Digital Inspection using Drone: Enabling Autonomous Intelligence in the Built Environment

From Visual Data to Actionable Engineering Insights

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Avetics

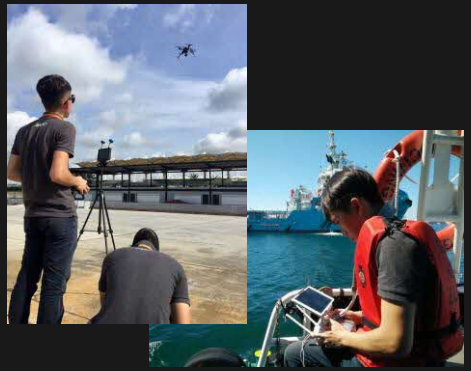
Who Are We?

Avetics Global is a Singapore-based drone solutions and robotics engineering company founded in 2013 and specialised provider of **industrial drone services**, **drone solutions**, **customised unmanned aerial systems (UAS)**, **data management**, and **training solutions.**

We focuses on end-to-end drone services for industrial applications, particularly in areas such as:

- Industrial inspections and surveying
- Aerial photography and videography
- Drone hardware and custom engineering solutions
- Drone data analytics and management software
- UAV training and certification (UAPL courses)

AVETICS COVERS ALL ASPECTS OF DRONE PRODUCTS AND SERVICES



Volarious

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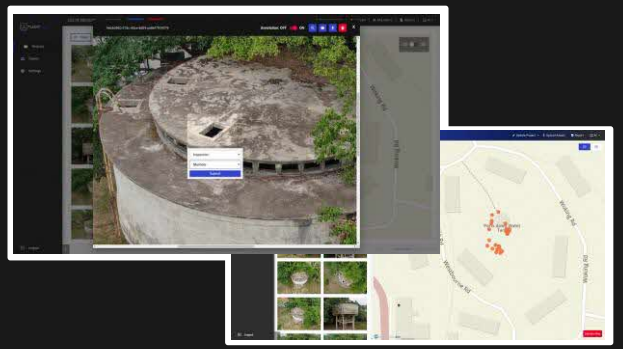


FLIGHTVAULT

SERVICES

Our wide-ranging industrial inspection services alongside our domain expertise, provides clients with an ease of mind during operations.

HARDWARE

Coupled with the latest drones from DJI and our complementary innovative hardware Volarious products, this is the frontier of drone technology.

SOFTWARE

FlightVault is a drone data management platform that makes use of AI to perform data analytics on drone photos for actionable insight

Avetics

The Construction Lifecycle & Drone Integration

Overview of where drones fit in **Building and Infrastructure** (Rooftops, Bridges, tunnel, power lines) Inspection

Pre-construction

- Site planning
- Topographic surveys
- Aerial Mapping

Active Construction

- Progress tracking/ monitoring
- safety audits
- quality control
- Photogrammetry
- BIM vs. As-Built

Milestone / Handover

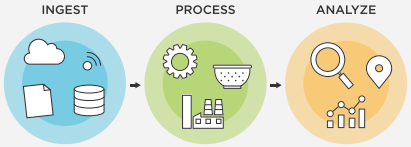
- As-built verification
- Building envelope scans
- Structural NDT

Operation & Maintenance

- Facility management
- Periodic Structural Inspection
- Periodic Façade Inspection

The Right Tool Framework

The Digital Workflow (From Drone to Desk)



1 Capture

High-fidelity sensors (High resolution imagery, LiDAR data, Thermal data, UT data)

2 Process / Analyze

Visual Annotation
AI Classification
Photogrammetry (point clouds/Mesh/3DGS)
Volume Calculation

3 Integrate

Moving data into CDE (Common Data Environment), Cloud Storage, or BIM-specific Platform

Goals

- Move from "Manual Subjective Inspection" to "**Digital Objective** Truth.“
- Deploy right kind of UAS in construction sites to capture data from height
- UAS or Drone generates **accurate and time-series datasets**, imagery, 3D models or orthomosaic maps, **ensuring consistency over time**

Photogrammetry, Progress Monitoring, Inspection, Verification

Multi-sensor payload: RGB zoom, thermal imaging, and LiDAR for comprehensive data capture.

