing and evaluation facility setup specially for unmanned drones.

✓ Challakere Drone Testing Site – Dedicated airspace for drone operations along with testing facility and a control room.

✓ Aeronautical Test range by DRDO, Bengaluru – Integrated test center for DRDO's cluster of aeronautical laboratories

✓ Hindustan Aeronautics Limited Drone testing site, Bengaluru – Dedicated testing sites for Military drones

2

Challenges faced by Drone Testing Sites in India

✓ Limited funding from the government and private investment

✓ Infrastructure supporting the drone testing sites are not available at all sites

✓ Lack of specialized skill required to build and operate a drone testing site

Current Infrastructure available at Drone testing sites in India

✓ Research and Development Facilities

✓ Wind tunnel and flight range for testing

✓ Access to high-speed network and connectivity

✓ Dedicated testing facility for military drones

✓ Dedicated Airspace for testing

Source: Secondary Research

MEANWHILE, INFRASTRUCTURE OF DRONE TESTING SITES HAVE EVOLVED IN OTHER DEVELOPED REGIONS SUCH AS USA AND CHINA

Indoor and outdoor testing areas - Testing sites in USA have dedicated indoor and outdoor testing area and even dedicated air corridors

Data analytics systems - USA has focused on test range infrastructure, data collection and analysis as foundation of integrated testing environment; Access to advanced data analytics helps researchers and developers to analyze performance, test and refine new applications

Partnership with universities and industries - UAV test sites in USA often partner with leading institutions and industries for operations which comes with development and access to new and improved technologies

Research and development facilities - Testing sites in USA have dedicated R&D sites to aid the development of drone technologies; Research and operational data is provided to assist the development of procedures, standards and regulations to facilitate UAV civil operations

Runway and airspace access - In USA, large drones have access to runway and airspace for testing purposes ,in fact they can even access the hangars

Artificial intelligence systems - Access to high level artificial intelligent systems helps in development and testing of intelligent drone applications such as object identification, autonomous flight and intelligent navigation

Indoor testing areas - Testing sites in China have specialized indoor testing areas which supports in development of indoor navigation and obstacle avoidance application; Facilities include simulated environments with obstacle courses and mock buildings

High-speed network - Testing sites in China have access to high-speed network which aids them in real time data processing and analysis. This plays an important role in autonomous flight and intelligent logistics

Access to 5G connectivity - Few applications like drone's swarms and drone to drone communication requires high speed communication and connectivity; Selected sites have access to 5G connectivity which enables testing for applications mentioned above

Charging stations - Sites haves dedicated charging stations for drones which helps in prolonged testing for applications likes long distance surveying and package delivery

1

How Indian government is promoting drone testing of drones specific to defense through Defense Testing Infrastructure Scheme (DTIS)

✓ **DTIS was launched by Ministry of Defense** to boost the domestic defense and aerospace manufacturing

✓ The scheme has a **runtime of 5 years with 400 crores outlay** and a target to **set 6-8 Greenfield Defense testing infrastructure**

✓ Projects under the scheme would be prov**ided 75% government funding in the name of Grant-in-Aid** and the rest **25% will be borne by Special purpose vehicle constituents**

✓ In this regards, government has identified certain places for setting up Greenfield testing site and EOI has been published in the same regards

