

[Landing page content]

## **Building an Asset Management and Inspection Drone Program: The Ultimate Playbook**

*DJI's step-by-step guide for setting up an asset management and inspections drone program that actually saves time and money*

### **About**

So, you have heard about the transformational impact of commercial drones, or maybe you have even employed the services of a third-party to get a taste of the value that eyes in the sky can bring to your organization. Now, it's time to take control and develop your own drone program for asset management and inspections.

But where do you start? What are the essential parameters that you must plan for? Are there any best practices you could follow to get a solid framework for success? And how do you choose the right drone solutions?

How much does an in-house drone program cost anyway? And what kind of tangible and intangible ROI can you expect?

This beginners' guide to establishing an in-house asset management and inspection commercial drone program is specially designed for energy and inspection companies looking to integrate drones into their existing workflows.

Download this guide to learn everything you need to know about using drones for inspection or leveraging drones for asset management. This guide covers in detail:

- The Role of Drones in Asset Management and Inspection
- Challenges in Setting Up an AM&I Drone Program and Tips to Mitigate Them
- Costs and Budgeting
- The ROI of AM&I Drones, and much more!

Receive this guidebook by filling in the form below:

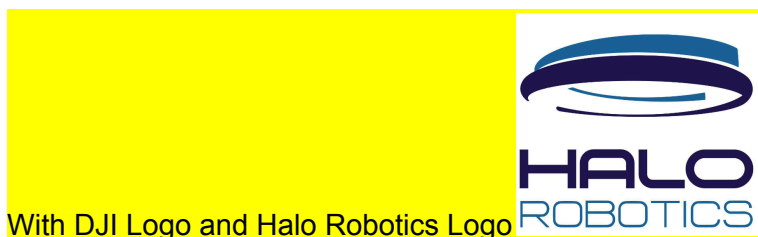
[Playbook content]



<https://www.shutterstock.com/image-photo/oil-gas-refinery-plant-petrochemical-industry-723518005>

## Building an Asset Management and Inspection Drone Program: The Ultimate Playbook

*DJI's step-by-step guide for setting up an asset management and inspections drone program that actually saves time and money*



With DJI Logo and Halo Robotics Logo

### Table of Contents

1. Introduction
2. The Role of Drones in Asset Management and Inspection
3. The ROI of AM&I Drones: Stories from the Sky
  - Powerline Inspection
  - Real-time Asset Monitoring
  - Asset Tracking and Logistics

- Wind Turbine Inspection
  - Solar Panel Inspection
  - Automated Inspection for Utilities
  - Power Transmission Structure Inspection
  - Oil and Gas Inspection
4. Setting Up an AM&I Drone Program: Challenges and Tips to Mitigate Them
    - Challenge #1: Budgeting and Management Buy-In
    - Challenge #2: Avoiding Project Scope Creep
    - Challenge #3: Determining the Frequency of Operations
    - Challenge #4: Navigating the Regulatory Ecosystem
    - Challenge #5: Systematic Documentation and Project Management Processes
    - Challenge #6: Safeguarding and Preparation for Operations
    - Challenge #7: Developing a Plan for Data Storage, Analysis, and Reporting
    - Challenge #8: Putting Together a Team that Works
  5. Setting Up an AM&I Drone Program: Costs and Budgeting
  6. Investing in the Right Hardware
  7. Prioritize Data Storage and Management
  8. Selecting the Right Software Solution
  9. Regulations and Permits
    - Drone laws: United States vs. European Union
    - US Regulations
    - EU Regulations
    - Unmanned Traffic Management
  10. Training
  11. Maintenance
    - DJI Maintenance Program
    - DJI Care Enterprise
  12. Summing Up

## Introduction

The energy sector is highly complex and capital-intensive. Not only do energy companies and utilities require significant infrastructure investment, their smooth functioning mandates efficient asset integrity management.

In the United States, for example, much of the electric grid was constructed in the 1950s and 1960s with an asset life expectancy of 50 years. This aging power infrastructure now requires greater attention than ever, to maintain transmission assets in good working order, and prevent costly power interruptions.

Traditionally, power companies and service providers have relied on cranes, scaffolding, rope access, or manned aircraft to manage and maintain transmission assets, which are typically distributed over large areas and often located in hard-to-reach places, such as mountains or deserts. These manual data collection methods are dangerous, costly, time intensive, and often require the assets to be taken offline in order to carry out the inspection, causing major losses in productivity.

[need an IMG of all energy assets: O&G, Solar, Utilities, Wind Turbines, Renewables, Hydro]



<https://www.shutterstock.com/image-photo/panoramic-collage-power-energy-concepts-products-750118813>

Studies suggest that asset inspection costs the global oil and gas industry [\\$37 billion](#) annually, while solar farm asset maintenance costs the industry [\\$1 billion](#) annually in labor alone. In the power sector, the cost to get transmission towers inspected by a helicopter can easily be [\\$5,000 per tower](#). Meanwhile for wind turbines, traditional rope access inspections can cost [\\$2,000](#) and require high-risk inspection techniques. In almost all cases, these types of assets need to be shut down for some period of time in order to be inspected safely, causing much larger costs from non-productive time.

But this doesn't have to be so. Commercial drones have an incredible potential to transform the way utilities and oil and gas companies manage their industrial assets. And this guide will tell you everything you need to know about using drones for inspections or asset management.





<https://www.shutterstock.com/image-photo/aerial-top-view-oil-gas-refinery-609092369>

## The Role of Drones in Asset Management and Inspection

With drones, a robust network of aerial sensors and cameras can provide asset managers and inspection companies with a continuous stream of data on the status and condition of all types of industrial assets and infrastructure.

In addition to directly improving the efficiency of inspections, streamlined drone solutions for data collection, processing, and reporting, can dramatically reduce asset downtime and potential revenue loss.



Further, drones can be used for as-built asset digitization, with survey-grade drones providing the spatial data needed to develop high-definition 3D models of complex facilities

and high risk structures. Updated as-built asset models and schematics can significantly improve the efficiency and accuracy of asset maintenance operations.

Here are some of the key benefits that the integration of drones brings to Asset Management and Inspection (AM&I) workflows:

- Empowers organizations for real-time monitoring of assets and critical infrastructure
- Increases speed, safety, and frequency of scheduled inspections
- Reduces risk to personnel by significantly limiting work at heights and in confined spaces
- Leads to substantial cost-savings since many inspections can be completed without interrupting the normal operation of facilities
- Eliminates blind spots and improves the total comprehensiveness of inspections, while also typically providing superior results versus manned inspections
- Enables a 'preventive maintenance' approach, allowing asset managers to localize manned inspections and limit the use of other technologies more specifically
- Improves prudence and timing of expensive CAPEX maintenance decisions
- Allows for systematic repetition of inspections, with results that can be better compared over time to analyze for long-term change detection

Now, all this looks great on paper. But how does this translate into real-world performance? Let's find out...



<https://www.shutterstock.com/image-photo/night-view-refinery-distillation-columns-blue-1656250393>

## The ROI of AM&I Drones: Stories from the Sky

The scalable return on investment (ROI) from a commercial drone initiative can broadly be divided into two categories:

1. **Reduction in Direct Costs:** When compared to traditional asset management and inspection methods
2. **Reduction in Asset Downtime:** Through a significant increase in efficiency and safety from drone-based data acquisition

Typically, most of the ROI from drone operations in asset-intensive industries comes from a reduction in non-productive time. Any heavy industry – ranging from Oil and Gas and Petrochemicals to Pulp and Paper and Power generation – will agree that non-productive time is their single biggest cost. For every hour an asset operates, it can make millions of dollars for the business. And for every hour the asset is forced to suspend operations, costs accumulate dramatically. Reducing the scheduled shutdown time for inspections by even one day can make a significant difference in the balance sheet.