Capabilities: Automated Data Capture, High-Resolution Photogrammetry, Slope Mission/Facade Inspection, Thermal Inspection, LiDAR Scanning, Stockpile Volumetrics

How Data Captured can be use: High-Resolution RGB Imagery, 2D Orthomosaic Maps, 3D Textured Mesh/Models, Point Clouds, DSM/DTM (Digital Surface/Terrain Models), Laser Rangefinder Data

Purpose:

Drone Applications in Inspection & Construction

Drones for Inspection: Regulation

Periodic Façade Inspection (PFI)

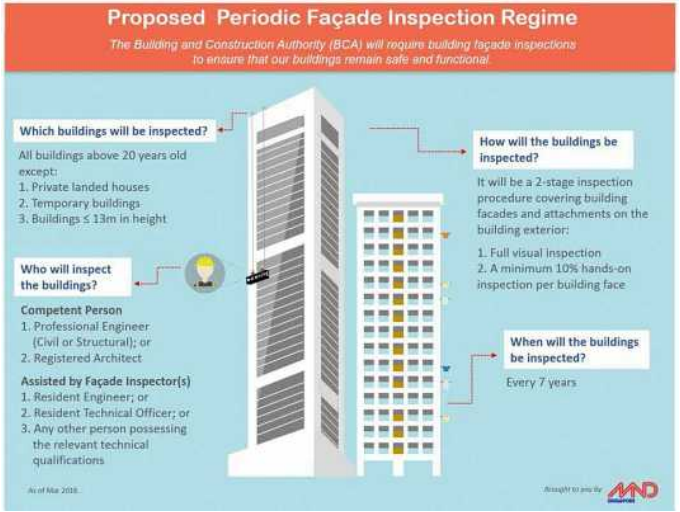
- **Mandatory inspection every 7 years** for buildings above 13m (regulated by BCA)
- Ensures façade safety by identifying **cracks, spalling, corrosion, and loose elements**
- Driven by risk of **falling objects in dense urban environments**

Challenges with Traditional Methods

- Requires **scaffolding, gondolas, or rope access**
- **High cost, manpower-intensive, and time-consuming**
- Increased **safety risk for work-at-height operations**

How Drones Add Value

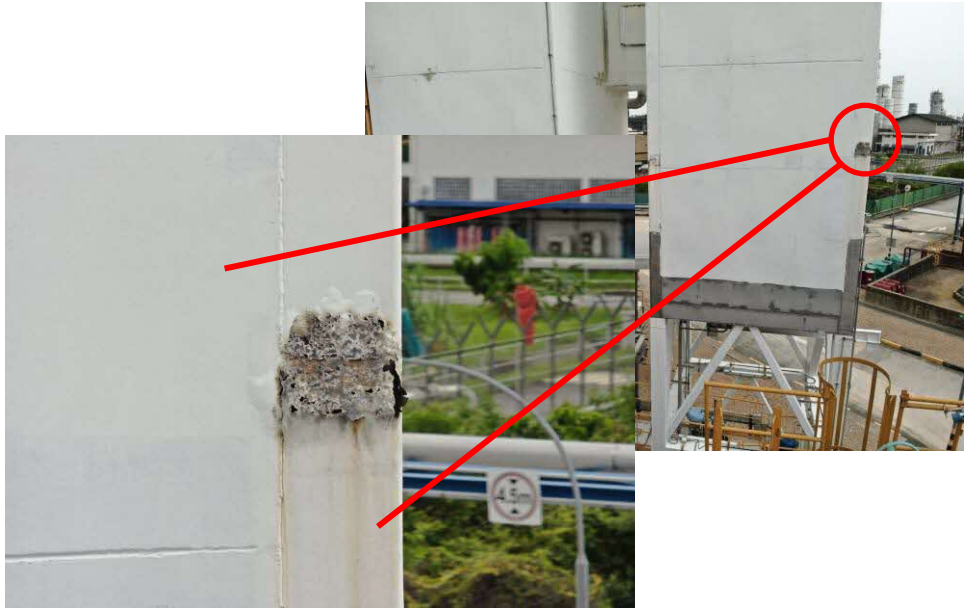
- **Safer inspections** with minimal human exposure to height
- **Faster deployment** and reduced downtime for buildings
- **Lower cost** by eliminating heavy access equipment
- **High-resolution data** for accurate reporting and compliance



