

Hummingbird Technologies



2019



Hummingbird
Technologies

“By pushing the boundaries of science and technology, our mission is to improve the efficiency of global crop production, and to feed the world’s growing population sustainably.”

TABLE OF CONTENTS

1. Introduction
2. What does Hummingbird do?
3. Our products
4. Ecological Benefits and Compliance
5. Current Operations Limitations
6. Potential Improvements and Impacts
8. Agricultural Technology
10. Future & Questions

WHO WE ARE

We provide **advanced crop analytics** to farmers, using **Machine Learning** based algorithms of imagery captured by drones, satellites and planes.



4x revenue
growth YoY



>100 customers
across **6 countries**



45 Full time employees
40 Part time pilots



Key partnerships with major **Agribusiness**
& **UAV companies** globally

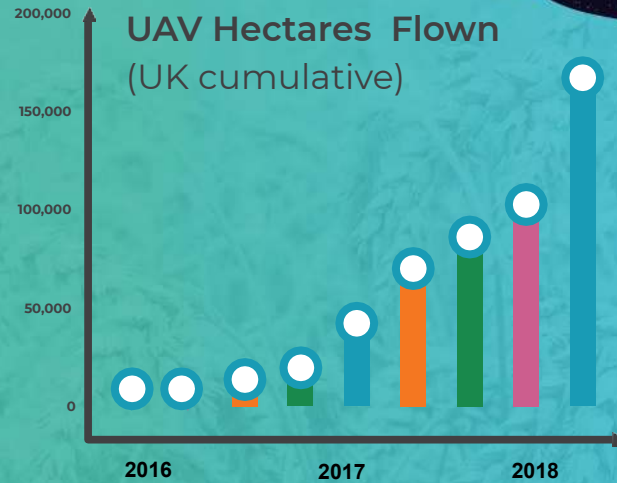


Proven ROI & Responsible Chemical Usage through targeted inputs

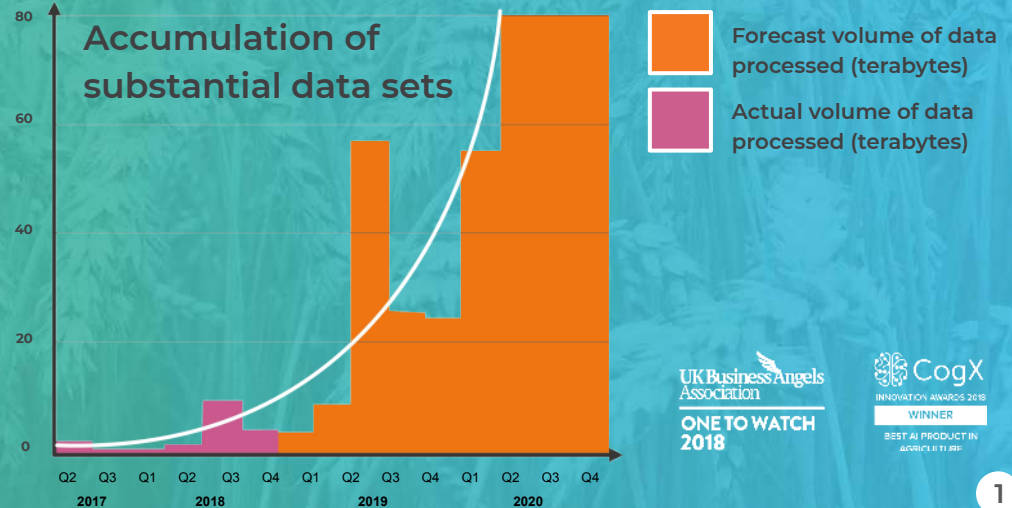


More than **95%**
customer retention

UAV Hectares Flown (UK cumulative)



