

CS124870

# Up, Up, and Away: UAV'ing in the Great White North! Eh!

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## Learning Objectives

- Learn the impact and benefits of drones on construction sites
- Discover lessons learned from an early adopter
- Learn about data capture from a drone and its uses
- Learn how to set up a drone fleet for your company

## Description

The drones are coming!

Are you considering buying one for your firm?

It's more involved than just grabbing the top of the line and then hitting the site for a flight. Yes, rules, regulations, and safety standards—our favorite words as Building Information Modeling (BIM) managers.

PCL Construction is the first contractors in Canada to have applied for and be granted a Special Flights Operation Certificate (SFOC) and amendment to fly to an altitude of 830' along with a No-Fly Zone (NFZ) on a T1 airport on a weekly basis.

These are some of our findings and lessons learned from using these tools on a construction site in a "cooler" climate.

- What are the regulations in Canada with Transport Canada and NavCanada?
- What is an SFOC or a Notice to Airmen (NOTAM)?
- What are the regulations in the United States? What is a Part 107 and an NFZ?
- What are the possible uses of drones, unmanned aerial vehicles (UAV), and unmanned aerial systems (UAS)?
- What data can be captured?
- How can it be processed?



## **Speaker**

Just short of the 30-year mark Mirra has been involved in AECO industry gaining a reputation for quality design and documentation and 9 years ago made the transition from traditional 2D to 3D modeling and is active in supporting others also transitioning through involvement in CanBIM, buildingSmart Canada, and the founder and chair of the local BIM user group in Edmonton BIM Community (eBIMc). And is now pioneering emerging technologies in Virtual Construction workflows to enhance PCL's processes in proposals, pursuits, estimating, operations, using a variety of applications, FormIt, InfraWorks, Civil 3D, Revit, Navisworks, 3D Studio, A360, Glue, Field, Bluebeam and yes AutoCAD.

## Regulations – These are both subject to change in Canada and the US

### Canada

#### Transport Canada

If you fly your drone for fun and it weighs more than 250 g and up to 35 kg, you do not need special permission from Transport Canada to fly.

UAS flights for fun (personal use)

- if the unit weight between 250g and 35 kg
- max height 90 M above ground
- 30 M away from vehicles and public (250 g to 1kg)
- 75 M away from vehicles and public (1kg to 35 kg)
- 5.5 KM away from aerodromes
- 1.8 Km away from heliport
- 9 Km away from disaster area
- Daylight only
- Line of sight
- 500 M of yourself
- Respect the privacy of other, cannot fly over private property taking photos of videos without permission

Non-recreation UAS, for work or research, and weight is more than 35 KG you must get a Special Flight Operation Certificate (SFOC) this outlines where and how your allowed to use your UAV.

#### **About the Special Flight Operations Certificate (SFOC)**

The *Canadian Aviation Regulations* (CARs) require unmanned air vehicle (UAV) operators to apply for SFOCs so Transport Canada can ensure operators use their UAV reliably and safely.

Each SFOC contains conditions for where and how to fly, such as:

- maximum altitudes
  - minimum distances from people and property
  - coordination requirements with air traffic services
- 
- If you fly a UAS where you are not allowed and choose not to follow the rules then you can face fines up to 3,000 (Canadian)
  - If you fly a UAS without a SFOC and should have one, the fine is \$5,000 and \$25,000 for a corporation

- Not following the requirements of your SFOC is a \$3,000 fine and \$15,000 for a corporation.

There are new regulations are coming within the next year so check back with the site

<https://www.tc.gc.ca/eng/civilaviation/publications/page-6557.html>

<https://www.tc.gc.ca/eng/civilaviation/opssvs/flying-drone-safely-legally.html>

<https://www.tc.gc.ca/eng/civilaviation/opssvs/proposed-rules-drones-canada.html>

## USA

### Part 107 – Small UAS Rule

According to Small UAS Rule (Part 107) released by the FAA on August 29, 2016 anyone who passes the remote pilot certificate exam will be legally allowed to fly a drone for commercial purposes.

<https://www.faa.gov/uas/>

[https://www.faa.gov/uas/getting\\_started/fly\\_for\\_work\\_business/becoming\\_a\\_pilot/](https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot/)

<https://3dr.com/faa/study-guides/>

An understanding of regulations pertaining to UAS flights

- Class A
- Class B
- Class C
- Class D
- Class E
- Class G
- NOTAM
- Visual line of sight (VLOS)
- Pilot in Charge (PIC)
- Operations over humans
- Prior authorization in certain airspace
- Operations near airports

Waivers

[https://www.faa.gov/uas/beyond\\_the\\_basics/#waiver](https://www.faa.gov/uas/beyond_the_basics/#waiver)

## The End is the Start for a UAS Selection

What do you want to use your UAS for? What are your end goals?

With the selection of the right unit for your firm it is best to have a clear picture of what your firm wants to achieve with your flights.

### Progress Photos

The quality of a UAS camera is quite remarkable and great for progress photos as a minimum.

### Videos

Having regular flights at set intervals or when there is a milestone will create a new deliverable for the clients and project team to see the progress of the building and compare this with the schedule.

### Aerial Photos – Orthomosaics Generation

There are several software's applications that will automatically process photos and these are combined into one single image. This will generate a Georeferenced image and optional surface model in various formats

#### Georeference Orthomosaic Image

This will generate an image in a Jpg or Png that will give you accurate measurements and are georeferenced

#### KML Tile Set

For display in Google Earth

#### Point Cloud (LAS)

LAS files can be imported into Civil 3D, ReCap then InfraWorks or Navisworks

#### Digital Surface Model (DSM) (GeoTIFF)

3D representation of the terrain's surface in a GeoTIFF format or also a DEM (digital elevation model) which will import into Civil 3D and InfraWorks

#### 3D Model (Obj)

3DS file that will import into most Autodesk platforms

## Inspections

Many firm and UAS pilots offer inspection services these can be photos and videos

## Thermal Data

Thermal cameras can be attached or bought for the UAS and these will capture heat loss and or other damage to the building envelope

## Factors for the Section

### Cost – What is your budget

Set a budget and do not look at the units outside this.

### Unit

Find a unit that fits your end goals and works with your location, temperature, moisture and wind conditions.

There are units that are all one (fixed) camera with a unit body and others that that have interchangeable payloads (camera).

### Payload the Camera!

This is where the expense goes up.

Find a camera photography expert in your company a “Gear Head”. Your camera will determine the quality and data captured from your flights.

- Video resolution
- Photo resolution
- Field of view
- Weight of camera
- Mechanical Shutter
- ISO Range

### Battery Life

The average temperature of your location will affect the battery life if your climate is too hot or too cold and will shorten the flight time drastically.

## Temperature

If you live in Edmonton, or similar where the average yearly temperature is 2 above freezing there are not a lot of units that will fly below freezing. If you have more rainy days than dry, moisture and fog will keep you from flying. Battery life is cut down the colder it gets outside can drop to half.

## Wind

High winds will also keep you out of the air and will impact the unit price as the price increases with the ability to fly in higher winds. High winds also cause battery life to decrease, thus if your climate is windy you will need to look at battery life closely.

## Your sites locations

Analyze where most of your sites or locations you plan to capture are. Are they in open areas or in an urban center? Both of these will affect your unit selection as some units have challenges operating in downtown centers. Also if your sites have tight property lines to the building this will affect your camera FOV. Some cameras need to be further away from the building to capture the building face.

## Size of your Company

### Data Storage

These photos and videos captured are extremely large and the better the quantity of the camera the larger these will become.

Hard drive space and bandwidth will become an issue

## Maintenance

### Air Data

### Operations Log

### Maintenance Log

**Flight Log**

**Unit Repair**

**Batteries**

**Operations procedures**

**Checklists**

## **Safety Considerations**

**Manual of Operations**

Procedures to the operations for the UAS program as well as for individual flights for.

**Insurance**

You will need to get insurance to fly.

**Weather**

Great app for this is UAV Weather

- Temperature
- Rain
- Clouds
- Fog
- Lightning
- Wind gusts
- Wind direction

**Checklists**

Humans forget things when distracted checklists are needed

- Preflight – 48 Hours
- Preflight – 24 Hours
- Preflight inspection
- Flight
- Post Flight



## Back-up plan

What to do in an emergency, plan for this before take-off in the air. You need to be ready for a loss of aircraft control link, a fly-away and loss of GPS signal and how to deal with each of these.

## Pilot stress

Recognize limitations

- Heatstroke
- Dehydration
- Frostbite
- Alcohol
- Medication
- Stress and fatigue
- Vision
- Fear

## Safety Kit

Have one

- Radio to monitor manned aircraft communications
- Radio for team if two command stations
- Spare PPE
- Spare parts
- Extra pens
- Class D fire extinguisher
- First aid kit
- Tools
- Water
- Back up power or second iPad

## Applications for Orthomosaic Capture and Generation

### [Pix4D](#)

Allows you to capture, process, analyze and share your data all in one program and web interface with their mobile to desktop to cloud solution

### [Drone Deploy](#)

Another mobile app that will analyze and share your data that you capture.

### [3DR Site Scan](#)

Another mobile app that will analyze and share your data that you capture

### [Skycatch](#)

Mobile application and web based hosting site that automatically processes and exports files for Autodesk, will do volume measurement, importing cad plans, and will support ground control points (GCP) in local coordinates.

### [AeroPoints \(Propeller\)](#)

AeroPoints are the world's only ground control points designed specifically for drones.

## Applications for Capturing your data (iPad based)

### [Autopilot](#) - \$29.99

DJI's own Go app is capable, but Autopilot adds a range of new features that make a DJI Phantom, Inspire 1 or Mavic Pro into a much more capable camera platform. It provides new ways to move the camera and track objects, creating much smoother, more natural-looking cinematic shots. Autopilot also captures a lot more data while the drone is flying, which is useful if you are having a technical problem and want to know where the problem lies.

### [Litchi](#) - \$19.99

Litchi is one of the most popular autonomous flight apps on the market. With a few simple clicks and taps users can set up flight plans that go way beyond a simple waypoint mission engine. Features include your standard Panorama, Orbit and Follow me, but you can also use select Focus mode, where Litchi assists you by taking control of both the gimbal and the drone's yaw axis, freeing you up to concentrate on horizontal movement.

Litchi creates readable flight logs for each flight, before automatically uploading them to your HealthyDrones account. This is a great feature for pilot's keen on instant post-flight analysis.

### [AirMap](#) - FREE

AirMap initially looks like just another map app for drones, indicating where you can and can't fly. It does that (in fact, most other apps source their no-fly-zone maps from AirMap), but it offers one interesting new feature: a Digital Notice and Awareness System. This is a new AirMap system that lets you push a button to notify nearby airports that you are flying a drone.

It's legal to fly a drone within 5 miles of an airport, but you should notify the airport or local air traffic control in case they detect it on their radar. AirMap does this online, using a system that the company is building in cooperation with airports, 125 of which support the system so far. This same system also keeps an eye on local air traffic, warning you if any manned aircraft are flying nearby.

### [Airster](#) – \$19.99

Airster offers pre-flight planning, waypoints and points of focus. The route your drone will take can be drawn with a swipe of your finger, and each point of interest is added by dropping a pin on the map.

Airster also comes with a 'Motion Camera' feature, which allows you to control your drone's camera just by panning and tilting the connected iOS device.

### [Parrot Flight Plan](#)

All Parrot drones come with a free app called FreeFlight Pro, which handles the basics of flight, providing on-screen controls and a preview of the camera image. The \$20 optional Flight Plan takes this further, adding the ability for you to plan a flight, then send that information to the drone for it to fly autonomously. You create a flight plan by selecting waypoints and how high you want the drone to be at each one. The app then calculates the path to take to fly between them, and, with the tap of a button, sends the drone along this flight path.

More advanced features are also available, such as controlling the direction that the camera is pointing and controlling when video is recorded. These preplanned flights can also be saved and reloaded at any time, which is useful if you want to take seasonal or construction videos.

### [Pix4D](#) – FREE

Photogrammetry is the process of creating a 3D model from a 2D image, such as a drone video. That's what Pix4D does: This app automatically creates a flight path for

your drone (models from DJI, 3DR and Parrot are supported), then uploads the video and flight data to the Pix4D servers. You can then use these servers or your desktop PC to crunch through this data, turning the images and location of the drone into a 3D model of whatever you were flying over. The full service isn't cheap (\$499 for a year's subscription of unlimited model making), but Pix4D does offer a 15-day trial that will allow you to try out the service.

### [Hover](#)

Flying a drone requires two things: good weather and a spot from which to take off. Hover helps you find both by providing a simple fly/no fly indication, based on live weather updates and a database of no-fly zones. At a glance, it indicates whether your location is a good one and if the weather is suitable for takeoff. The app also provides details of how the weather is going to change over the next few hours, which is useful for figuring out if you should fly now or later. It's a simple app that every drone pilot should have, and it also includes a simple flight log that helps you track your flying hours.

### [DJI Ground Station Pro](#) – FREE

DJI's app for serious and professional drone users who want to create complex autonomous flight paths. It's design to make the process of creating these paths easier by automating it. The user secrets an area on a map that they want to survey, and the app automatically creates a flight path that covers the entire area, giving you the ability to adjust the amount of details that is needed.

This is good app for a quick, rough overview, and if you want a more detailed image for a 3D model or for surveying it will create a path with more passes that provide the multiple views that the enhanced detail needs.