Drones for Inspection: External structural visual Inspection

Benefits:

- Early detection of façade defects such as cracks, spalling, corrosion, and loose elements
- Reduces inspection cost by eliminating scaffolding, gondolas, and rope access
- Lower insurance and liability exposure by reducing work-at-height risks
- Minimises building downtime and disruption to occupants during inspection



Video: Building Facade Inspection with Drone – Avetics (57s)

Drones for Inspection: Indoor & Confined Space Inspection

The collision-resistant design of the protective cage consist of impact absorbing nylon and carbon fiber for strength.

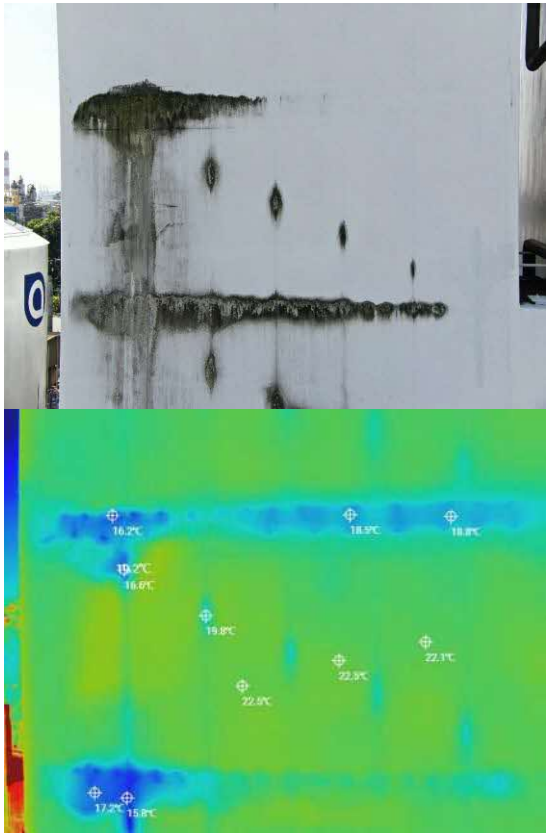
This combination allows excess energy to be absorbed and safely dissipated by the cage.

Drones for Inspection: Indoor & Confined Space Inspection

Video Footage from Drone

Drones for Inspection: Thermal Inspection

- Thermal inspection for equipment at height.
- Detects **early-stage faults (overheating, moisture ingress, electrical leakage)** not visible to the naked eye
- Enables **preventive maintenance in humid tropical conditions** (common cause of corrosion and water seepage)
- High-resolution thermal imaging for **accurate anomaly detection, with wide thermal measurement range** from **-20°C up to 1600°C (with IR filter**



External Structural visual Inspection specialist

- **High-resolution imaging (up to 40MP)** captures fine surface details, enabling accurate identification of small defects such as hairline cracks and surface deterioration.
- Enable efficient inspection of confined, elevated, and complex structures—such as towers, rooftops and facades—by accessing areas that are difficult or impossible to reach using traditional methods.
- High-quality data capture through high-resolution imaging, powerful zoom for detailed inspections without close proximity, and repeatable flight paths for consistent monitoring over time.
- Automated flight planning allows pre-defined, repeatable missions for consistent façade coverage, ensuring reliable data capture for periodic inspections.