Accumulation of substantial data sets

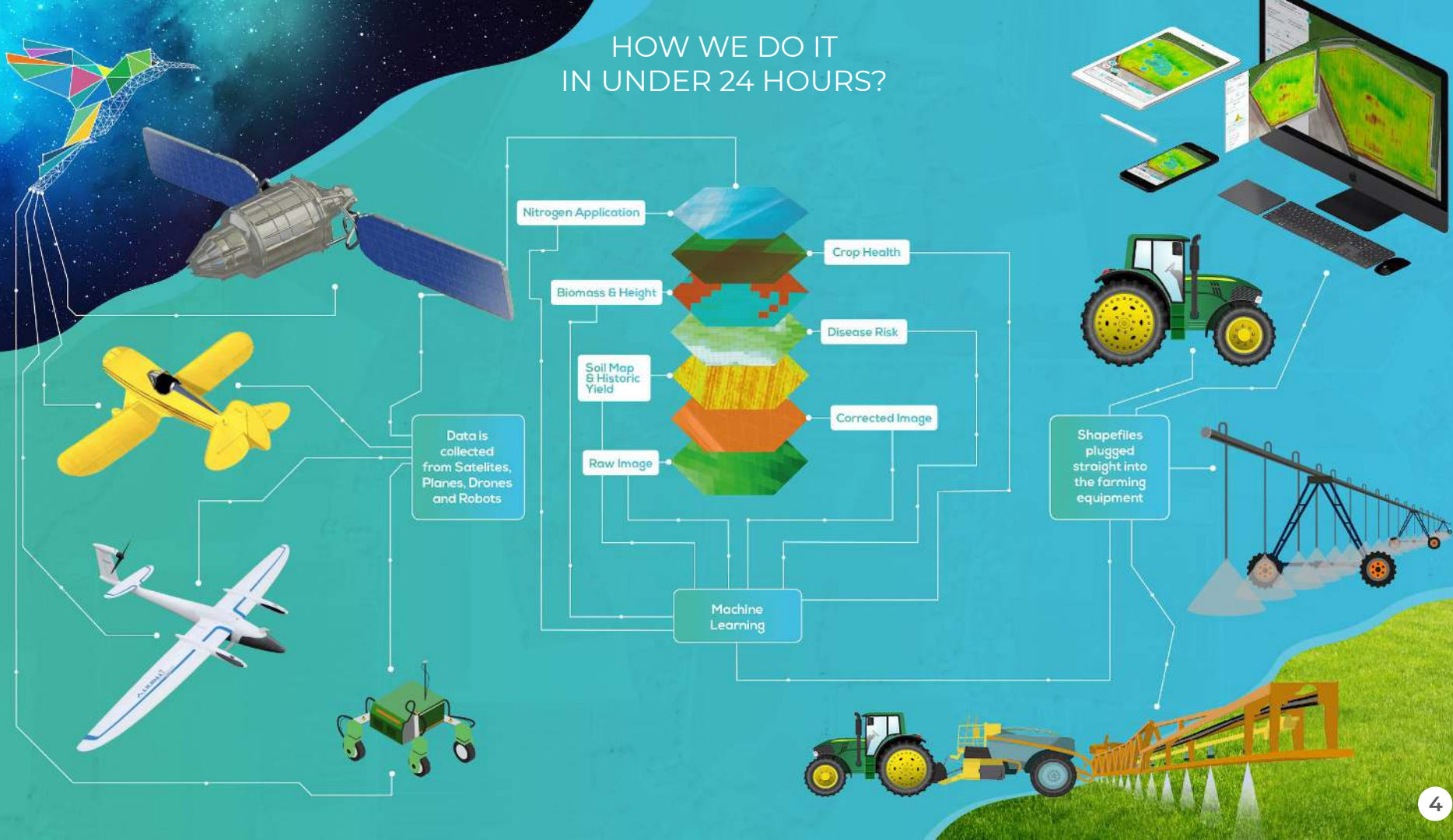


Forecast volume of data processed (terabytes)
Actual volume of data processed (terabytes)

UK Business Angels
Association
**ONE TO WATCH
2018**

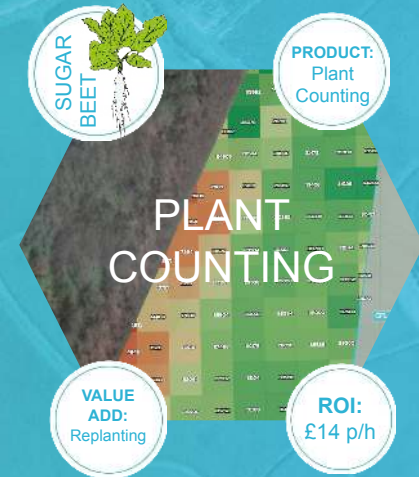
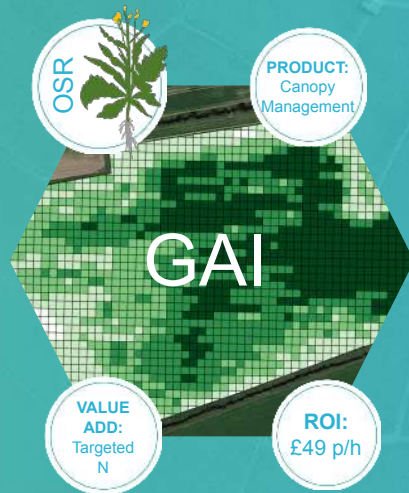
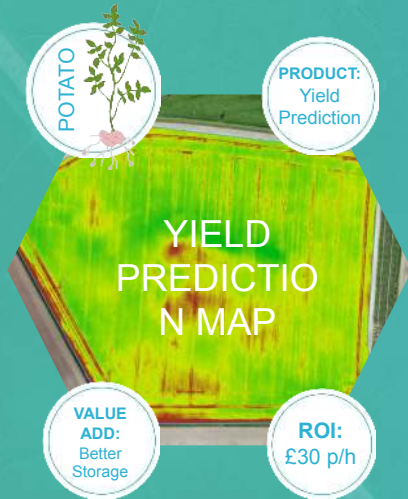
CogX
INNOVATION AWARDS 2018
WINNER
BEST AI PRODUCT IN
AGRICULTURE

HOW WE DO IT IN UNDER 24 HOURS?



WHAT TANGIBLE VALUE DO WE DELIVER TO OUR CUSTOMERS?

Case Studies & Testimonials



“Hummingbird’s platform is intuitive, easy to use and accessible on both my computer and phone when I’m field walking.”

Farmer, Wiltshire

“Hummingbird’s variable rate nitrogen tool allows us to generate detailed application plans based on the actual needs of the crop.”

Farmer, