65 PRO TIPS

FOR RUNNING YOUR DRONE OPERATION

A SKYWARD WEBINAR COMPANION GUIDE

Watch Webinar Recording

Skyward

At Skyward, we've received thousands of questions from commercial drone operators around the world on everything from training to pricing to operations to data collection. We invited three experts to share their experience and provide tried-and-true tips on:

1. Training
2. Pricing
3. On-Site Efficiency
4. Maintenance
5. Data Analysis
6. Marketing

This information is also available via an on-demand webinar recording that you can watch here. This eBook allows you to review all 65 pro tips covered in the webinar, and it goes in depth on a few key areas with further insight from our panel of experts.

Meet the Panel

Tariq Rashid is the flight operations lead and a professional services analyst at Skyward. He is a retired U.S. Navy helicopter pilot with 2,350 flight hours and significant operational experience in demanding environments flying from ship and shore. Tariq is a Computer Modeling & Simulation M.S. graduate from the Naval Postgraduate School and has experience with business process automation at the headquarters level. He has spent several years in Europe and the Middle East working with international staff. At Skyward he specializes in synthesizing emergent commercial aerial robotics operational policy from the domains of both aviation and computer science.

Alan Perlman is the founder of Drone Pilot Ground School. He's an FAA-certified drone pilot and logs flight hours on a wide variety of models and reports on drone regulations, new technology, and other industry developments at UAV Coach, which he founded in 2014 to help new drone pilots break into the sUAS industry. When he's not behind the computer or outside flying, he's likely playing with his dog Bleeker.

Alan is a graduate of Washington University in St. Louis. Earlier in his professional career, he ran a boutique marketing agency, built a customer certification program for a publicly-traded marketing software company, and traveled to 50+ countries as a cost-of-living research analyst.

Thomas Haun is a commercial, business development, strategy, marketing, and finance leader experienced with new business creation. He currently leads global business execution for PrecisionHawk, where he oversees strategic direction, ecosystem development, and commercial performance.

Previously Thomas was a member of DuPont's Management Leadership Development Program where he built new market opportunities for DuPont Pioneer's Encirca services business and internal commercial strategy development for several DuPont businesses. He holds an MBA from Harvard Business School, as well as a BS in mathematics and BA in economics from the University of Maryland.

TRAINING

Knowledge Training: Preparing for the Part 107 Knowledge Test

Training falls into two different categories: *flight* training and *knowledge* training. In the United States, the FAA requires all pilots flying commercially under Part 107 to pass a knowledge exam at an approved test center. There are a few important things to keep in mind when preparing for this test, whether you're an individual or an organization preparing a team of operators to pass.

The test comprises 60 questions covering information from 120 topics including:

- How to read a METAR & TAF report
- How temperature inversion and density altitude can affect flight performance
- Reading a VFR Sectional

Overall, the knowledge exam is approachable but it does require some studying, especially for those without an aviation background.

> *"The biggest challenge for most of our students is learning how to read a sectional chart. Specifically, distinguishing between different airspace classes, the rules for accessing controlled and uncontrolled airspace, and how to interpret all of the information on the chart."*
>
> -Alan Perlman,
> Drone Pilot Ground School

TRAINING TIPS

1. Create internal requirements for knowledge tests and flight exercise tests.
2. The FAA recommends 20 hours of study to pass the Part 107 Knowledge Exam—find a study buddy!
3. Send any personnel without aviation backgrounds to an online or in-person ground school specific to sUAS.
4. Consult resources like Skyward's Airspace User Guide and map to know where it's safe to fly.
5. Read your user manual at least three times through.

Flight Training: Master Safe Drone Operations

Getting certified as a commercial drone operator doesn't necessarily mean that you're a qualified UAS pilot. The FAA doesn't require a flight proficiency exam for the remote pilot certificate. To become a master pilot, focus on these two things:

1. Flight Simulators

Using a flight simulator can be a cost effective way for individual pilots and companies to overcome the initial hurdle of learning to fly quadcopters. They allow you to navigate the controls in a safe environment without risk to an aircraft. Many that are currently on the market offer realistic flight environments. Plus, you don't have to worry about weather, airspace restrictions, or daylight.

You'll have the flexibility to train anytime that is convenient to you. Alan Perlman of Drone Pilot Ground School recommends this resource to help choose the right tool.

2. Flying Manually

Too many new pilots skip foundational steps such as reading the aircraft user manual (at least three times) to understand all settings, modes, and failsafes.

GPS can never be relied on entirely. When you're building multirotor flight proficiency, always fly without GPS.

It takes more than sporadic short flights to improve your skills as a remote pilot. Take the time to invest in regular flight training to make continual improvement.