2

Identified sites for testing / demonstration of UAS

Phagwara
Sakkanpur
Sultanpur
Lucknow
Daparijo Airfield
Sivasagar
Sonapur
Surendranagar
Surendranagar
Shirpur Airport
Amravati
Aurangabad
Ahmednagar
Hyderabad
Chitradurga
Coorg
Vellore
Salem
Erode
Munnar
Idukki
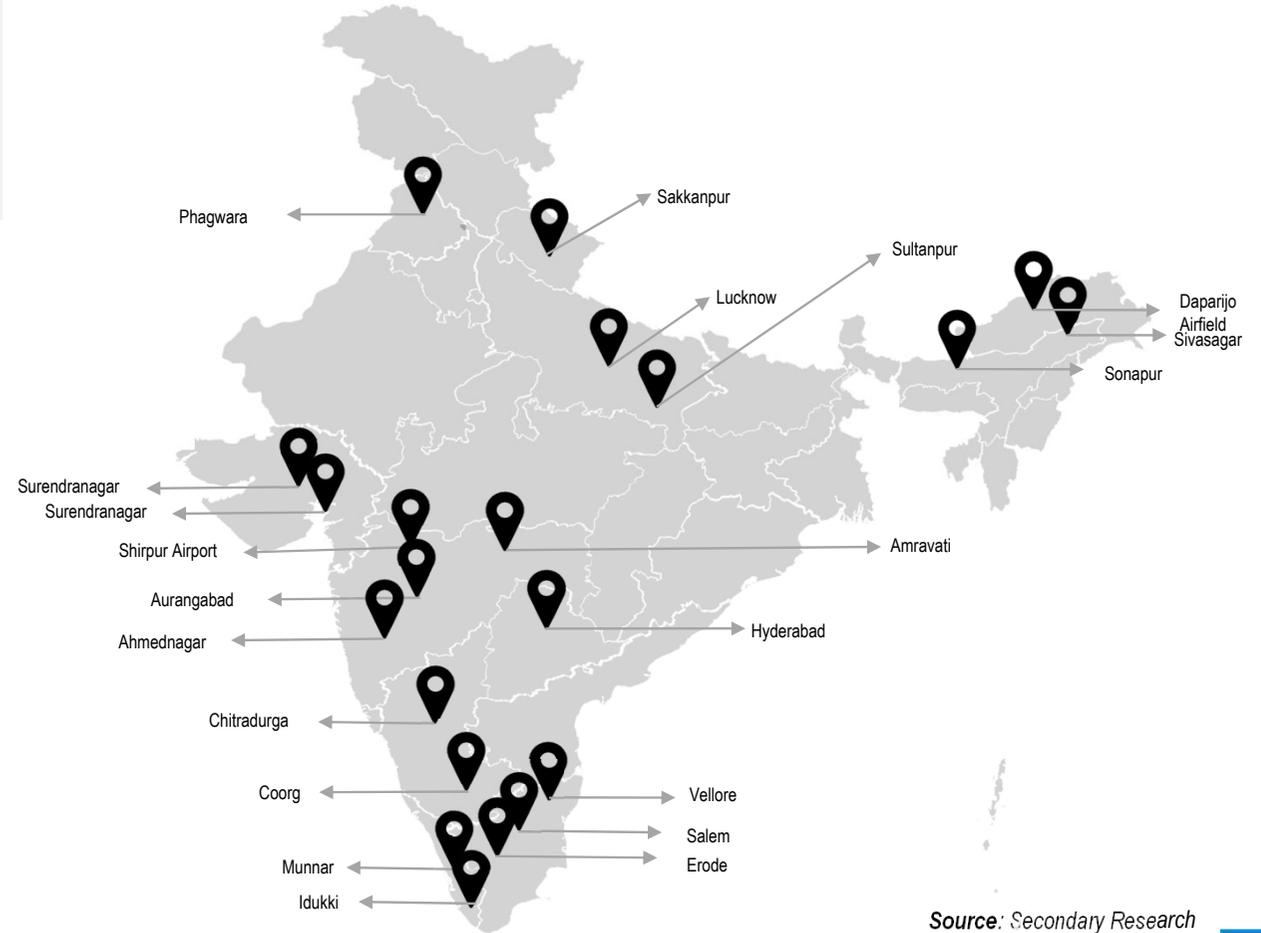
Source: Secondary Research

5 PESTLE ANALYSIS ON THE DRONE ECOSYSTEM IN INDIA

POLITICAL ASPECTS

Government Policies

- The push and support provided by central government with the notification of various rules and regulations as well as incentives for boosting supply and demand as being appreciated well by the stakeholders within the ecosystem.

