

General Farm Commodities and Risk Management subcommittee hearing, “Big Data and Agriculture: Innovation in the Air”

Topic: **Innovation in aerial imagery and how it can be useful to farmers**

Written testimony submitted by TerrAvion.

TerrAvion helps farms take a high-tech approach to improving yield and revenue, with the first cloud-based, next day aerial imaging and data analytics service for agriculture. From small family farms, to the largest agribusinesses, TerrAvion provides producers with images and data that accurately detail the conditions of every acre, allowing farmers to identify problems before they can impact yield. As we move into the future, with our ever growing population, we will have to rely on precision agriculture, and just plain farm smarter.

Our company began with our founder and CEO Robert Morris, who served in U.S. Army as the Tactical Unmanned Aerial (TUAV) Platoon Leader in Afghanistan. The platoon was the first of its kind in Afghanistan, and helped uncover critical intelligence that altered the course of a number of strategically important operations. When he returned to civilian life, in 2012, a farmer friend said to him, “You ran a drone platoon in the army. I need to see all of my crops every week. Can I use drones for that?” The friend was not able to survey the entirety of his fields in the time he had. It was the same problem that the army had solved with drones and stealth aircraft.

Robert explored the market and quickly ascertained that, as useful as drones can be, they would not provide a scalable, and affordable, service to the people that needed it most, the farmers. The other option of plane-based imagery was available, but they charged \$6-\$15 per acre, per pass (fly by), and the imagery was not sent for weeks! Not only was the cost prohibitive, the delay in receiving the imagery caused the data captured to be too out of date for anything but a few, limited uses.

Due to his time in the military, Robert know that it was possible to deliver imagery much more quickly. Our imagery is available next day, and we are working on cutting that time down. He ultimately decided to partner with an an expert in computer imagery and equipped light aircraft with the hardware necessary to collect large amounts of data and deliver it to TerrAvion’s servers in real time, where it could be packaged and sent to individual clients. For far less than the cost -both in time, and capital- of procuring a drone, or drone service, a producer can subscribe to TerrAvion’s cloud-based service and not have to worry about the extra management. Electric drone collection uses 20 times more labor per acre than TerrAvion. This model simply doesn’t work for growers who are trying to control costs or for a populus expected to reach nearly 10(9) billion people by 2050. Last year TerrAvion collected more acres per week than all electric drones combined did in a year. With TerrAvion, the farmer can focus on their farm.

TerrAvion's core focus is to provide growers with high quality aerial imagery that is current and actionable. For most of our customers this means imagery delivered once per week within 24 hours of capture. By cutting down the time it takes between gathering the data, and putting it in the farmer's hands, we allow them to act on the imagery in a meaningful way. With our subscription based plan, we can take more images and avoid weather and time constraints that affect other services, namely drones and satellites. The high frequency of flights gives the grower the ability to rapidly detect issues and target problem areas in the fields, as well as monitor the efficacy of different fertilizers, pesticides, seeds, etc. While about 90% of our customers sign up for annual subscriptions we also provide single and multi-shot services for a variety of needs and purposes. As we continue to grow we will apply our services to the crop insurance adjustment sector. In the past, we have provided our customers with timely imagery of their crops after disasters such as wildfires or flooding. This information allowed them to document damages and calculate the acreage affected, a useful tool for farmers and insurance companies alike.

Our current offerings can be summed up by the following list:

- Visible imagery
 - Provides overview of entire operation in one image.
 - Directly comparable to what would be seen on the ground.
 - Directed scouting, where to focus manpower, where you don't need to check.
- IR
 - Color Infrared, a traditional imaging technique allows for rapid detection and assessment of vegetation.
 - NDVI (Normalized Difference Vegetation Index) allows for the assessment of plant health and vitality.
- Thermal
 - Water management, leaks and plant growth associated with leaks have a strong signature in the Thermal Band.
 - Stressed plants can be distinguished from non-stressed plants easily in the Thermal Band
- Analytics
 - Through image processing useful information can be extracted into tabular form. Vegetation mean, planted acreage, quality variation, et cetera.
 - This tabular data can easily be compared, field to field, region to region, or track a crop through time.
- Big Data
 - Our data can be combined with other GIS ready data such as weather, soil chemistry, irrigation data, treatment regimens, et cetera.
 - Analysis and planning can be done combining all available data.

These offerings lead me to point another advantage of the precision agriculture movement, and of TerrAvion in particular. We manage all of the technological burden. We collect and process the data and make it deliverable through a standard web browser or mobile

application. All we require from a customer is the location and geometry of the area they need flown and when. Our API is fully supported and has already been integrated with several of the largest agricultural retailers in the U.S., allowing our customers to quickly, and easily, access their imagery in existing management systems.

TerrAvion provides full documentation and training programs, free of charge, to teach growers who are not used to using aerial imagery so that they may manage their crops more efficiently. This support provides a tremendous value to the grower and reduces a primary barrier to entry into the usage of aerial photography. While we provide some analytics, and that amount is growing, TerrAvion knows that technology is not going to replace farmers, or their personal knowledge. We seek to provide them the support they need to move forward in a rapidly changing world. In our minds, we work for the growers.

Because of all of the reasons listed above, growers can farm smarter. Aerial imagery allows for farmers to target problems areas, drastically reducing labor costs as well as other inputs. The extra time provides farmers the ability to improve the entirety of their field, increasing yield, while decreasing their investments. With our service a grower can view the entirety of their crops in one place and have confidence that the choices they are making are accomplishing results.

As recently as five years ago, what we do would not have been possible at a large scale. The speed of image processing and cloud computing has made this service accessible to every grower. Sensors are constantly evolving, giving farmers more and more insight into the plants they see every day. With our plane-based systems we have the ability to add more sensors to our collection at a miniscule increase in cost. And now, we can do this at a resolution that is competitive, or better than drones and satellites at lower cost that is better or competitive.

What makes TerrAvion different/unique among aerial imagery options? Among other mapping and technology options?

- High revisit and up to date images.
- Rapid delivery of imagery. We strive for 24 hour turnaround from capture to delivery to the customer.
- Subscription based service. Cost is for a season of up to date images, not per pass. 90% of our customers use annual subscription, about 10% do single or up to three passes.
- Cost and scalability are unbeatable.
- Easy integration with other management systems.
- Our company is built on serving the needs of farmers/the market and not on technology/silicon valley hype, that being said we are always innovating.
- We have the ability to survey large areas for insurance adjusting after natural disasters

What new, innovative practices is TerrAvion employing?

- Distributed collection brings collection costs down.
- Cloud based storage, processing, and delivery reduces infrastructure overhead bringing costs down.
- Distributed labor force allows for 24 hour coverage and overnight delivery.
- Image processing and analytics as a service.

How is this different from something farmers could get 5 years ago? 10 years ago? 20 years ago?

- Speed of collection and rate of delivery
- Cloud computing has allowed for the processing and delivery of data on a scale what would have been cost prohibitive even 5 years ago.
- Sensor size has dramatically increased while costs have decreased in the past 20 years.
- Competitive or better resolutions than satellite and drones

What challenges for farmers can be mitigated by using TerrAvion?

- Directed scouting, documentation, and overall labor reduction.
- Crop management: problem detection (pest, disease, water, etc.), yield prediction, side by side trial comparisons, informed decision making.
- Big data analytics