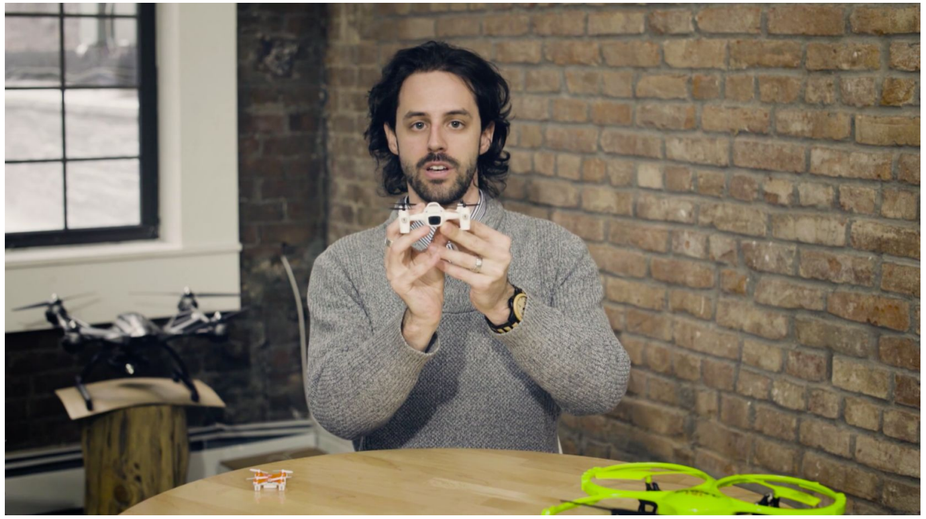
6 Use a simulator to log additional flight hours.

7 Learn to fly manually, without GPS—embrace ATTI mode.

8 Checklists are a pilot’s best friend. Develop and standardize across your flight crews and teams.

9 Buy extra batteries. Always have more flight time available than you think you’ll need.

10 Master multirotor orientation with a deliberate set of milestones.



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www.dronepilotgroundschool.com

Master Multirotor Orientation with a Deliberate Set of Milestones

If you've never flown before, or if you're a company looking to get more employees involved in your UAS program, it's important to establish guidelines and milestones for flight training. If you're building a training program think about the proficiency goals you'd like your pilots to attain. Alan Perlman of Drone Pilot Ground School recommends including mastery of these maneuvers in your requirements:

1. Hover at eye-level
2. Hover and yaw, left and right (10:00 and 2:00, and 9:00 and 3:00 on an imaginary clock face)
3. Targeted takeoffs and landings
4. Square pattern, with and without yaw
5. Circle pattern, with and without yaw
6. Figure-8 pattern, with and without yaw
7. 180-degree inverted landing

PRICING

PRICING

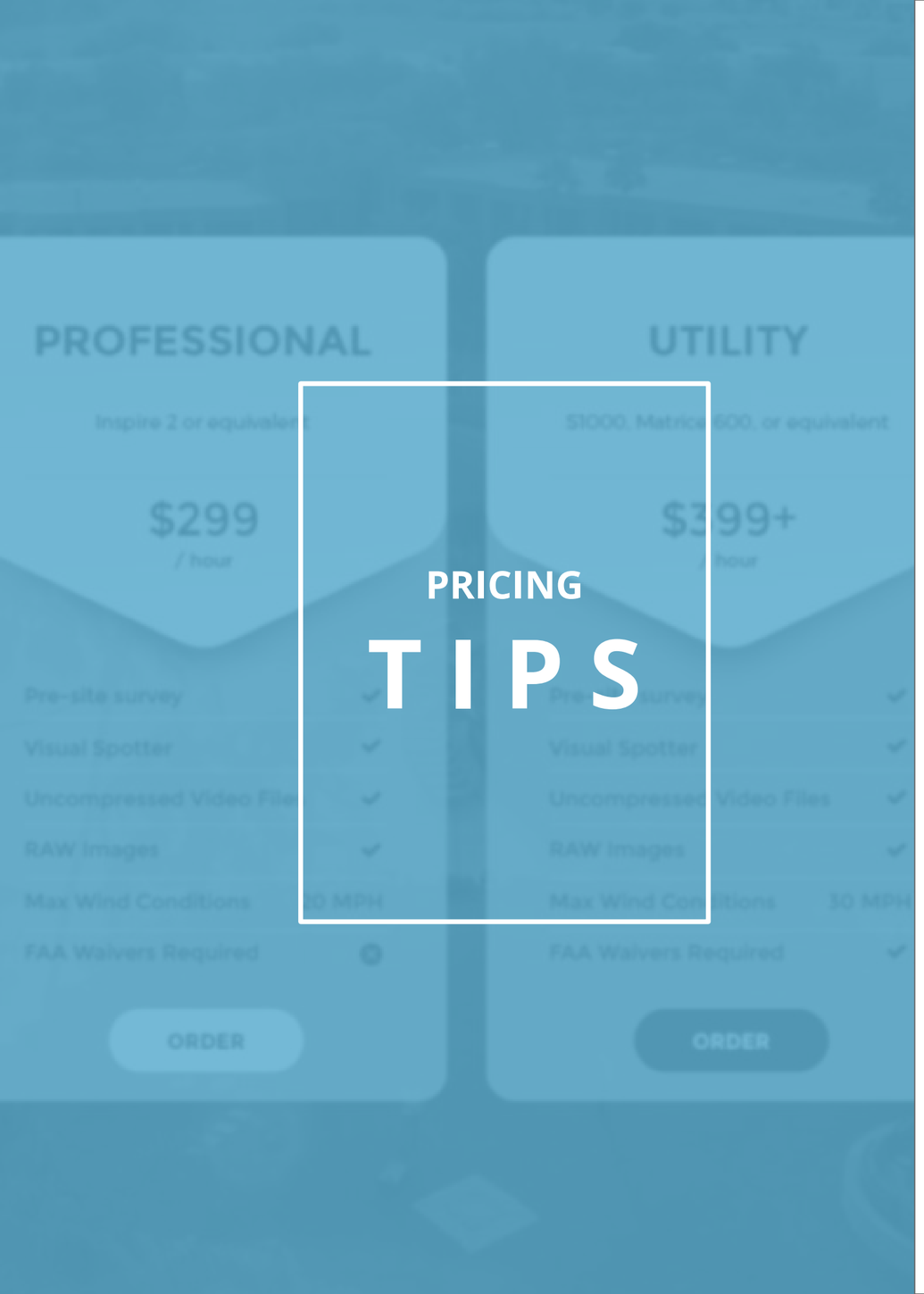
Successful training eventually leads to expertise. And proven expertise allows operators to command a higher price for services. We hear from many business owners and entrepreneurs who are unsure of how to structure pricing for drone services. Operators are asking: “How much do I charge for services and what is a fair price?”