Purpose: To deliver safer, faster, and data-driven façade inspections with consistent and repeatable results

Indoor & Confined Space Specialist

Flyability Elios 3 (Internal Inspection).

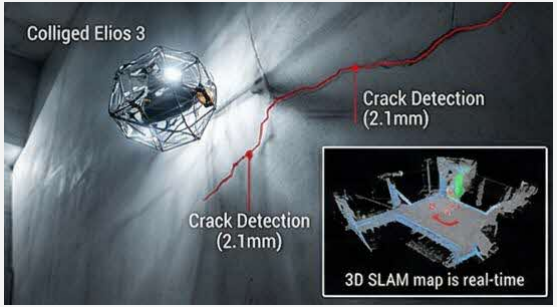
- Collision Tolerance: A spherical, carbon fiber cage allows the drone to operate in tight spaces (as small as 50x50 cm) and navigate confined areas without damaging equipment.
- Resume Inspection: Automatically returns to the last point after battery swaps.
- SLAM Mapping: Creates a real-time 3D model in GPS-denied shafts and tunnels.

Purpose:

- Safety—inspecting ventilation, lift shafts, and storage tanks without human entry.

Data Captured:

- High-Resolution 4K video and 12-megapixel imagery, including thermal imaging to detect moisture or heat-related anomalies in structures.
- Ultrasonic Thickness (UT) Measurements with UT payload allows remote non-destructive testing (NDT)
- LiDAR-Powered 3D Models with Ouster REV 7 LiDAR (128-beam)



Indoor & Confined Space Specialist: Alternative

Volarious Lumicopter(Internal Inspection).

- Collision Tolerance: A spherical, carbon fiber cage allows the drone to operate in tight spaces (as small as 50x50 cm) and navigate confined areas without damaging equipment.
- Cheaper alternative to the Elios 3.
- Not available anymore.

Purpose:

- Safety—inspecting ventilation, lift shafts, and storage tanks without human entry.

Data Captured:

- 4K video and 12-megapixel imagery,
- No thermal imaging, UT Measurements with UT payload to allows remote non-destructive testing (NDT)

Powered Tethered Drone System – Safe & Continuous Flight

Volarious V-Line Pro
Compact and Intelligent Tethered Drone System

Purpose

- **Enhanced Safety and Control** as a physical safety restraint, critical for **operations in No-Fly Zone**.

Capabilities

- **Unlimited Flight Time** from a continuous power supply from the ground station.
- **Persistent Surveillance & Security** as continuous "eyes in the sky".
- **Secure & High-Speed Data Transfer** with tethered cable that allows for reliable, high-speed data transmission. .
- **Auto-tensioned reel system** for smooth operation, along with automated landing and takeoff.

VOLARIOUS
Tethered Drone System Specialist

Drone Applications for Construction

The "Drone-in-a-Box" Revolution

Transforming Construction with Automated Drone Workflows

DJI Dock 3 with Matrice 4D or 4TD drones.

Operational Value:

- Generate highly-accurate 2D and 3D models to monitor progress and easily compare with historical data.
- True Autonomy: Scheduled "Daily Site Scans" without a pilot on-site.
- Rapid Charging: 20% to 90% in just 32 minutes.

Purpose:

- Progress Monitoring
- 24/7 security,
- Safety PPE monitoring,
- hyper-consistent "As-Built" records.

DJI Dock 3: Introducing DJI Dock 3: Rise to Any Challenge **(5mins)**

The "Drone-in-a-Box" Revolution

Transforming Construction with Automated Drone Workflows

Flighthub2 – Drone Management Software

FlightHub 2 Capabilities:

- **Centralised drone & dock management:** Monitor fleet status, missions, and devices in one platform
- **Remote operations & livestreaming:** Real-time video, control, and situational awareness from anywhere
- **Mission planning & automation:** Schedule flights, automated routes, and recurring inspections
- **Data capture, mapping & analysis:** Generate 2D maps, 3D models, and inspection reports
- **Collaboration & real-time coordination:** Share data, annotate maps, and coordinate teams live
- **AI-powered inspection & alerts:** Detect anomalies and automate workflows for inspections

The "Drone-in-a-Box" Revolution

Flighthub2 – Drone Management software

The Future is here – Drone-in-a-Box Infrastructure

- **Fully autonomous**, "permanently stationed" **aerial monitoring**.
- The "Box" (The **Dock**): A weather-rated (IP55+) base station that handles:
  - **Automated Charging/Battery Swapping**: Recharges the drone in 30 minutes.
  - **Climate Control**: Keeps batteries at optimal temperatures in extreme heat or cold.
  - **Data Uplink**: High-speed 5G or Starlink connection to the cloud.
- The **Workflow**:
  - **Schedule**: Set a 7:00 AM "Morning Site Scan" and a 6:00 PM "Security Patrol."
  - **Launch**: The box opens; the drone performs a pre-flight check and takes off.
  - **Execute**: The drone flies a precise, pre-programmed path (BVLOS).
  - **Process**: Upon landing, data is uploaded before you finish your coffee.
- **Construction Value**:
  - **Autonomy**: Scheduled missions for "as-built" verification every 24 hours.
  - **Efficiency**: Eliminates pilot mobilization costs; provides 100% consistent data angles for time-lapse comparisons.
  - **Reliability**: Weather-proof docks ensure data capture continues regardless of site conditions

Use Cases 1: Automated Asset Digitisation & Bim

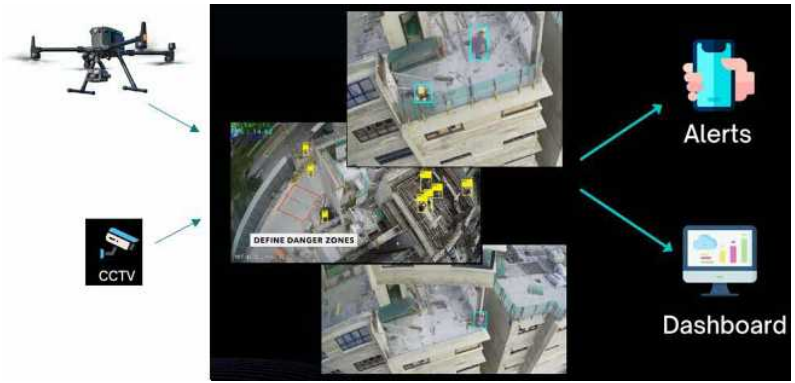
Active Construction, Operation & Maintenance

- **The Problem**: Traditional "As-Built" vs "As-Designed" checks are done via manual tape measurements.
- **Key Features**
  - **Drone captures hundreds of 2D images**, which **DJI Terra software stitches into 3D models** and orthomosaics through routine flying.
  - Can be exported out overlay with BIM, can be automatically aligns the **3D drone point cloud** with the architectural BIM model.
  - Missing Element Detection: The system flags if a column, HVAC duct, or wall segment is missing or out of alignment by more than 2cm.
  - Automated Stockpile Reports: AI segments piles of soil/gravel and calculates volume, density, and cost-to-move without human input.

Use Case 2: AI-Powered Safety & PPE MonitoringC

Active Construction

- **The Problem**: Safety officers cannot be everywhere at once on a 50-acre site.
- **Key Features**:
  - **Regular interval area scans by drone** to **fly pre-planned, grid-like paths at set times** (e.g., daily, weekly, or monthly)
  - **PPE Compliance**: Automatically flags workers missing Hard Hats, High-Vis Vests, Gloves, or Harnesses.
  - **Geofencing & Proximity**: Sends an instant alert if a worker enters a "Red Zone" (e.g., under a live crane load) or gets too close to moving heavy machinery.
  - **Fall Detection**: Onboard AI detect the "physics of a fall" and alert emergency services in seconds.
- **The AI Solution**: Real-time object recognition and behavioral analytics.
- **Data Output**: Real-time SMS/Email alerts, Daily Safety Compliance Scorecards (PDF), and "Incident Replay" video clips.



Use Cases 3: Visual Progress Management

Active Construction

The Problem: Senior management lacks, real-time visualisation of site progress, making it difficult to track status and make informed decisions.

Key Feature:

- **Automated Mission Planning:** Pre-planned, repeatable flight paths for consistent data capture
- **Grid-Based Data Capture:** Structured image collection for full site coverage at regular intervals (daily/weekly)
- **Time-Based Comparison:** Track changes over time to monitor construction progress accurately
- **Centralised Data View:** Grid view and map-based interface for easy review and analysis

Mission Plan

Data Capture

Grid View

The Solution: Automated drone data capture combined with visual analytics for real-time progress tracking and reporting

Video: DJI Dock 3: Transforming Construction with Automated Drone Workflows (4mins)

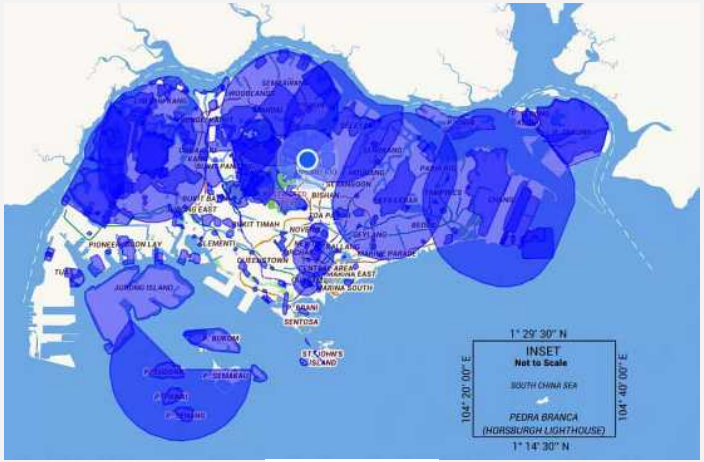
Regulations for Unmanned Aircrafts

Permit Requirements for drone activity

- **Governing Body:** Civil Aviation Authority of Singapore (CAAS)
- **Permits and Requirements:**
  - **Operator Permit (OP):** Grants an organisation or individual that demonstrates the ability to operate the Unmanned Aircraft (UA) safely.
  - **Activities Permits: Grant** an organisation or individual for a single activity or a block of repeated activities to be carried out.
    - Class 1 and Class 2 Activity Permit.
  - **Unmanned Aircraft Pilot License (UAPL**): Organistion are required to have a UAPL certified pilot to carry out these drone activities.
    - Class A: <7kg or <25kg
    - Class B: >25kg