Taxation

- At present, GST is being levied by the government on the purchase of drones. However, majority of the stakeholders including manufacturers and end-use consumers suggested to pause the present taxation structure till the time a sufficient demand has been built within the space through large-scale demonstrations and declining costs.

Industry Regulations

- The government has incentivized supply and demand with the introduction of PLI scheme for manufacturing and schemes such as Sub-Mission on Agricultural Mechanization intended to boost the demand, especially on the agriculture sector. However, the need for synchronization among the center and states as well as timely disbursement of incentives has been stressed upon by the manufacturers to ensure effective implementation of schemes.
- To provide necessary boost to start-ups within the ecosystem, majority of stakeholders have highlighted need for relaxation in qualifying criteria for government tenders to allow participation from start-ups, thus, providing a platform to showcase their capabilities and build a portfolio of hands-on project experience.
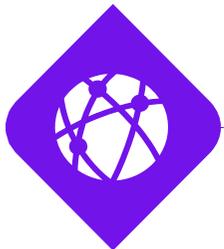
Global Trade Agreements and Restrictions

- India aims to become a global drone hub by 2030 by on ensuring indigenization of the drone supply chain. This has been supported by initiatives such as PLI scheme as well as the ban on the import of foreign drones. Indian government is looking into liberalizing policy for the export of drones in the near future.
- Indian government is also looking into certain global trade agreements; one such example being Project Agreement signed between Ministry of Defense & US Department of Defense under Defense Technology & Trade Initiative focused on collaborations in design, development, demonstration, testing and evaluation of systems.

ECONOMIC ASPECTS

Market Demand and Growth Potential
- Indian drone market value is expected to grow at rate of ~58% from 2020 levels to reach 2.95 lakh crores by 2030. Along with drones the market for support service is also expected to grow.

Foreign Investment and Exchange Rates
- To cater the growing demand and technological needs, the Indian drone industry is heavily dependent on foreign investment and stable exchange rates. With recent currency swap deal between India and Japan, countries wouldn't require dollars to trade between themselves and this would help bring stability in exchange rates

Labor Cost and Availability
- Biggest advantage that India as a country has been the availability of labor in abundance which solves the problem of availability and brings in cost effectiveness too

Globalization
- Availability of cheap and skilled labor, favorable government policies , stable economic growth and the high expected growth rate makes India for a favorable county for spread of technology, goods and products, information and even investments

Pricing competition
- Imposition of GST on the drones which takes the prices on the higher side making it a price sensitive market
- Government has launched schemes to aid the manufacturing of drones but there is lack of synchroneity between finalized and actual disbursement of fund , funds which can be used to decrease the price and boost the demand
- Government is providing funds for manufacturers and on the other hand GST is being imposed which ultimately brings the prices on more or less the same levels and this has been emphasized by the stakeholders

SOCIAL ASPECTS

Sector Experience and Language of Training and Capacity Building

- Training and capacity building of end-use consumers is very crucial in the journey of drone adoption across its various application areas. For the same, having pre-requisite sector experience as well as availability of training in local language are essential to ensure effective training and capacity building. The need for multi-lingual information and training material is underlined, especially across agriculture sector, by the stakeholders at various levels as the language requirements for the end-use consumer varies drastically among regions and states.

Building Expertise: Knowledge Sharing and Stewardship

- As the demand for drones is expected to increase in the future, present end-use consumers are expected to play a crucial part in the journey. The knowledge gained can help in boosting demand within the respective sector through targeted knowledge sharing and stewardship programmes, thus, building the required expertise.
- At present, there are 40 drone schools have produced over 2500 certified drone pilots. The Ministry of Civil Aviation is working towards increasing the number of schools to 100 and number of certified pilots to 10,000.
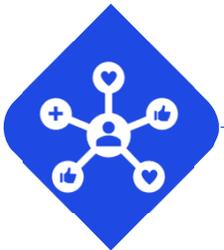
Building Demand: Demonstration and Outreach

- Demonstrations and outreach are expected to be the building blocks to build demand for drone applications. They are expected to led the 'wildfire' revolution by demonstrating the use-case for the technology across different application areas. Sector and region-specific demonstration programmes can help in building the required demand.