**[IMG] @Ham please add this copy on top of the image "When an asset is down due to it not being properly maintained, it is costing the operator time and money. Reduce non-productive time (NPT) with drone-enabled maintenance checks." + DJI logo**



www.shutterstock.com · 1672890445

<https://www.shutterstock.com/de/image-photo/oil-pumps-work-silhouetted-against-setting-1672890445>

Yet even a direct comparison of the cost of a drone inspection with the cost of a traditional scaffolding or rope access inspection makes clear that using drones is a better choice.

Scaffolding, which costs money, takes a long time to set up. The process then requires manned inspectors to systematically inspect the asset, after which the scaffolding must be taken down. All this can take days, if not weeks, depending on the assets being inspected. The same operation can be done by a drone, obtaining identical if not superior systematic inspection results, without any scaffolding, and typically in a fraction of the time. On the safety side, many workplace fatalities and safety accidents are actually caused in relation to the use of scaffolding and rope access technology.

Indonesia-headquartered Halo Robotics – a drone solutions and service provider that works with many Fortune 500 companies in Mining, O&G, Power, Cement, Steel, Telecoms and Critical Infrastructure – reveals that its **clients are universally able to achieve 50-70 percent reductions in scaffolding inspections through the use of drones**, and in many cases are able to completely eliminate the requirement for a manned inspection.

[IMG] - @Ham please put the copy “Up to 50-70% costs saved in scaffolding inspections with the use of drones.” At the bottom of that please these logos DJI Enterprise | Halo Robotics





www.shutterstock.com · 1168774231

<https://www.shutterstock.com/de/image-photo/officials-measuring-resistance-highvoltage-blade-switch-1168774231>

One common example of this is during turnarounds – a type of asset maintenance project involving a full scheduled shutdown, and mobilization of all contractors to execute inspection and maintenance activities at one organized time. By providing high-resolution inspection results quickly, drones can significantly increase the total speed of the turnaround, resulting in less total downtime of the assets.

In the case of one O&G supermajor that Halo recently worked with, a turnaround project at their LNG facilities had allocated six days for asset inspection. Using drones made it possible to reduce this time to three days (finishing all inspection scopes in 50% of the time) which increased the total speed of the turnaround by several days. As Halo learned, the cost of operating the large-scale energy facility in question was several million dollars per hour. And so, the cost savings achieved by three full days of additional operations were truly enormous!

Let's take a look at some more user stories...

**[img @Ham please edit the image and add the [Alpiq logo](#), you may also explore add the headline “Powerline Inspection: 50%....” on the image if it would look nice]**



## **Powerline Inspection: 50% improvement in inspection efficiency for Swiss grid operators**

Powerline inspection is no mean feat. But, for Switzerland's national transmission grid operator, Swissgrid, the challenges are threefold:

- Swissgrid's vast network of 6,700 km of transmission lines runs across Switzerland's notoriously steep mountain ranges
- Harsh weather conditions make inspections even more difficult
- The aging infrastructure, the majority of which was erected in the 1950s and 70s, has necessitated the need to increase the frequency of inspections

Working alongside Swissgrid to keep this network running is Alpiq EnerTrans, specialists on high and medium voltage lines. For a recent inspection of 65 pylons along a 50KV line, Alpiq EnerTrans decided to deploy DJI's RTK-enabled drones for their enviable flight time and stable flying behavior even in the proximity of high magnetic interference. The team leveraged Zenmuse's visual and thermal cameras to spot damages and detect anomalies.

When local energy network operator Altdorf Utility Company saw the detailed drone data, here's what they said:

*"Alpiq EnerTrans were given 5 days to inspect 65 pylons and completed the work in 3 days. If we would have done the same 65 pylons in the conventional way with a line controller, it would have taken 6-7 days, so it saved us 40-50% of the time, let alone the increase in job safety."*

Read the complete case study [here](#).



[IMG @Ham if you decide to add a headline in the Alpiq image, kindly make it consistent with the rest]



### **Real-time Asset Monitoring: 15 min turnaround at Shell refinery**

At Shell Deer Park, a fully integrated refinery and chemical plant spanning 2,300 acres in Texas, US, DJI's inspection drones have been dotting the skies since 2016. The missions these flying robots take on are a combination of scheduled inspections and incident response.

Shell routinely uses drones to inspect flare tips and floating roof tanks (up to 47 units per week) and to detect abnormal situations like system steam leak or a loose railing at the top of a 260ft stack. Whether or not the mission is planned in advance, Shell engineers are always on hand to guide the flight and assess things in real-time.

*"There's no more guessing. We can get the same picture of the same tank every week, which makes it a lot easier to compare any issues and make smarter maintenance decisions,"* says John McClain, the site's Chief Drone Pilot. *"The big thing is safety: anytime you can put a piece of equipment at height and not a person, that's a plus. That's how we've written our policies for the site."*

For more details about this user story, [click here](#).

[[IMG](#) same principle as above, logo [here](#).]



### **Asset Tracking and Logistics: Significant time and fuel savings at Europe's busiest harbor terminal**

Every year, DFDS, the Danish leader of transport and logistics, moves more than 3 million trailers in their own stock and from partners. In 2018, the company decided to deploy drones for locating and confirming the position of each trailer, instead of continuing with tedious manual operations.

With UAS Denmark and Lorenz Technology as partners, DFDS utilized AI computing on DJI drone platforms to conduct automated inspections. This led to 15 minutes in time-savings on loading and discharging trailers from vessels. The company was also able to reduce the amount of fuel used by one ton when loading items onto a trailer, ultimately resulting in a significant reduction in both CO<sub>2</sub> emissions and costs. DFDS now plans to leverage drones and AI to detect damages on the cargo.

According to Mads Bentzen Billeso, Senior Project Manager, DFDS, *"We see great potential in the use of drones in our terminals and we are convinced that drone-related services can optimize operations dramatically for the benefit of employees, customers, and the environment."*

Find more details [here](#).



### **Wind Turbine Inspection: High-efficiency inspection of more than 5 turbines per day**

To maintain peak performance, wind turbine blades require constant inspection and maintenance. The problem is that the most widely used rope access method of inspection, which allows for a close look at the damage, poses a security risk to the personnel working at height.

Further, since the wind turbine remains off-service throughout the inspection process, a method where even the most experienced technicians can inspect only 1 or 2 turbines per day, eats into the profits of the wind farm considerably.

This is why Greece-based Industrial Drone Services (IDS) relies on highly-efficient DJI drone solutions instead. Using Matrice 300 RTK drone equipped with H20T hybrid sensor, IDS is able to closely inspect more than 5 wind turbines per day. Moreover, the drone captures images from all four sides of the blade, ensuring 100 percent surface coverage, at a downtime of only 1 hour or less. And there is no risk to personnel as well.



Find how drone wind turbine inspection works [here](#).



### **Solar Panel Inspection: 10 km<sup>2</sup> area covered in 13 days, 6,000 anomalies discovered**

The sheer size of large, modern solar farms mean that traditional manual inspections are extremely time-consuming and expensive. Even after deploying an army of workers at a tremendous cost, only about 2-3 percent of a plant can be analyzed, which results in highly inaccurate performance reports.

To overcome this challenge of scale, Brazil-based tech company Drone Visual utilizes DJI drones equipped with visual and thermal imaging cameras. This enables operators to cost-effectively identify both non-electrical issues, such as soiling, shading, or animal nesting, as well as electrical problems like defective cells.



At a recent drone solar inspection, a team of two was able to inspect three sites covering a combined area of 10 sq km within 13 days – something that would have been impossible to achieve on foot. The operators identified almost 6,000 profitability-reducing anomalies across the sites, with issues ranging from broken solar panels and defects in bypass diodes to solar cell malfunction and accumulation of dirt on the panels. Maintenance teams can now repair or clean the faulty units and keep the solar farms running at peak capacity.

Read more [here](#).



**[IMG same principle as above, logo [here](#)] Automated Inspection for Utilities:  
15x inspection business scalability at China Southern Power Grid**

China Southern Power Grid (CSG) operates and manages thousands of kilometers of powerlines across 5 provinces of China's rich southern territories. Between 2015 and 2018, CSG's inspection fleet increased the length of powerlines it could inspect in-house by 15 times. In 2018, the team clocked 241,000 km in powerline inspections, up from 2015's 11,000 km.