People will pay up to the limit of what they can afford. If you have a product that someone is willing to pay $700 for and you charge $200, you’re leaving $500 of income on the table. If you’re just starting out, consider tiered pricing.

You know your customers are already shopping around. Choice matters, and tiered pricing allows them to choose between you, and you, and you!

Get creative and consider what will be best for both you and your customers. You can base your rates on the time it takes, the product you deliver, the expertise required to produce it, etc. By offering a basic, standard, and deluxe offering for customers to choose from, you’ll be able to appeal to more customers, which will lead to more business over time.

Make sure you publish your profile in Skyward so larger businesses and corporations can find you, potentially leading to lucrative jobs and ongoing contracts. Define your service area so that you aren’t taking work that is unprofitable due to the time and cost of traveling to the site. Factor in all the costs of doing business in your pricing. These costs include travel, insurance, equipment, personnel, site hosting, software subscriptions, rent, and operating costs.



PRICING TIPS

11 Use clear, tiered pricing to anchor your service offerings. [This article provides more information.]

12 Pricing isn't permanent. Experiment with charging hourly, by deliverable, or by day.

13 Define your business goals first. That will help to guide your pricing decisions and business strategy.

14 Consider ALL of your costs: rent, utilities, equipment, insurance, software, travel, post processing.

15 Know what an hour of your time is worth, even if you charge by the project.

Don’t be afraid to turn down work if you would lose money by taking it on. 16

Provide a scope of work to your clients that includes deliverables, timelines, and rates. 17

Define a reasonable service area—know what travel time can cost you. 18

Agree on the timeframe for payment with the customer before the job begins. 19

Don’t worry about the bottom of the market; if you’re truly a professional, focus on swimming upstream. 20

Don’t Worry about the Bottom of the Market

Embrace the idea that you are not just a person with a drone who takes pictures. You are a licensed and insured professional who is taking on liability and offering a specialty skill and a valuable product. Stand behind this and reflect it in your pricing and marketing.

Focus on your business, and don’t worry about the competition. Increasing your quality and staying focused will attract top-tier clients that are willing to pay for the quality and professionalism you offer.

LEARN MORE
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You are a professional who:

- Operates expensive equipment
- Accepts liability if anything goes wrong
- Handles not just the photo/video/data capture but also post-processing, using expensive editing or mapping software
- Has a proven track record of bringing value to clients
- Is well versed in all local and federal regulations and has the proper documentation and insurance
- And the list goes on...

ON-SITE EFFICIENCY

ON-SITE EFFICIENCY

Documented procedures help you maximize your time once you're out in the field and flying. The best processes increase efficiency, lower costs, mitigate risks, and empower your crew to do their best work.

Much of the work that ensures that flights run smoothly is done ahead of your crew's arrival at the job site.

Through interviews with the customer or using the Skyward Airspace Map determine obstructions (like buildings, cranes, power lines) that are in the area so you know what to expect before you arrive. Preflight planning lets you determine take-off and landing areas and have a plan in place before you arrive. If a remote site assessment won't provide the information you need, visit the site ahead of time.

Anytime there is a new variable (site area, type of data collection, aircraft, crew member, etc), risk is introduced. Safe operations are all about mitigating risk to the greatest extent possible.

For example, it may be hard to tell if there is an obstruction that would impede line of sight without a site visit. By visiting in advance, you can plan a workaround, for example, by breaking the flight path into phases.

Things like non-participants approaching your area or sun glare that blocks the view of your GCS can also stall your operation and introduce risk. There are simple things you can do to prevent distractions and dangerous situations but each requires advance planning and preparation.