TECHNOLOGICAL ASPECTS

Innovation and Advancements
- Indian drone industry is seeing technological advancements which is making it more attractive market. R&D in the field of edge and fog computing, development of autonomous and hybrid drones and drones which can run on alternative fuel sources are few examples of technological advancement
- As per the stakeholders robust manufacturing which increase the quality of products and brings down the cost of drones is missing in India but this can be improved through collaboration

Increased use of Artificial Intelligence and Machine Learning
- Use of AI & ML have become an integral part of drone ecosystem these days making them more autonomous and enhance their capabilities in areas like object detection, tracking and collision prevention

Cyber Security
- Cyber security is going to be an issue with increasing number of drones in sky. Companies are focusing on increasing the security by updating the drone's firmware, use of VPN and ensuring the drones are equipped with Return to Home(RTH) for enhanced safety
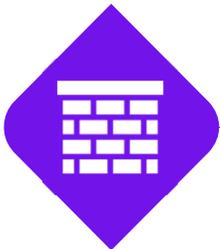
Infrastructure
- Dedicated centers for research and development of drone technologies have been operational in India where the prime focus is on to develop new technologies to enhance the drone ecosystem in India and to cater the growing demand.
- Institutes like Indian Institute of technology Delhi, Kanpur, Guwahati have done incubation hubs dedicated to research and development.

LEGAL ASPECTS

Lack of Type Certified Drones

- At present, there are only 11 type certified drones present in the market. This number is reported to grow in the coming years as Ministry is targeting to provide type certification to 20 more drone manufacturers with the next year.
- However, many manufacturers have highlighted that there is deployment of non-type certified drones due to limited type certified drones available in the market and lack of strict compliance for deployment of type certified drones. The lack of legitimate players ensuring quality of the products deployed may influence future demand negatively.
- Additionally, certifications are only present for drones for use within visual line of sight (VLOS). The need for certifications for drones for use beyond visual line of sight (BVLOS).

Illegal Operations and Malpractices

- Most of the manufacturers have highlighted that there are certain illegal operations and malpractices taking place across the drone application space, especially in the agriculture sector, which would create a negative impression of the new technology and, thus, impact the future demand.

Passport Requirement Hindering Drone Adoption

- Presently, passport is mandatory to obtain drone pilot certificate. However, it is a challenge for many end-use consumers, especially farmers, as they don't have a passport and hesitate in applying for the same as they are reluctant to contact the police for their clearance as is required for a passport.
- The stakeholders have raised these concerns about the same at multiple levels while requesting a change in the pre-requisite requirement.

ENVIRONMENTAL ASPECTS

Shift to Alternative Fuel Sources
- Drones that operates on fossil fuel adds on the pollution which is increasing on an alarming rate which has led to increase in demand for drones which can operate on alternate fuel sources like hydrogen powered fuel cells, solar powered drones. Research is ongoing and there are developments in this field .

Environmental Restrictions
- Government of India has few regulations in place to keep a check usage of drones to protect the environment and prevent pollution
- The Civil Aviation Requirements for drones in India specifies maximum permissible noise level and maximum flying altitude for drones

Procurement
- Procurement of drones and related components have a significant environmental impact. Companies these days focusses more on using of recyclable material for manufacturing parts of drones without compromising on the quality
- Government has introduced Sustainable Public Procurement which promotes use of eco friendly products, reduce waste and carbon emissions

End-of-life Management
- With growing demand for drone applications, there is a potential for huge amount of electronic waste that will be generated in the due process, from faulty machines to the machines that have served their life. This raises the questions for sustainability and end-of-life waste management. As the growing market is at a nascent stage, there is a huge uphill task which shall require collaborations and support from research and development to capture the potential offered by end-of-life management for the drone industry.

PESTLE ANALYSIS

Knowledge sharing and stewardship as well as **demonstrations and outreach** are the **building blocks** for the growing ecosystem by developing channels for ensuring demand and expertise within the market. Additionally, **knowledge of the application area/ sector and availability of multi-lingual information** can help build the local demand.

Being a nascent stage, there is huge potential for **innovation and advancement** in technology for the **development of new technology** as well as **commercialization** of the newly developed technologies. **Integration of technological advancements** such as **AI & ML with the drone** to enhance drone application along with building the **necessary infrastructure for deployment** and **ensuring cyber security** are other potential areas of collaboration among stakeholders.

There is a huge potential for drone industry within India as has been forecasted by various studies. However, as **majority of the technology is imported**, Indian drone market is dependent on **foreign investment & stable exchange rates**.

It is important to ensure **strict compliance** on the various aspects including **type certification** to ensure a **stop on illegal operations and malpractices of drones**, which may **negatively influence** the perspective of end-use consumers and, thus, future demand.

While **incentives are provided** by government to boost demand and supply, **levying of GST** on the other hand has led to **price sensitivity of products** within the market.

Social

Technological

Economic

Legal

Removal of pre-requisite requirement of passport to avail drone pilot certification can help in building local demand as consumers are reluctant to apply for the same as it **requires obtaining clearance from police**.

The **push and support provided** by the government with the notification of various rules and regulations and **liberalization of ecosystem** has been **appreciated** by the stakeholders.

Political

Environmental

Shift to alternate fuel sources as well as **ensuring end-of-life management** are some of the key questions on the environmental aspect of drone use requiring solutions.
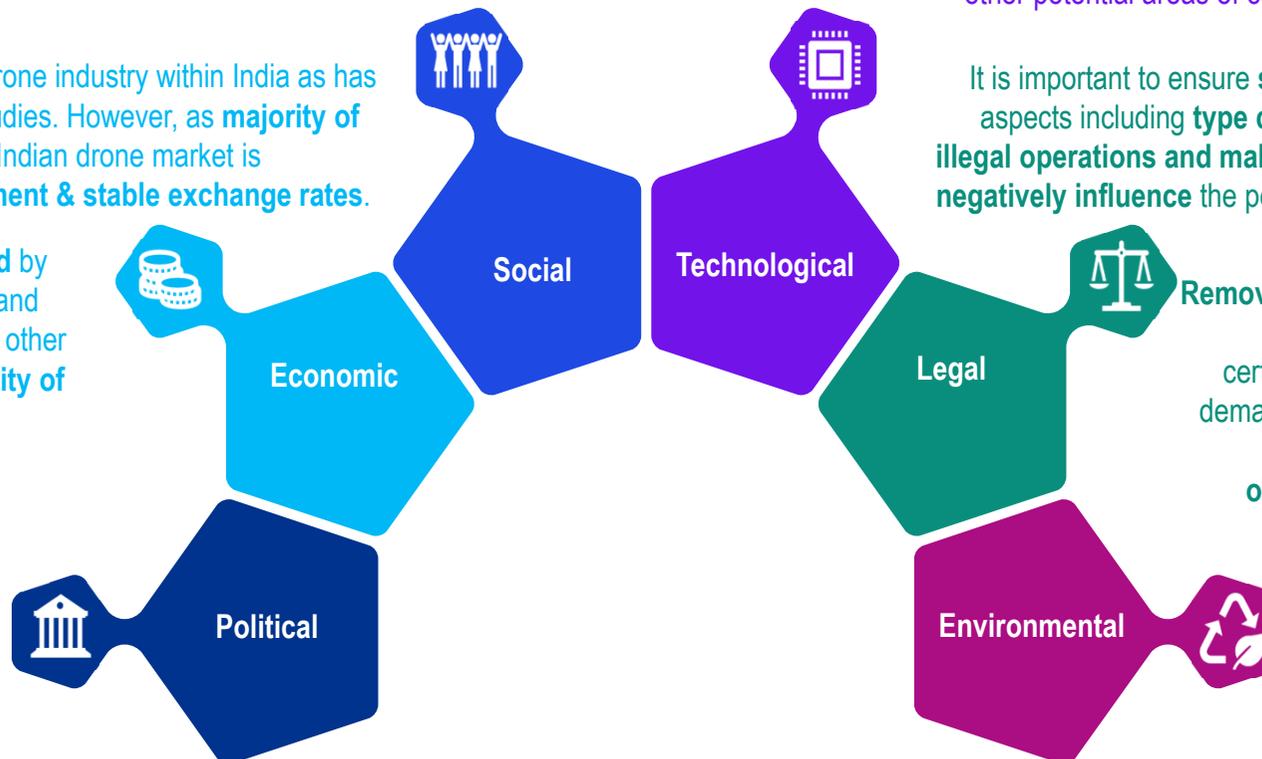
6   CONCLUSION

INDIA AND JAPAN JOINING HANDS

PRESENT INDIAN MARKET

- The Indian market offers **huge potential** for the **deployment of drones in the airspace** across different application areas. **Policy and regulatory push** offered by the Government has **provided the necessary support** to the new players entering the ecosystem.

- Although majority of the components for drones are imported, there is a **growing market for domestic manufacturing** of these components and **overall indigenization of the supply chain**, wherein at present challenges included **ensuring quality and cost-effectiveness** of the products.

- The massive deployment of drones in the future would lead to **increase in testing requirements** as well as **amount of data being captured**, thus, underlining **need for testing centers** as well as **data centers for managing and processing the data**.

INDIA-JAPAN JOINING HANDS

- **Japan has undoubtedly become a leader in innovation and technology**. Japan's progress in the fields of automation, robotics, and artificial intelligence is likely to continue to thrive for the better.

- Taking advantage of **the relevant technological capabilities and knowledge**, **synergies for technology transfer and capacity building must be explored** for supporting India's vision of **indigenization of drone supply chain** and, thus, becoming a global drone hub by 2030.

- Support in **component-level hardware manufacturing and R&D** as well as **establishment of testing and data centers** within India would provide **huge untapped potential for growth**.

- **Drone adoption and mobilization of investments**, especially **at corporate level**, would help in **commercialization** and, thus, **building the demand**.

India-Japan Collaboration Areas

## Drone Hardware Manufacturing and Designing Capabilities

- Support in **component-level hardware manufacturing**, especially for **flight controllers, chip components, motors, propellers, radio links** within India as well as support in **developing designing capabilities** will not only help in catering domestic demand but also opening-up the market for export. **Manpower support from India** and **technology transfer from Japan** would help in providing the necessary support on the supply-side of the value chain.

Drone Testing and Data Management Centers

- To **cater to multi-fold increase in demand for drones** within the Indian market, the **demand for testing centers is expected to increase** to **support research** and integration of new technologies as well as **ensure compliance of drone manufacturing with standards** outlined by guidelines and regulations.

- The multi-fold increase in demand for drones is also expected to induce an **exponential increase in amount of data being captured** and, thus, leading to a **demand for data management centers** to **manage and process** the huge chunks of **data captured**.