How did the team improve inspection efficiency and scale-out the operations so significantly in 3 short years? They used DJI drones (6,000 units and counting).

2018 was a year of intelligence explosion for CSG. With route planning becoming more accurate, a drone could auto-inspect 36 towers with 3 landing points with minimum human interference. AI integration meant that the drones were able to send back visuals of identified defects in real-time. Deep learning algorithms could correctly detect something as small as an armor clamp pin missing with 77% accuracy. The highly precise defect-recognition mechanism cut the response time at the company by at least 80%.

Read more [here](#).



### **Power Transmission Structure Inspection: 30% inspection efficiency boost for US-based Valmont Utility**

As a leading manufacturer of custom-engineered T&D poles, US-based Valmont Utility is considered an authority on high-quality inspection of powerline structures. Over the last 2 years, the company has switched roughly 70% of the inspection work over to drones. Why?

*“This has increased both the quality and speed of our inspections, and we can offer more accurate, actionable reports to the customers. Even more impressively, we have saved a ton of money, literally millions of dollars, for our clients,”* explains Jake Lahmann, Quality - UAS Manager, Valmont Utility.

For the most challenging inspections, Valmont Utility relies on DJI’s Matrice 300 RTK with Zenmuse H20 Series payload, which allows unprecedented agility and maneuverability even in the high winds and harsh environments like those in West Texas. With 55 minutes of flight time and onboard AI algorithms to empower long-term change detection, the drone solution has proven to be a “gamechanger” for Valmont.

*“Overall, the M300 RTK with Zenmuse H20 Series payload has increased our efficiency by at least 30 percent. This means that this drone is not just a purchase for us; it’s an investment that would pay for itself.”*

[Click here](#) for more details.



### **[IMG] Oil and Gas Inspection: Millions saved in potential revenue loss at Argentina’s oil and gas refineries**

Since 2015, oil and gas refineries in Argentina have been using drones to inspect refinery flares, assess steam systems, identify weak points in structures, pinpoint failures in flanges,

reveal deformations, and perform scheduled maintenance more thoroughly. And all this is done without shutting down operations for extended periods.

*“Oil and gas refineries could potentially lose millions of dollars a day if they are forced to halt services,”* explains Felipe Vadillo - professional drone service provider

a professional aircraft engineer who conducts inspections for Argentine oil and gas refineries with thermal drones.

Additional benefits have been realized in terms of time-savings and improved efficiencies. Even while adhering to numerous protocols, such as gaining entrance to the plant, obtaining work permits, coordinating with the team inspector, becoming familiar with the plant, and evaluating flight routes, an inspection can take anywhere from 4 to 6 hours. However, this is still exponentially less when compared to the amount of time needed for inspections performed without drones – which can reach up to 15 days.

More details [here](#).





<https://www.shutterstock.com/image-photo/close-industrial-view-oil-refinery-plant-549195883>

## Setting Up an AM&I Drone Program: Challenges and Tips to Mitigate Them

Contrary to what you may expect as an asset manager, rapid strides in drone technologies in the last few years have ensured that operating unmanned aerial vehicles safely and skillfully is easier than ever today. Instead, the key challenges and criteria for success relate more to project management and systematic organization of the aerial data.

It is important to chalk out realistic goals and decide on the parameters of success vis-à-vis traditional or alternative methods. You also need to determine which types of assets you will be focusing on, using what kind of data, and how said data will be managed once you start to gather lots of it.

Let's discuss some common challenges and practical tips that would guide you to the key areas where you should focus your efforts to successfully use commercial drones for asset management and inspection...

### Challenge #1: Budgeting and Management Buy-In

Although the cost of drone hardware is falling, investing in a fleet of drones, sensors, new hires, and pilot training can amount to significant expenditure. There are immediate costs for acquiring drone technology, ongoing operational costs related to human resources, and routine expenses related to the practical aspects of storage, organization and transportation of the drone equipment. All of this will need to be justified by a quantitative evaluation of the Return on Investment (ROI).

Although the gains can be dramatic and cost may not be prohibitive, there are many things to consider, and this explains why many organizations choose to avoid those upfront costs and work at first with a third-party drone service provider.



www.shutterstock.com · 672920704

<https://www.shutterstock.com/de/image-photo/engineer-technician-working-together-on-drone-672920704>

It makes sense to validate your long-term aerial ambitions before investing heavily. In fact, it may be a necessary step to getting the management buy-in for an in-house program. If you want to scale and/or tailor your drone operations to meet your organization's exact requirements, you'll need to explain what the drone program might look like in 2-3 years, and be clear about what approvals and funding will be needed from the management in order to bring things in-house.

Convincing the management becomes easy when you start small with a proof of concept (POC) for a single application, define the parameters of success, measure your results, and compare those records to your traditional data-gathering methods.

But keep in mind that starting small doesn't mean making a small impact. The ROI from drone applications is often dramatic versus traditional methods. Choose a business area that will clearly benefit from easy, fast, and safe digitization. Inspection of complex tall structures, real-time asset monitoring, and 3D visualizations of assets are three solid examples.

## **Challenge #2: Avoiding Project Scope Creep**

Scope creep is a key pitfall to avoid. This is why you must know how the broad scope of the drone program relates to your organization's objectives. Define the scope that the drone program is clearly going to accomplish. Like any project, be clear about what it is trying to do *and* what it is **not** trying to do.

Now, drones can do many things. So, generally, companies try to maximize the return on their investment by spreading out drone use across a lot of different things. This is a natural impulse, but it is also one of the main reasons that could cause a drone program to falter or face bottlenecks.

Since you don't want to end up with too many cooks in the kitchen, spreading the team too thin constantly "jumping around" between different things for different managers, the best way to think about drones is like computers – a standard tool used across the enterprise, but not necessarily shared around departments and multiple users without a clear scope which defines this from the start.

Setting up an inspection drone program, therefore, is best done with a clear scope and goals relating to inspection and asset integrity management, with expenditures that are intended to be focused on this one area, and bringing in personnel to specialize in the use of drones in this particular scope.

### **Challenge #3: Determining the Frequency of Operations**

It is imperative to ascertain if the drone operations are going to be periodic or ongoing. Smartly identifying those things that will need to be undertaken from time to time, or on a scheduled basis, and also those things that will be done continually will help you to plan the drone program in a much more efficient manner.

This frequency of operations, to give you an example, is the key differentiator between drone programs for security surveillance and those for asset inspection. Security users will have ongoing needs that are continuous and located in the same places, whereas surveys or inspections will generally be periodic, and will require that the drone be transported from one place to another.

**[IMG]**



And so, ensuring that the investment in drone technologies is not overstretched across multiple users in the organization, and scheduling the routine as well as periodic requirements for the drones, will help you avoid some very predictable and inevitable issues.

## Challenge #4: Navigating the Regulatory Ecosystem

It is vital the solutions you have planned comply with the relevant regulatory landscape. Operating drones for commercial purposes as part of your AEC operations will likely fall under existing regulations, meaning you'll need qualified pilots to carry out your operations.

If you plan on flying at night, over people, in controlled airspace, or beyond visual line of sight, a waiver or permit may be necessary. Regulations around commercial drone use are likely to shift as aviation bodies around the world attempt to keep up with hardware and software advances. You'll need to closely monitor these updates and ensure a member of your in-house team is responsible for compliance.

[IMGI](#)



www.shutterstock.com · 1581100603

High-risk industries are often privately regulated with their own permits systems. Certain conditions might be required internally for different operations, such as maintaining a certain “stand off” distance between the drone and the assets for different types of flights or following specific requirements when flying directly over people or property. Access Control permits might also be required for the drone operators to move around different parts of a site. In all of this, coordination with safety and site management is key. Not only is it important to ensure understanding and compliance with internal policies in order to get a drone program off to a good start, but your safety and site management stakeholders will also become essential to support the expansion of your drone program over time.

## Challenge #5: Systematic Documentation and Project Management Processes

When you are an organization that is new to drone operations, it's easy to look past the importance of regular, methodical documentation. Systematic and standardized procedures are essential, both for preparation and execution of the operations, as well as for reporting results and keeping the data organized over time. Two critical documents that have become global standards are the Operations Manual (Ops Manual), which lays down the common



standard operating procedures; and Work Method Statements (WMS) which are used for scope organization and safe execution of individual projects.

The Ops Manual is an internal document used to govern the drone program, providing a systematic guide for safe and effective flight operations. Adapted from the commercial aviation industry, the Ops Manual has standard parts which include organizational structure, internal processes, safety management, and template documents to be used for planning, execution, maintenance, and reporting. Often required by regulators for licenses and approvals, an Ops Manual is certainly a best practice and should be developed for any drone program – even if not required by law. Templates are available online ([for example Australia's CASA provides this sample](#)), but it is important to really develop these further to suit the procedures and aircraft that are required for any particular drone program.



(shutterstock from last guidebook)

Work Method Statements are then used for project management, governing specific drone missions to ensure each deployment is executed professionally, getting the results that are needed while also operating safely. Like the Ops Manual, these documents have standard parts which provide clear-cut scope management for the operations, flight planning and data capture considerations for the specific assets to be inspected, and finally, risk assessment and mitigation. Method Statements are absolutely essential, say operators like Halo Robotics, who suggest that it is standard to implement any time a drone is used – even for internal demonstrations and tests – in order to organize the scope and ensure satisfactory deliverables.

Professionalism is key to the success of a long term drone program. Well documented procedures and safety standards for the drone program, together with a systematic project management approach for specific operations, will ensure safety and success of the missions, while also ensuring good records and data management over time.

**[VECTOR - Hi @Ham could we make our own but we inject drone vectors]**



## Challenge #6: Safeguarding and Preparation for Operations

Comprehensive flight planning and preparation for a drone operation is an indispensable part of any successful drone program. In fact, preparation is usually the most time consuming part of many drone operations, whereas the drone data acquisition missions themselves are finished quickly.

Any type of information about the assets that helps the pilots to understand the mission and safety considerations is welcome in the preparation, including schematics, blueprints, diagrams, drawings, photos, CAD models, and previous inspection records. Any and all information about the assets could prove invaluable to ensure that drone operations achieve the objectives and are executed safely.



**[Vector] Hi Ham can we make this nicer and prettier with icons for each bullet point]**

Flight planning is, of course, based on the scope of work that is provided for the assets, but it is important to be specific about:

- The number of flights that are planned
- Battery use and recharging requirements
- Take-off positions and flight routes, and
- Safe flight considerations to avoid flying over people or property, and/or mitigate other identified risks
- Emergency scenarios and specific steps in the event of these situations

|                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |  |  |  |  |  |
| Toxic                                                                             | Harmful or irritant                                                               | Corrosive                                                                         | Biohazard                                                                         | Oxidizing                                                                          | Highly Flammable                                                                    | Explosive                                                                           |

**Risk assessment and mitigation is a crucial part of preparation.** Thankfully, this extremely important step is quite simple to execute. Think through operations systematically, point by point. Your commonly-used risk matrices should start with an initial list of hazards, which should then be quantified into various levels of operational risk with a formula that includes *at least*:

1. **Likelihood** of the hazard occurring; and
2. **Consequence** if the hazard does occur.

After this, create a corresponding list of mitigation steps that will be taken, as needed, to result in a reduced risk score for all the different hazards that have been identified.

**RISK MATRIX:**

|          |                         | Likelihood of Occurrence            |                                 |                                    |                               |                                 |
|----------|-------------------------|-------------------------------------|---------------------------------|------------------------------------|-------------------------------|---------------------------------|
|          |                         | Unlikely<br>< 1 : 1,000,000 – [ 1 ] | Seldom<br>< 1 : 100,000 – [ 2 ] | Occasional<br>< 1 : 10,000 – [ 3 ] | Likely<br>< 1 : 1,000 – [ 4 ] | Definite<br>> 1 : 1,000 – [ 5 ] |
| Severity | Slight Damage – [ 1 ]   | 1                                   | 2                               | 3                                  | 4                             | 5                               |
|          | Minor Damage – [ 2 ]    | 2                                   | 4                               | 6                                  | 8                             | 10                              |
|          | Moderate Damage – [ 3 ] | 3                                   | 6                               | 9                                  | 12                            | 15                              |
|          | Major Damage – [ 4 ]    | 4                                   | 8                               | 12                                 | 16                            | 20                              |
|          | Massive Damage – [ 5 ]  | 5                                   | 10                              | 15                                 | 20                            | 25                              |

**Guide to Matrix**

**Job steps**

**Hazard - Description**

**Hazard - Effect**

**Initial Risk - Severity**

**Initial Risk - Likelihood**

**Initial Risk - Score**

**Mitigation**

**Residual Risk - Severity**

**Residual Risk - Likelihood**

**Residual Risk - Score**

Separate the job into individual tasks and record in sequence

Describe all hazards identified (please note: additional hazards may be caused by interaction with other work)

Describe hazard effect for each task based on observation and experience

From matrix, identify severity with no controls in place for each hazard

From matrix, identify likelihood of occurrence with no controls in place for each hazard

Classify risk rating from matrix for each hazard

list of all controls required

Use initial hazard severity to determine residual risk

From matrix, identify likelihood of occurrence with controls in place for each hazard

Classify risk rating with control from matrix for each hazard

Also include emergency scenarios in your risk assessment and mitigation plans. For any emergency scenarios that are identified, lay out the steps that will be taken in each situation, and ensure that those steps are modified or adapted to every specific drone deployment as needed. Signal loss, for example, is a standard emergency scenario during drone operations, and requires preparation of the Return to Home (RTH) safety settings for the drone in those instances. RTH parameters should be reviewed for every operation, to ensure that the drone follows the best path and altitude to its original take off position, should RTH ever be required. Emergency scenarios can vary across locations and specific assets, so a good preparation will include careful review of this and make specific changes as needed.

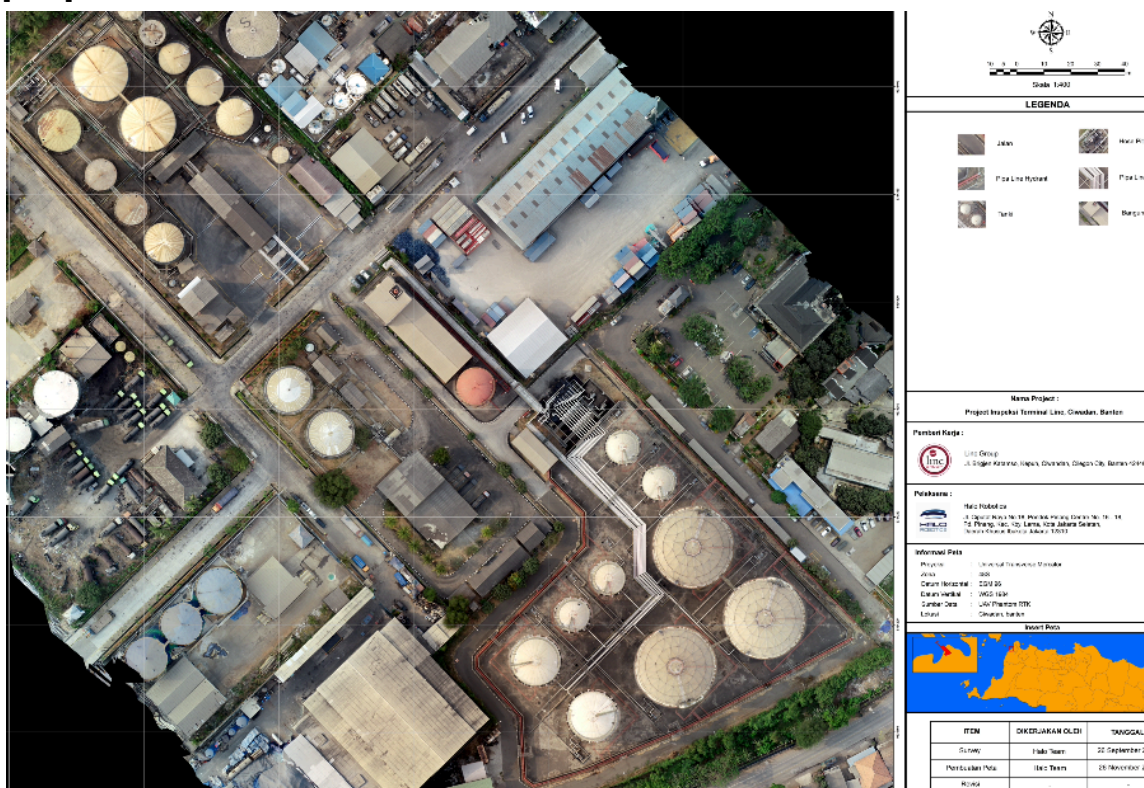
Download Halo Robotic's Method Statement [here](#).