In manned aviation, it took decades to optimize the flight deck, the place where the pilots sit. As UAV pilots, we need to do our best to achieve that same level of consistency and standardization.

One of the ways we can achieve that level of standardization is through procedures. When you get to a site, have a set routine that includes things like placing cones around your take-off and landing zones, or wearing high visibility clothing. These are two easy ways that you can establish control of your “flight deck.”

Knowing how you’ll handle many possible scenarios helps you act quickly in a potentially dangerous situation. For example, if you are approached by a non-participant and you don’t have a visual observer, don’t lose visual contact with the aircraft. Let the person know you’ll be able to answer questions after the flight. Tell them to stay outside of the marked areas. If they do not comply, land the aircraft as soon as possible in a safe location to avoid distracted flying. Rehearsing this scenario ahead of time will help you stay calm and professional if it should happen in the field.

Skyward’s Take Flight package provides the foundation of safety, professionalism, and efficiency across your orglanization, with customizable policies and procedures, as well as operational templates. The package is more than 130 pages of expertly validated materials you can edit for your business, including:

- Multi-Level Training Protocols
- Risk Management Procedures
- Crew Coordination Standards
- Standards for Operating in Remote and Densely Populated Areas
- Flight Dispatch Checklist
- Aircraft Maintenance
- LiPo Battery Handling Standards
- Job Safety Standards
- Before-Launch Checklist
- Before Takeoff Checklist
- Final Landing Checklist
- Accident Response Checklist
- Control Link Failure Standards
- Loss of Visual Awareness Standards
- Advice on Obtaining Property Permissions

ON-SITE EFFICIENCY TIPS

21 If the job location or product requirements are unusual, conduct an on-site assessment prior to accepting work.

22 Check and verify that you collected the necessary data before shutting down and leaving the site.

23 BYOS—bring your own shade: It can be hard to see the GCS or tablet on a bright day.

24 Set up cones or markers to keep passerby from wandering into your flight area.

25 Standardized procedures, including a general operating manual & checklists, are essential for flying UAS commercially.

Plan operations in the office before you arrive to maximize on-site efficiency. 26

Choose a minimum distance the GCS should be from a structure that may block line of sight. 27

If the precise height of a hazard isn't already available, conduct a height check. 28

Always have a backup aircraft. Field repairs are difficult and time-consuming. Always have a Plan B. 29

Complete pre-flight checks on all aircraft before the first flight at each job site. 30

MAINTENANCE

GENERAL MAINTENANCE

Maintenance is essential, and not just after an incident. Even with so much automation and out-of-the-box functionality, there are many reasons for your business to have its own maintenance program.

In the U.S., Part 107 specifies: "No person may operate a civil [sUAS] unless it is in a condition for safe operation. Prior to each flight, the remote pilot in command must check the [sUAS] to determine whether it is in a condition for safe operation."

Your fleet can’t produce value unless it’s fulfilling missions. So the purpose of a maintenance program is to: a) Make sure that all aircraft are in a condition for safe operation and b) make sure all aircraft are reliable.

That said, drones aren’t 737s or S-92 helicopters. It's a mistake to self-impose manned aircraft maintenance practices on your sUAS operation. Yet the goal is the same: to detect non-airworthy conditions before flight via routine inspections and preflight systems checks.

- Document changes to the configuration of the aircraft and any non-airworthy conditions.
- Use standardized, repeatable process for maintenance actions.
- Do a close inspection of the aircraft after every maintenance action.
- Do a test flight of the aircraft any time a critical component (motor, flight controller, etc) is replaced.

GENERAL MAINTENANCE

There are areas of maintenance that can be handled in-house, but it's important to know when to go back to the manufacturer or a maintenance professional.

Generally, if there is a replacement part available and you can obtain instructions from the manufacturer or another trusted source, it's acceptable to do the repair yourself. In practice, this means everything except for board-level electronics repairs. At Skyward, most of our flying is operational testing and evaluation so this approach works for us. Decide if the time you spend on maintenance could be better used on other activities. A big delay might be imposed by lack of the correct spare parts or tools. The manufacturer or a maintenance provider is likely to have immediate access to both.

This is the main advantage of using an external provider. They are more likely to diagnose a problem faster, have parts on hand, and make the repair faster. When you consider total operating cost and include loss-of-use while waiting for a part, it may make more sense to send the aircraft out for repair. Large operations with aircraft concentrated in one place may invest in dedicated repair technicians.

Battery maintenance isn’t complicated—just boring and often neglected. For batteries with protection circuits, *stay on top of the firmware updates.* Conventional LiPo batteries shouldn’t be discharged too much or left fully charged for extended periods. We don’t recommend flying with conventional LiPo without an alarm. Modifications or repairs to battery connectors should only be done by someone with appropriate experience. It's very easy to do a bad job wiring a connector.