Regulation & Airspace

Compliance First

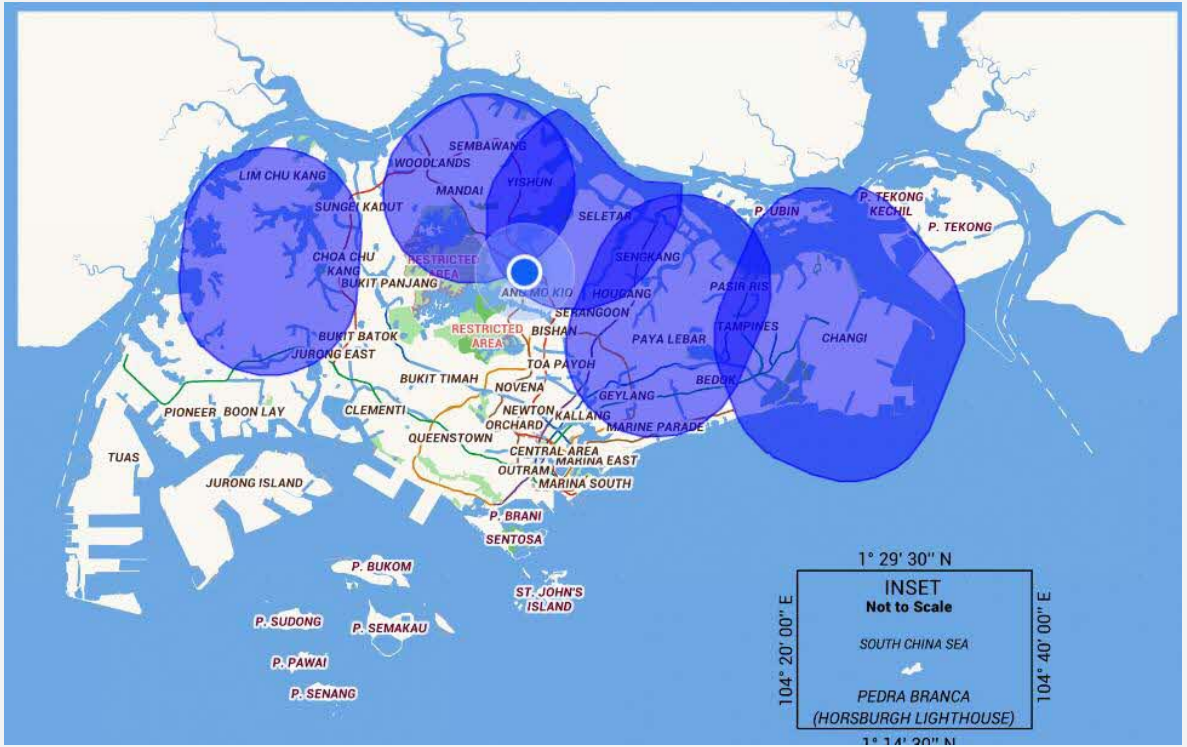


No Fly Zones(NFZ): refers to areas where you are not allowed to operate your UA if you do not hold the requisite permit(s). General no-fly zones include:

- Areas within 5km of aerodromes
- Areas within danger areas
- Protected areas under Air Navigation Act
- Areas within prohibited areas
- Areas within restricted areas

OneMap.gov: Before flying a UA in Singapore, operators are advised to check OneMap, a one stop application that has been curated for UA users to identify areas where UA flying is recommended and where permits are required and contains useful geographical and regulatory requirements in certain areas for all UA operators..

Regulation & Airspace : Aerodromes



Within 5km from airbases and airports

<u>Tengah, Sembawang and Paya Lebar Airbase:</u>

- AP usually only grants to fly during after 10:30pm or weekends for free-flying.
- Else must be tethered.

<u>Seletar and Changi Airport:</u>

- Has to be tethered.

Summary

- **The Unmanned Aircraft System (Multi-Drone) Ecosystem**
  - Leverage a multi-platform fleet to provide a **100% digital site records from data capture**.
  - ✓ The Workhorse (DJI Enterprise Drones): For high-precision high-resolution datasets at height.
  - ✓ The Specialist (Flyability Elios 3): For confined, GPS-denied indoor spaces.
- **Actionable Intelligence**
  - **Deliver digital outputs** in standard formats .LAS Point Clouds, .OBJ meshes, and AI-driven defect reports, which can be integrate directly into your BIM/CDE software.
- **Autonomous Progress**
  - "**Drone-in-a-Box**" (DJI Dock 3) allows for daily, automated site monitoring without on-site pilots.
- **Drone Deployment** drastically **cut maintenance costs, improve safety, and enhance data accuracy** through drone-powered inspections.
- This shift away from costly, reactive maintenance **toward predictive, risk-based inspections** ensures **better asset management and long-term savings. However, Drone operations remain tightly regulated to ensure safety, compliance, and responsible deployment.**


Thank You

Back Up