## Challenge #7: Developing a Plan for Data Storage, Analysis, and Reporting

You may begin the drone program with certain fixed deliverables in mind, but as drone inspection data starts to come in, further requirements will begin to be elaborated by the users for the data and asset analysis. Thus, it's important to anticipate the long-term use of the data, and ensure the data is managed well from the start.

The post-processing of drone data – i.e., analyzing the data, reporting the data, and organizing the data – may require additional investments in third-party software and computer tools. Depending on the size of the drone program and the amount of data complexity that is involved, data management and analysis can quite easily become the most significant part of a drone program's cost.

[IMG]



From the beginning, think about how old data will be pulled up for comparison. How will you call back old photos and files, for example, to analyze changes that may be taking place in an asset over an extended period of time? Is the data stored online in the cloud, or is it stored on computers or specific hard drives; and do you have a consistent system to find old files from a specific asset, from a specific date?

If this is a complex subject due to the size and scale of the assets under management, will you seek the help of a third-party software or service provider for this? Or will you do this internally, utilizing an enterprise-level data management tool which your company may have already invested in?



In fact, in the experience of operators like Halo Robotics in Indonesia, safely using drones in high risk environments is often the easiest part of a drone program to implement, while actually the real risk most often overlooked is related to storage and use of the data over time. To mitigate this risk and ensure good long term value from any drone technology investment, the drone program should take proactive steps to set up systems for data storage, data management, and data retrieval over time.

## **Challenge #8: Putting Together a Team that Works**

In many companies, the most successful drone programs include people with prior industry-specific experience of the assets that are at the core of the operations. It is very common that tech-savvy inspection engineers, corrosion engineers, pressure and steam system engineers, and other personnel involved in maintenance inspection and operational management, are brought into the drone program as drone program managers. These are the people who will push for internal innovation, coordinate between many different stakeholders, and ensure that all the functions of the program are running smoothly.



The thing to remember is that flying the drone safely, by itself, is the easy part. Drone technology is now just as user friendly as it is powerful, with clear controls and safety features that make drones relatively easy to learn, and many training providers increasingly available throughout the world, to provide pilot training if needed. The key skills that will actually make or break a successful drone program in a business context are related to professionalism, including preparation and planning, project management, data analysis, and data management.



<https://www.shutterstock.com/image-photo/industrial-zone-steel-pipelines-valves-519431095>

## Setting Up an AM&I Drone Program: Costs and Budgeting

Though your costs and budget will be governed by the project scope and accuracy requirements, keep in mind that a successful commercial drone program always allows for redundancies. This means, a drone program dedicated to any specific asset should budget for two (2x) drones, if not more.

This is important because inspection and survey missions are typically time-sensitive and take place onsite, often in remote areas where there is no quick way to resolve an issue you may be facing. A second 'backup' drone is essential to guarantee operational continuity, even in the worst-case scenario.

And let's not forget that even large-scale, ultra-high-value assets are typically no larger than 5-50 hectares in size, and therefore, can be systematically addressed with a two-drone drone program.

If asset inspection is the only objective, one that can basically be achieved with one type of camera payload, then two or three drone platforms should be able to address even the most rigorous ongoing requirements.

The number of drones will need to be increased if other sensors and applications are brought into the scope. For example, if surveying and mapping requirements are introduced, then, to keep things organized and to prevent overuse of the same drones, more units will need to be purchased.

In terms of pure numbers, a complete DJI M300 RTK drone solution – the gold standard in asset management and inspections – can cost as little as ~\$25,000 with 10-12 spare batteries and charging station equipment. Additional payloads, such as a Zenmuse camera or the DJI L1 LiDAR sensor, can cost anywhere between \$2,500 and \$20,000.

[IMG]



The perfect starter drone for any new asset management and inspection program, the Mavic 2 Enterprise Zoom is available at a starting price of ~\$3,000.



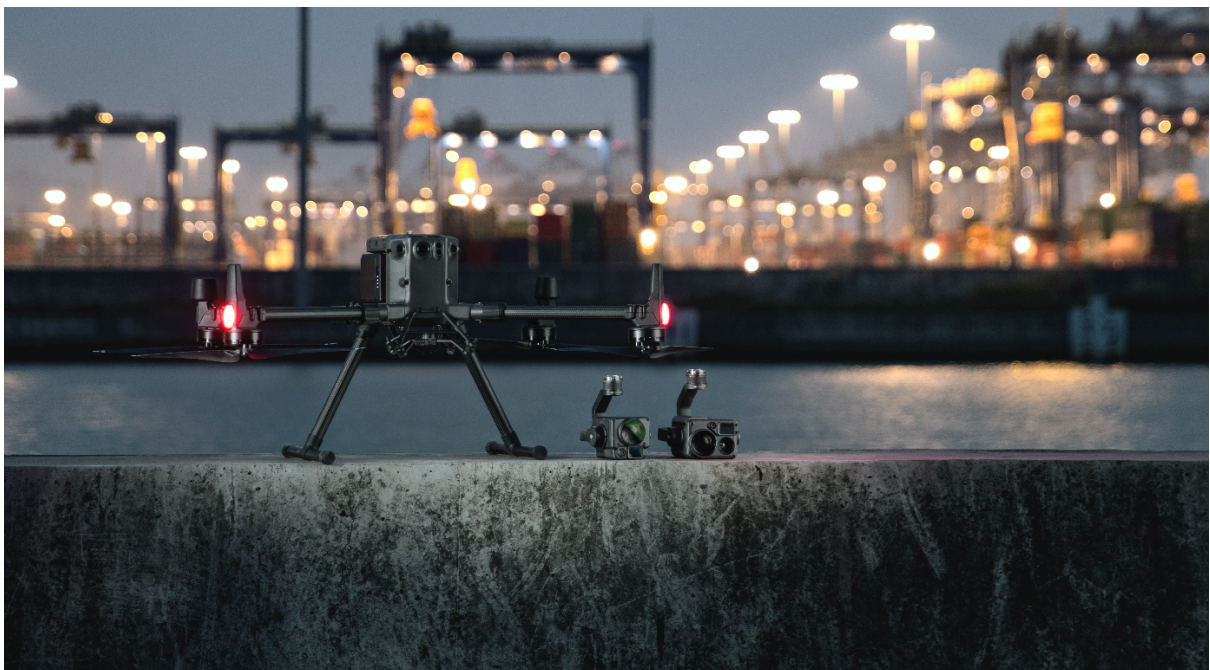
In addition to the hardware, your drone program budget must also account for the license fee of the post-processing software, drone insurance and maintenance outlays, pilot training and certification expenses, costs for any third-party reporting tools or service providers, as well as the salaries of the pilots and drone operations managers.

Continue reading this playbook for more details on these aspects.





## Investing in the Right Hardware





When selecting a drone solution, it is important to recognize your needs and the tradeoff between speed and accuracy. This is how multirotor drones, with their easy maneuverability and advances in autonomous flight and mission planning, have become the go-to tool for aerial inspections and asset digitization programs.

The compact form factor of these drones makes the set-up and take-down extremely easy, ensuring that the drone is in the air or ready to transport to the next location within minutes. Moreover, these drones can work with interchangeable high-spec imaging, thermal, and LiDAR payloads to adapt to the growing needs of any business. This versatility of multirotor commercial drone platforms also means that the market today has something to offer to every budget and requirement.

At the same time, since oilfields and pipelines are often located in challenging environments, a rugged drone that is purpose-built for operations in windy or wet areas could be key. DJI's drones are the perfect starting point:

### **Phantom 4 RTK**

This high-precision machine is engineered to meet the requirements of complex inspection operations. The DJI P4 RTK can provide a full picture of structural issues with centimeter-level accuracy, enabling service teams to locate damages easily with a high-resolution drone map in hand. The drone features strong interference resistance, which means it can easily be used for the analysis of powerlines and surrounding vegetation.

[Click here to learn more, or visit our store to purchase.](#)

**[IMG]**



### **Mavic 2 Enterprise Series**

With an integrated radiometric FLIR® thermal sensor, the M2E Dual offers the best of both worlds – real-time visible and thermal imagery. Not only can you monitor and measure temperatures to detect anomalies, but you can also oversee temperature measurements on specific areas for localized inspection. You can also set predefined Isotherm settings to suit your operational needs. And with a 2x optical and 3x digital zoom camera, you can operate in close range missions without putting any employee in harm's way.

[Click here to learn more, or visit our store to purchase.](#)

[\[IMG\]](#) (can use the same images as the AEC&Surveying whitepaper for products)



## **Mavic 2 Enterprise Advanced**

Building upon the success of the Mavic 2 Enterprise Series, the Mavic 2 Enterprise Advanced has received upgrades to sensors and features which have long been requested by Inspection customers. A massive 48MP visual camera and an improved radiometric thermal sensor with 640x512 resolution at 30 Hz frame rate enables you to capture more detail for temperature-based analysis. The M2EA's revamped waypoint mission planning system and an attachable RTK module allow automated and repeatable inspections, with centimeter-level accuracy and additional safety mitigation in electromagnetic and high frequency environments.

[\[IMG\]](#)



## **Matrice 200 Series V2**

This high-performance solution deck combines a rugged design with advanced flight and data safety, and intelligent control systems. With features like an extended flight range of up to 8km, TimeSync system for data accuracy, IP43 rating, FPV camera, anti-collision beacon, and a dedicated mode for discrete operations, the Matrice 200 Series V2 is a durable and versatile solution for operations in less than ideal environment.

[Click here to learn more, or visit our store to purchase.](#)

[IMG]



### Matrice 300 RTK

Aptly called an [inspector's dream tool](#), the DJI M300 RTK is custom-designed to automate complex inspections. The drone provides protection from EMI, is equipped with a next-gen collision avoidance system, and boasts up to 55 minutes of flight time. It has endured [six hardcore weather tests](#) to earn its IP45 protection rating. And its 20 MP Zoom and 23x Hybrid Optical Zoom empower NDT inspectors to identify even the slightest of defects from a safe distance. The M300 RTK's cutting-edge AI Spot Check feature, meanwhile, utilizes onboard machine learning algorithms to recognize the subject of interest and identify it again in subsequent automated missions for long-term change detection.

[Click here to learn more](#), or visit our store to purchase.

[IMG]



### Zenmuse H20 Series

With multi-sensor payloads that bring a whole new meaning to mission efficiency, the Zenmuse H20 and H20T combine wide, zoom, and thermal cameras to provide the full picture without missing any details wherever or whenever the mission takes place. For asset management and inspection workflows, the series boasts features like AI Spot Check and High-Res Grid Photo that can be trusted to automate routine inspections, provide unparalleled details, and capture consistent results every time.

[Click here to learn more](#), or visit our store to purchase.

[\[IMG\]](#)



### **Zenmuse P1**

The P1 combines a 45-megapixel full-frame low-noise high-sensitivity sensor with envinous data-capturing efficiency – you can take a photo every 0.7 seconds during the flight. This payload also supports a Smart Oblique Capture feature where the drone captures five different images from five different angles to eliminate blind spots and improve the efficiency and comprehensiveness of inspections.

[Click here to learn more](#), or visit our store to purchase.

[\[IMG\]](#)



### **Zenmuse L1**

The L1 is a powerful yet affordable LiDAR drone solution, designed to capture accurate data even during low-light situations or in areas with a dense canopy cover. With an integrated inertial measurement unit providing unparalleled accuracy, the L1 leverages an innovative feature called ‘Non-Repetitive Petal Scan Mode’ to provide the full coverage of an area of interest in very short amounts of time.

[Click here to learn more](#), or visit our store to purchase.

[\[IMG\]](#)







## Prioritize Data Storage and Management

Since data is at the core of every drone program, safeguarding it and storing it securely should be a priority for any organization.

Commercial drones can generate enormous amounts of data very quickly and, depending on the sensors, quite often in different formats. While gathering all the data together to make an inspection report is a challenge in itself, efficient storage and management of the data are also critical to reap the full benefits of a drone program of any scale. This is because drone inspection data essentially *gains value* over time. You can use this data to create predictive maintenance models or simply compare inspection results on a year-on-year basis to analyze any changes that may have taken place.

This makes it important to anticipate ballooning data storage requirements as well. The key is to implement systematic procedures for labeling and storing asset data, using rigorous organization skills right from the beginning of the drone program. Smaller asset managers and drone operators may find it possible to manage the drone data in-house by storing it on secure servers in the headquarters, but it has become increasingly common for larger asset managers and drone service providers to leverage enterprise-level cloud data management platforms.

## **Data Security**

DJI takes your data privacy and security seriously. As part of our commitment to ongoing transparency and education, we have created a Security white paper to help outline key systems and identify security measures DJI has implemented to protect the integrity of user data. We have also provided some [extra steps you can take to protect your data](#) when using DJI products.





<https://www.shutterstock.com/de/image-photo/laptop-control-industrial-drone-1801444393>

## Selecting the Right Software Solution

If you are looking to develop a drone program or sharpening an existing one, picking the right software mix could be imperative to unlocking the true potential of aerial inspection and asset mapping data. Many companies find it useful to work with an all-in-one solution that takes care of all their needs – right from mission planning and data acquisition to post-processing and analyzing the data. An intuitive software solution that fosters automation of complex missions will hit the sweet spot in terms of AM&I workflows.

DJI Terra is one such AI-driven software solution that has been designed to take asset inspections to the next level. The software allows you to easily perform detailed probes on complex assets, while its special optimizations for powerlines ensure that vertical assets and structures are inspected safely.



[Vector - Hi @Ham could we do a vector/icon for each]

**Painless Mission Planning:** Since accurate details are vital to AM&I operations, Terra comes with a special Oblique Mission Planning feature. This mode lets you capture a rich 3D model data set by adjusting the angle of the camera at a tilted angle to receive an extra crisp view of the asset. Other mission types include Waypoints Mission Planning, Corridor Mission Planning, and Detailed Inspection Mission Planning.

**Superior 3D Model Reconstructions:** Terra supports a 5-camera oblique system which allows you to plan 5 flight routes to capture the same amount of data as you would have attained using 5 cameras simultaneously on the drone. The routes will correspond to the 5 camera headings – downward, forward, backward, leftward, and rightward. The end result is more accurate asset digitization than ever before!

**Swift Post-Processing:** Once the data capture is complete, you only need to retrieve the SD card and plug it into your laptop to import the images for post-processing – no special hardware required. To give you some context, Terra requires only 1 GM of RAM to process 400 images from the DJI P4 RTK. Terra also has a 'Region of Interest' image reconstruction feature to target specific inspection areas and save processing time.

**Optimization for Utilities:** The software's CUDA-based reconstruction algorithms are optimized to quickly process large amounts of data to deliver quality models of thin powerlines and complex vertical structures. Terra, in fact, has a dedicated version designed for powerlines and utilities.

**Annotations and Reporting:** You can easily edit labels of observations on inspected assets to improve reporting and communication throughout ongoing AM&I projects.

**Seamless Integration and Ease of Use:** It only helps that the Terra syncs seamlessly with DJI's Phantom 4 series as well as with Zenmuse P1, L1, and X7 payloads. As such, you can expect to get the best, most accurate results from your drone operations by using Terra to process the data. As a bonus, the software is so easy to use that your drone data analysts will not require any special training to get started.



Find out more about DJI Terra [here](#).



## Drone Program Management

Once you are armed with the best hardware and software solution, you will need to devise and iterate the solution's workflow. Broadly, that should include the following steps:

[Vector - Hi @Ham could we do a vector/icon for each]

- **Mission Initiation:** Ensure a process is in place to accept a request for drone data and all the detail that entails.
- **Fleet Logistics and Maintenance:** Devise a method that allows missions and flights to be scheduled with the right payloads for the job. Include a process to ensure equipment is maintained and upgraded as necessary.
- **Pilot Management:** The processes by which pilots are assigned tasks, trained, and supervised.

- **Compliance Management:** Design processes to ensure local airspace and flight regulations are adhered to during every mission, in addition to internal procedures and compliance requirements.
- **Mission Planning:** Put in place a pre-flight checklist that includes a schedule and flight plan covering altitude, the route and any external factors. Ensure emergency scenarios are covered in risk assessments and mitigation plans.
- **Data Collection and Storage:** Define and prepare data collection methods, including sensor, payload and software procedures.
- **Logging Flights:** Collect operational and telemetry data to document and learn from each flight.
- **Data Analytics:** Devise a method to process captured data into something useful.
- **Ongoing Program Development:** Ensure that stakeholder feedback is sought and incorporated to iterate applications and workflows as time goes on.



(from last guidebook)

## Regulations and Permits

Though regulators in many parts of the world are still playing catch-up to swift advancements in unmanned hardware and software, drones have proven that contactless operations make them an essential tool to safeguard the viability of heavy industries in the long-term. The way the drone industry has rallied to face the unprecedented challenges put forth by the COVID-19 pandemic has made civil aviation authorities realize that the need to find the right balance between public safety and innovation is now more urgent than ever.

Today, the public acceptance of drones is at an all-time high. And, as such, it is absolutely vital to ensure that your drone program fully complies with the local laws and regulations and helps to retain the trust that has taken some time to come to this industry. It may even be worthwhile to seek expert guidance when cultivating advanced operations with one eye on the future.

### **Drone laws: United States vs. European Union**

There have been notable differences between how the United States' Federal Aviation Administration (FAA) and the European Union Aviation Safety Agency (EASA) have

approached drone regulations in the past. The US has been able to provide much stronger and clearer mandates, while EASA's multinational makeup has meant that the civil aviation authorities of its member states have had their own interpretations of what should be made permissible and what not. But all that has changed now.

On Dec 30, 2020, the European Union adopted [standardized drone regulations across the continent](#), paving the way for an era of harmonization across the 27 EU Member States as well as Iceland, Norway, Liechtenstein, and the UK. In Switzerland, domestic discussions are currently unfolding on whether to apply the full regulations, part of them, or none at all.

## **US Regulations**

The FAA permits the operations of a small drone weighing less than 55 pounds (25 kg) for commercial purposes if the Part 107 guidelines are followed. There are three main steps to the process:

### **Step 1: Learn the Rules**

Though you can access a summary of the Part 107 rules [here](#), the highlights include:

- Visual line-of-sight (VLOS) operations only
- Daylight-only operations
- No flying over people
- Maximum groundspeed of 100 mph (87 knots) and maximum altitude of 400 feet
- No careless or reckless operations
- No carriage of hazardous materials
- One operator can fly only one drone at one time

### **Step 2: Become an FAA-Certified Drone Pilot by Passing the Knowledge Test**

You can obtain a Remote Pilot Certificate from the FAA if you are at least 16 years old and pass the initial aeronautical knowledge exam. This certificate will be valid for 2 years, post which certificate holders will need to pass a recurrent knowledge test every two years. Note that the FAA requires the certificate to be easily accessible by the remote pilot during all drone operations.

### **Step 3: Register your Drone with the FAA**

Registration costs \$5 and is valid for 3 years. Once you've registered, mark your drone with your registration number in case it gets lost or stolen. The marking can be done via engraving or using a permanent marker or label.



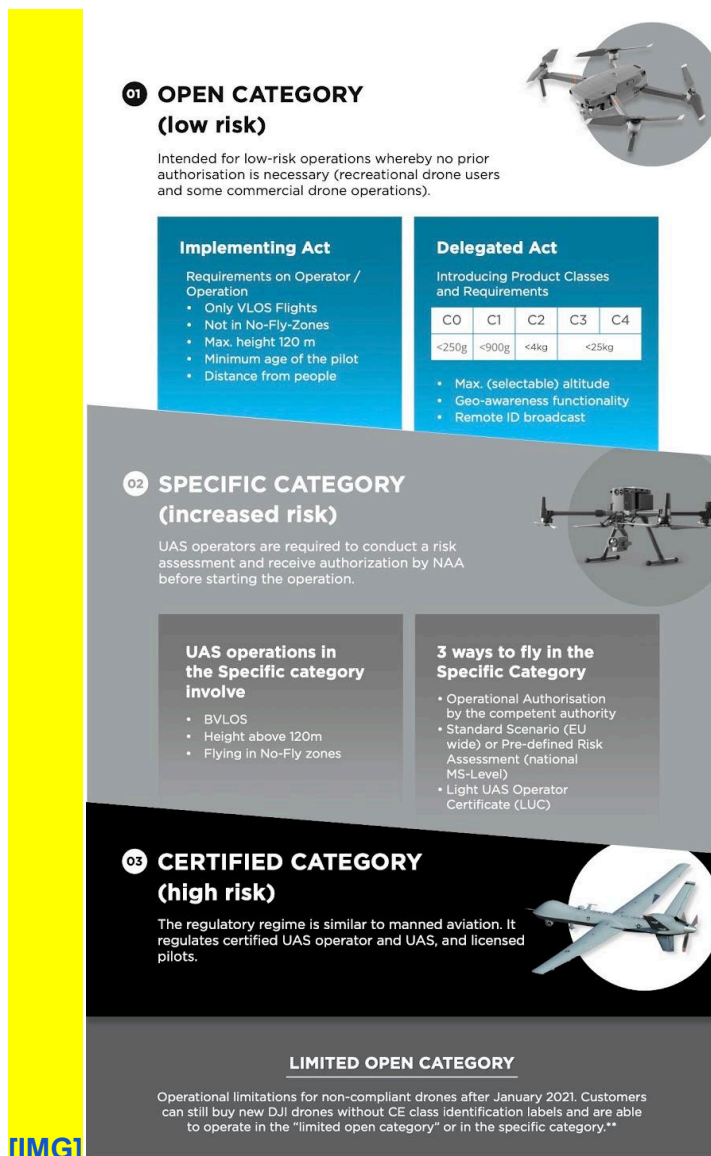
## **EU Regulations**

The new European Drone regulation divides drone use into three categories of operations: the 'open', 'specific' and 'certified' based on their level of risk.

The 'open' category addresses operations in the lower risk bracket, where safety is ensured provided the drone operator complies with the relevant requirements for its intended operation. This category is subdivided into three further subcategories called A1, A2, and A3. No authorization is required before starting a flight ...

The 'specific' category covers riskier operations, where safety is ensured by the drone operator obtaining an operational authorization from the national competent authority before starting the operation. To obtain the authorization, the drone operator is required to conduct a safety risk assessment, which will determine the requirements necessary for safe operation of the drone(s).

In the 'certified' category, the safety risk is so high that certification of the drone operator and the aircraft is required to ensure safety, as well as the licensing of the remote pilot(s).



**01 OPEN CATEGORY (low risk)**

Intended for low-risk operations whereby no prior authorisation is necessary (recreational drone users and some commercial drone operations).

**Implementing Act**  
 Requirements on Operator / Operation
 

- Only VLOS Flights
- Not in No-Fly-Zones
- Max. height 120 m
- Minimum age of the pilot
- Distance from people

**Delegated Act**  
 Introducing Product Classes and Requirements
 

| C0    | C1    | C2   | C3    | C4 |
|-------|-------|------|-------|----|
| <250g | <900g | <4kg | <25kg |    |

- Max. (selectable) altitude
- Geo-awareness functionality
- Remote ID broadcast

**02 SPECIFIC CATEGORY (increased risk)**

UAS operators are required to conduct a risk assessment and receive authorization by NAA before starting the operation.

**UAS operations in the Specific category involve**

- BVLOS
- Height above 120m
- Flying in No-Fly zones

**3 ways to fly in the Specific Category**

- Operational Authorisation by the competent authority
- Standard Scenario (EU wide) or Pre-defined Risk Assessment (national MS-Level)
- Light UAS Operator Certificate (LUC)

**03 CERTIFIED CATEGORY (high risk)**

The regulatory regime is similar to manned aviation. It regulates certified UAS operator and UAS, and licensed pilots.

**LIMITED OPEN CATEGORY**

Operational limitations for non-compliant drones after January 2021. Customers can still buy new DJI drones without CE class identification labels and are able to operate in the "limited open category" or in the specific category.\*\*

[IMG]

EASA has made these rules available in a consolidated, easy-to-read format [here](#). It's worth observing that DJI's products tick all the boxes in terms of compliance with these new laws, including relevant or applicable EU CE directives.

## Unmanned Traffic Management

In the meantime, the race is also on to develop the best standards and rules for urban air mobility and a traffic management system for drones, aka UTM. Once these regulations are in place, drone operators across the US and EU should be able to reap the benefits of flying drones safely over long distances beyond visual line of sight (BVLOS) for asset management and inspection. Right now, this cannot be done without applying for and receiving special BVLOS waivers from aviation authorities.



(from last guidebook)

## Training

The FAA requires drone operators to obtain a Part 107 certification before they can fly for commercial purposes such as asset management and inspections. EASA's new rules, on the other hand, mandate pilots to take a practical exam before flying drones that weigh between 4 kg (9 lbs) and 25 kg (55 lbs) – irrespective of whether it is for commercial purposes or recreational ones. This certification stays valid for five years and operators are needed to display their license number on each drone they fly.

It is a common practice among organizations to select existing employees from their inspection teams and cross-train them to obtain pilot certifications. Alternatively, it may make

more financial sense for some businesses to kick off their in-house drone program by hiring experienced pilots and facilitate training for other workers in preparation for scaling the program.

In any case, for the complete mission readiness of your pilots and managers, a comprehensive training module is necessary. By covering topics like drone rules and regulations, technical aspects of the product, equipment go/no-go criteria, preflight and in-flight checklists, the effect of weather patterns on operations, safe storage of drone data, and how to deal with different emergencies, you can empower your team to conduct safe, fast, and effective AM&I missions.

And remember, training is not a one-time event. It should continue on the job as more applications develop. You could even employ the services of an external party, such as a retired manned aircraft pilot, to help create flight standards and incident protocols.

DJI's partner network, including Halo Robotics, also provides certified training, official warranty, and repair support, and a service approach centered on a partnership philosophy, to help organizations grow their use of drones and achieve high-value results. More information about Halo Robotics training programs [can be found here](#).







(from last guidebook)

## Maintenance

Regular maintenance checks are necessary to improve the efficiency and safety of your drone fleet. And industry leaders like DJI make it a point to handout [maintenanwce tips](#) for their top-of-the-line machines. However, since drones are highly-complex technology products, involving many intertwined systems, a regular operator can find it difficult to inspect and maintain a drone fleet without professional help.

For that reason, it is important to source your commercial drone products from a reliable solutions provider who can handle any technical after-sales and maintenance requirements that may come up through the regular use of drones. Specialized arrangements, such as Service Level Agreements or SLAs, can also be developed with suppliers to assure maintenance, repairs, and replacements in a given period of time or at a fixed cost.

## DJI Maintenance Program

DJI offers dedicated Maintenance Programs to its customers in North American and European Union. Since the question 'When do I need to service my drone?' is one that will invariably come up when you are budgeting for maintenance costs, DJI has also created a general service timeline for new customers.

[Graphic:

[https://enterprise-insights.dji.com/hs-fs/hubfs/Maintenance%20Cyle%20Infographic%20\(1\).png?width=1755&name=Maintenance%20Cyle%20Infographic%20\(1\).png](https://enterprise-insights.dji.com/hs-fs/hubfs/Maintenance%20Cyle%20Infographic%20(1).png?width=1755&name=Maintenance%20Cyle%20Infographic%20(1).png)

| RECOMMENDED MAINTENANCE CYCLE<br>Guideline on When to Use DJI's Maintenance Service |                            |               |
|-------------------------------------------------------------------------------------|----------------------------|---------------|
|                                                                                     | Cumulative Equipment Usage | Service Level |
| 1st Check                                                                           | 6 months or 200 hours      | Basic         |
| 2nd Check                                                                           | 12 months or 400 hours     | Standard      |
| 3rd Check                                                                           | 18 months or 600 hours     | Premium       |
| 4th Check                                                                           | 24 months or 800 hours     | Basic         |
| 5th Check                                                                           | 30 months or 1,000 hours   | Standard      |

Notes:  
(1) The usage that triggers the need for a maintenance check is either months between the last service or total flight time, whichever comes first.  
(2) The maintenance cycle continues past the 5th check, only stopping when an organization has retired a specific aircraft.

DJI drones are very high quality and dependable tools with fast-moving parts inside, including motors and electronic speed controllers (ESCs). Like with any aircraft, the best practice is to replace these parts after a certain number of flight hours. DJI drones being quite robust, a full replacement of the fast-moving common parts is not required until 600 hours of flight. In high-risk environments, you may choose to get these parts replaced after 400 hours of flight.

You will also need to replace the batteries from time to time. DJI invests highly in developing rigorous batteries for long-term use, with smart features incorporated to increase their life and safety redundancies. If you follow these [best practices for care and maintenance](#), you can get the most from your DJI batteries.

Nonetheless, if you regularly operate in high-risk environments such as near powerlines, it is recommended to replace the batteries after 100 flight hours. The old batteries can still be used for training new pilots, conducting demos, and other incidental requirements.

### **DJI Care Enterprise**

In addition to being on top of your maintenance game, it is also a good idea to invest in a comprehensive protection plan, such as DJI Care Enterprise, which will give you unlimited replacements or free repair services for accidental damage such as crashing, water damage, or signal interference. With options of free shipping and rapid delivery, this plan will give you the peace of mind you need to concentrate all energies on the mission itself.

Read more about DJI Care Enterprise and different plan options [here](#).



<https://www.shutterstock.com/image-photo/gas-turbine-electrical-power-plant-twilight-1723451140>

### **Summing Up**

Creating a successful drone program that provides robust data, improves workplace safety and efficiency, increases uptime, and provides a measurable impact on a business is not difficult if you get your fundamentals right. Yes, it is going to take time and a lot of planning, but once you have designed a drone program that fits your organization's needs perfectly, the benefits are immediate.

As you have seen throughout this guidebook, DJI has developed end-to-end hardware and software solutions for AM&I workflows that are guaranteed to streamline your operations and fatten your bottom line.

### **Get Your Drone Program Off the Ground**

DJI and its partner network work with enterprises around the world to supply and facilitate the deployment of drones for asset management and inspection workflows. To start your drone journey, get in touch with us [here](#).