Research and Development of Drone and Drone-Related Technologies

- The **Japanese companies as well as research institutions do have the relevant technological capabilities and knowledge** on the technological advancements within the drone industry. While Indian technical institutions, including **IITs, have been working to support the research and development** in the drone ecosystem, stakeholders have expressed the **need for technology transfer and capacity building** in a bid to **support R&D within the drone ecosystem**.
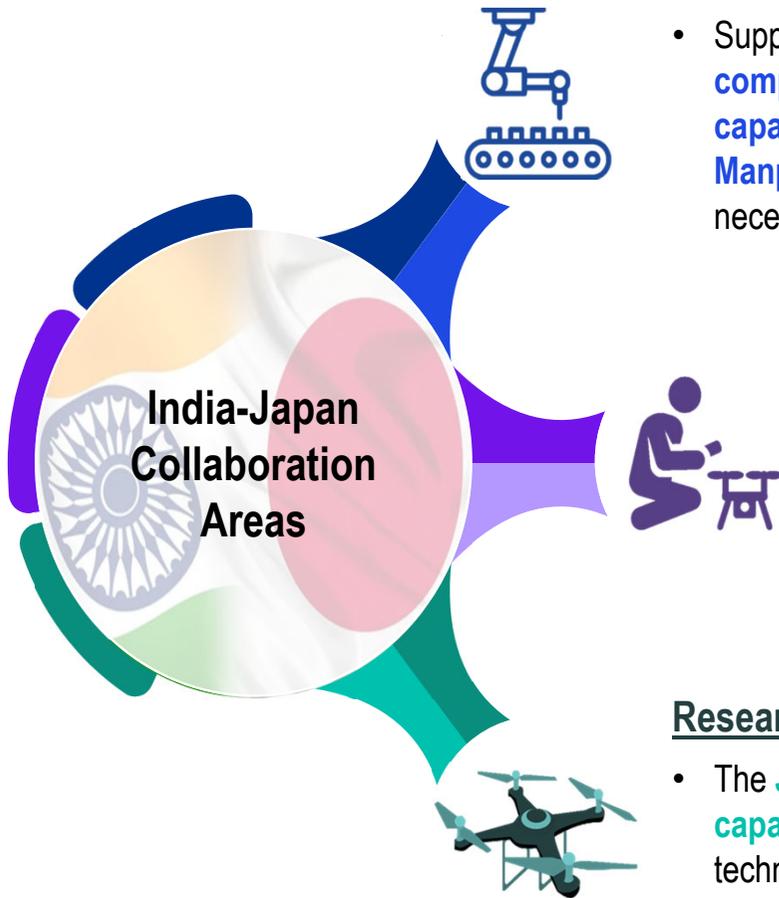
WAY FORWARD FOR INDIA-JAPAN COLLABORATIONS

Targeted Stakeholder Consultations

- Targeted stakeholder consultations will assist in assessing the present gaps and future opportunities within the drone value chain
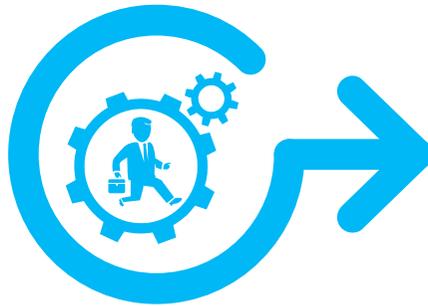
Enabling Technology Transfer and Capacity Building

- An overview of the present gaps and future opportunities will help us assess the level of technology transfer and capacity building which is required within the drone value chain
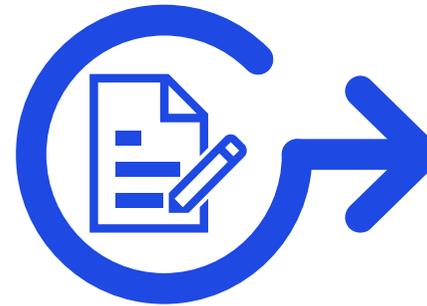
Assessment of Future Infrastructure Requirement

- Based on the level of technology transfer and capacity building required, an assessment of infrastructure requirements would help in defining the objective for collaborations and formation of joint ventures.

Formulation of Business Plan for Joint Ventures

- Once all the preliminary assessment and consultations are completed, the formulation of the business plan for the formation of joint ventures/ collaborations would help in defining the roles and responsibilities within the partnerships.