MAINTENANCE TIPS

31 Keep a detailed maintenance log for all aircraft to track flight hours and service events.

32 Conduct a maintenance review of your fleet at the beginning of each week.

33 Use a defined maintenance checklist from the manufacturer or Skyward's Take Flight.

34 Set and stick to a schedule: every month or after a certain number of logged flight hours.

35 Schedule needed maintenance immediately.

Firmware upgrades are a part of maintenance—don’t forget to log them. 36

Determine which maintenance can be performed internally and which should be outsourced. 37

When adding new drones to your fleet, follow an aircraft acceptance check. 38

Follow IATA guidelines for transporting lithium polymer batteries (for example, discharge to 30%). 39

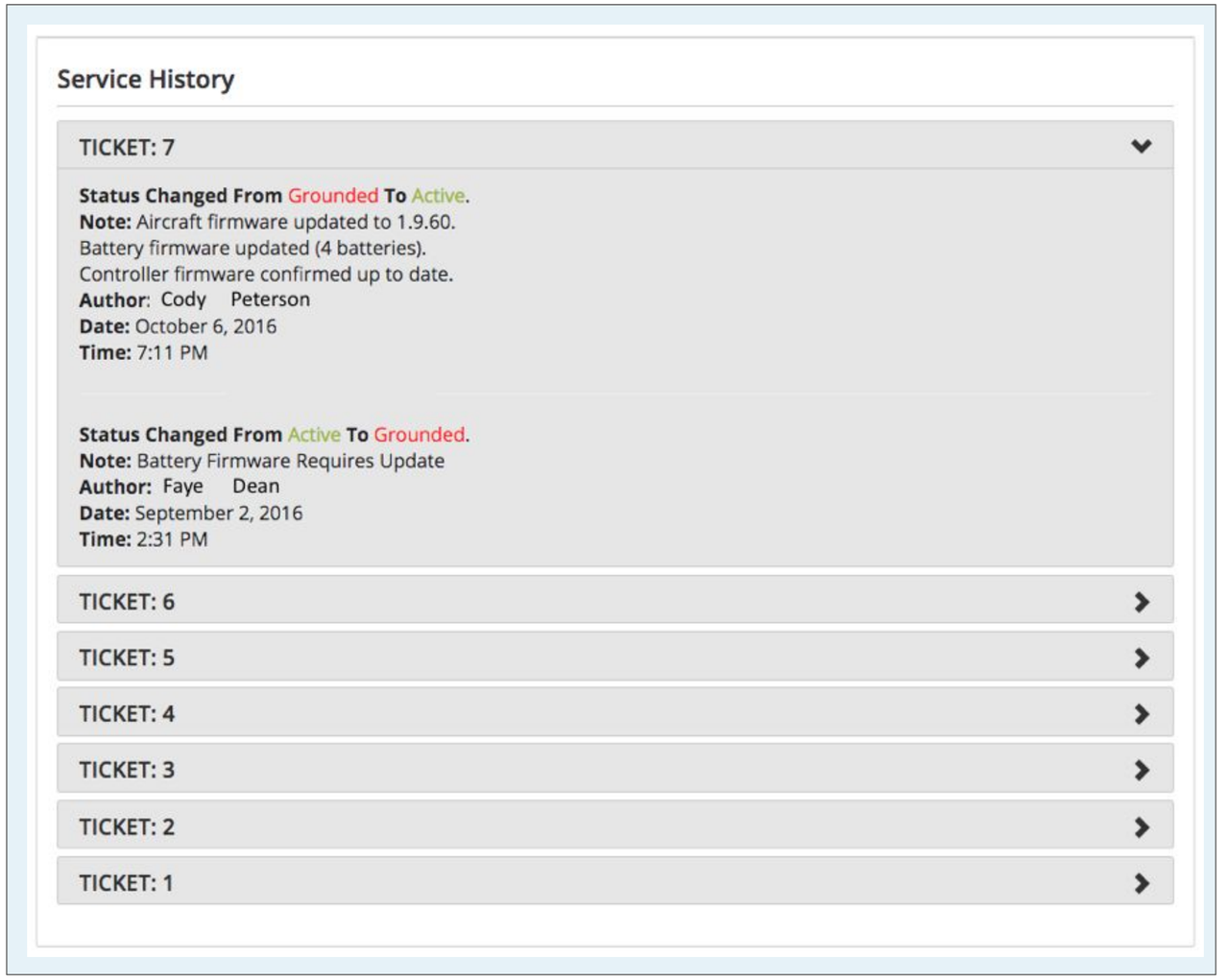
Keep company sUAS in lockable protective containers when not in service or being used for a job. 40

MAINTENANCE TIPS

Logging Maintenance with Skyward

It's easy to track the status of the aircraft (grounded or active) within Skyward. Each service event triggers a ticket that logs the maintenance requirement, as well as who found it and when. This information helps you meet Part 107.15(a) which requires you keep your aircraft reliable and in airworthy condition.

- Open aircraft record.
- Create grounding service event.
- Document details, and note if aircraft is safe to fly.
- Once part is replaced or firmware is updated, create a new event.



DATA ANALYSIS

GENERAL MAINTENANCE

Training, pricing, on-site efficiency, and maintenance are essential foundational elements of any professional drone program. But what really matters, and what keeps clients coming back, is actionable data.

It's important to know in advance exactly what data you'll be able to collect as well as what data your customers actually *need.* Often operators need to educate their clients on the types of data that drones can collect. This is an opportunity to listen and learn your client's challenges. Then, see if you can match your capabilities to those needs.

Another good practice is to have an industry expert (agriculture, construction, mining, media, etc) who can advise you.

This gives you an insider perspective. Ask your adviser to help you frame the questions you'll be asking prospects and clients to decipher their exact data needs.

Once you understand what a client needs, it's time to gather quality imagery and data to keep them coming back. Weather (wind, cloud cover, precipitation, temperature) affects safety, and it can also affect data quality. To gather robust data, make sure to operate in ideal conditions for the sensor you're working with. For example, if you're working with a multi-spectral imager, operate when it's either sunny or cloudy, not in between. This is also important for repeatability. To detect changes over time, collect imagery and data under like weather conditions so you aren't comparing sunny-day data to cloudy-day data.

Take insurance, for example. Insurance companies regularly need to detect very small changes (like a roof's slope or condition). If you aren't following best practices outlined in tips 42-43 you might detect changes that aren't actually there.

We can also save time processing data by making appropriate decisions based on the client needs. For example, for industrial use cases there is often value in 2D and 3D data. But sometimes the client just wants to see or count items—which doesn't require a 3D model.

A lot of people believe that if a use case is industrial aby nature, there needs to be a point cloud or a digital surface model, which are both three dimensional. So take the time up front to really learn what the customer needs, and make sure you meet their goal. You'll save valuable processing time in the long run. If they don't require 3D data, don't take the time to process information that won't be useful or valuable to them.

PrecsionHawk partnered with DJI to introduce the Smarter Farming Package. It includes all of the software, hardware, and sensors to get the agriculture data a farmer would need.

Learn more about PrecisionHawk's data-processing solutions

DATA ANALYSIS

TIPS

41 Prove yourself first. You should know what you're capable of offering before you begin seeking clients.

42 Know the data requirements. Understand the sensors, altitude, etc before you start.

43 Confirm sensor collects geotagged imagery. Your data will not process otherwise.

44 Check the weather. Temperature, cloud cover, visibility, and wind affect data quality.

45 Use GCPs. This increases the accuracy of orthomosaics and keeps data from multiple surveys aligned.

Apply algorithm analysis. Simple photogrammetry is no longer sufficient. 46

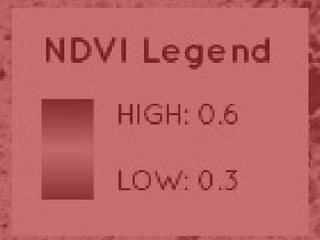
Process 3D maps only when necessary. Algorithm analysis may only require 2D orthomosaic. 47

Find an answer. You won't want to provide data to clients that isn't actionable. 48

Request case studies. Your customers' success is your success, so share the best stories. 49

Be creative. The biggest potential of drone data might not even be conceived yet! 50

DATA ANALYSIS TIPS



DATA ANALYSIS

CASE STUDY

Drone Data on the Farm

With volatile commodity prices and unpredictable weather conditions, farmers need information to optimize their yields while maintaining a budget. In 2016 ,PrecisionHawk worked with a user of its Smarter Farming Package to understand where growers should target their sidedress application within the field to get maximum return on investment.

Nitrogen (N) sidedressing is often a binary decision – yes or no – and how much? The typical process, pictured below, involves consulting last season's prescription with adjustments for losses in addition to various sampling methods: visual, soil, or plant tissue.

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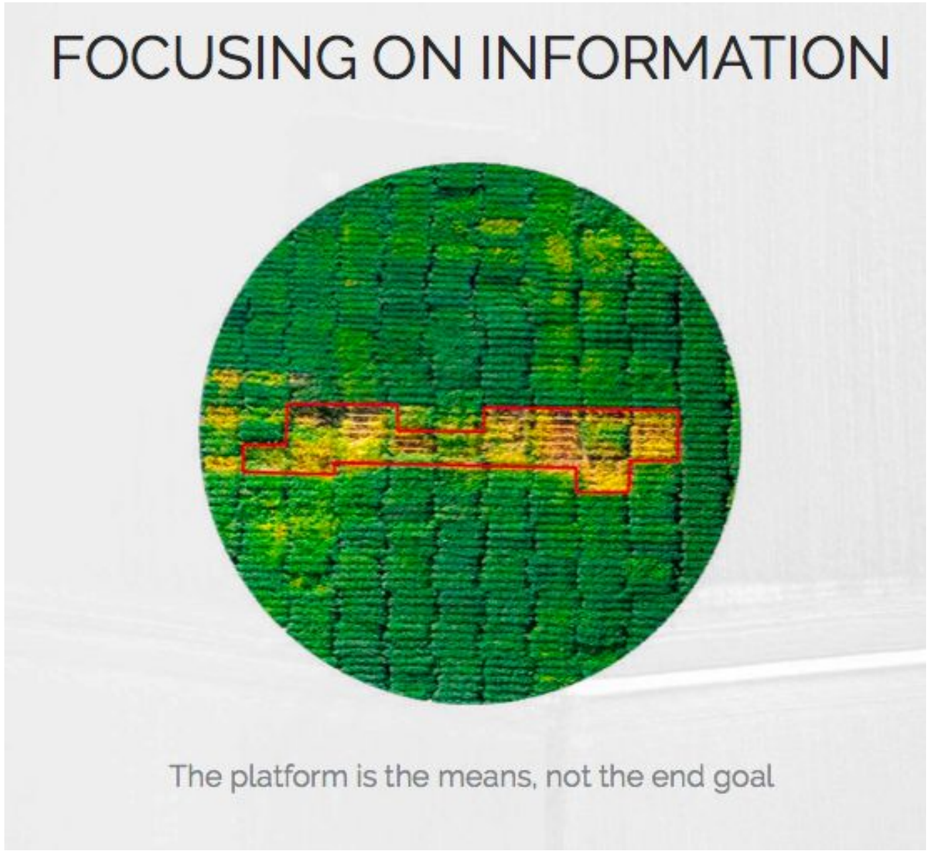


Measuring the return on investment

Based on the information gleaned from using the Smarter Farming Drone Package on typical corn/corn 320 acre fields targeting 140 bu./acre, growers were able to determine that the average actual nitrogen deficiency was only 30% of the total field, rather than the 100% the farmers would have otherwise dressed. This resulted in a $9.80 savings per acre.

Focus on your customer’s needs.

Today’s decision makers require hyper accurate, high-resolution data in a near real-time, which is difficult to achieve using traditional methods. This is where drones entered the remote sensing arena. UAV flights can be conducted daily, for smaller areas, at low altitudes, resulting in higher resolution imagery at a fraction of the cost.

But, beyond trying to push a drone out there or sensors or a piece of software, our goal is to make products that fit the lives of our customers. We focus entirely on how we can make it work well for the application, whether it is counting row crops at emergence or identifying the exact amount of damage to a roof after a storm.

How PrecisionHawk Can Help

- Reliable combination of hardware and software
- Advanced analytics
- First waiver to fly BVLOS
- Experience across multiple industries (ag, construction, energy, insurance)
- Safety services

www.precisionhawk.com

OPS MANAGEMENT & SAFETY

OPS MANAGEMENT & SAFETY TIPS

51 Know the rules; you're responsible for abiding by all federal, state, and local regulations.

52 Don't pigeonhole yourself. Drones aren't A *one-size-fits-all* technology.

53 Know your gear, be well trained, and never rely solely on software automation.

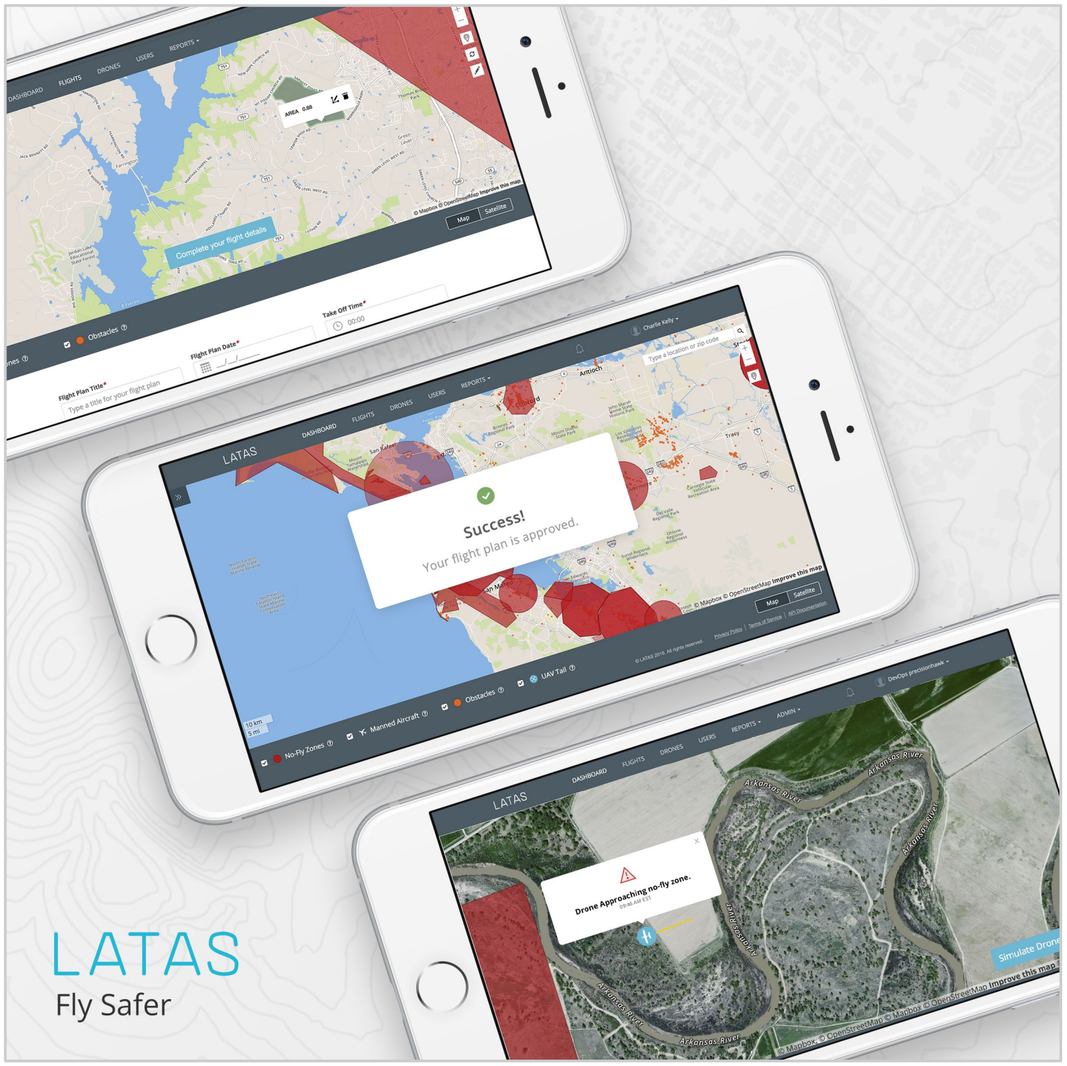
54 Master your industry. You must understand your market to best serve it.

55 Consider drone tracking—seek out additional layers of security.

Low Altitude Traffic and Airspace Safety

PrecisionHawk's LATAS platform acts as an air traffic control system for drones. Know where your drones are and keep them aware of their surroundings, on the ground and in the air, to ensure safe flights. LATAS can be used by drone operators for free to see when and where it's safe to fly. LATAS is powered by the Skyward Drone Airspace Map.

LEARN MORE
www.flylatas.com



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BUDGETING & MARKETING

If you're in the U.S., the IRS allows you to claim a tax deduction of up to $5,000 for costs related to starting up a new business. Additionally, *most* expenses you incur in the process of doing business are deductible so save your receipts and don't pay more than you have to. You can deduct the costs of office space, web hosting, drone pilot ground school, ops management software like Skyward, data analysis and safety tools like DataMapper and LATAS, drones and batteries, and much more.

If you're at a larger company, one of the best things you can do to achieve executive buy-in is to show case studies and examples, like the nitrogen sidedressing study PrecisionHawk shared. That demonstrates the true value and ROI of an internal drone program.

There are a lot of simple things you can do to help market your business such as publishing your profile in Skyward and joining a reputable drone network. No matter what you do, showing that you are a safe professional who understands regulations, tracks and manages information important to clients, uses professional grade equipment and software, has insurance and ges the job done is key.

Learn how to publish a Pilot Profile

ROI & BUDGETING

TIPS

56 Know your tax deductions. For example, you can deduct up to $5,000 in start-up costs.

57 Have use cases and examples of how drones save time and money ready before you seek executive buy in.

58 Show clients how to use data beyond what was contracted like revenue assurance or safety hazard identification.

59 Establish an online presence. Get a website and share your work on social media. Make sure people can easily contact you!

60 Understand your business and how you are different than other drone service providers

Focus on the deliverables you provide rather than the tools you use. 61

Publish your pilot profile in Skyward so that other businesses can find you. 62

Consider partnering with a reputable drone network—they have access to major corporations. 63

Include your insurance coverage on your website and marketing materials. 64

Be a showoff. You should share as much as you can to the public through a comprehensive marketing strategy. 65

MARKETING

TIPS

Connect your people, projects, and equipment into one efficient workflow

Skyward

PLAN | PROVISION | FLY | PROCESS | DELIVER | ANALYZE & IMPROVE

Skyward

TAKE FLIGHT

Your comprehensive guide to launching and managing a UAS program.

- STANDARD OPERATING PROCEDURES
- JOB SCOPING
- CUSTOMIZABLE CHECKLISTS
- TRAINING GUIDES
- WORKFLOW AND CREW COORDINATION
- OPERATIONAL AND RISK MANAGEMENT GUIDANCE

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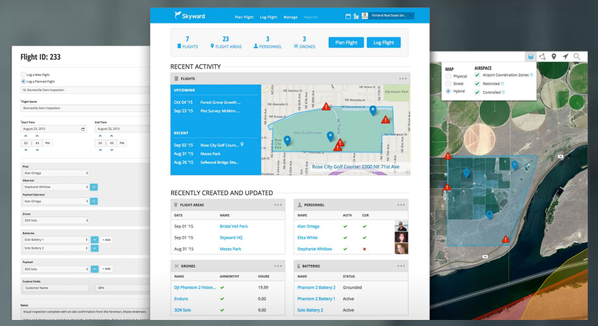

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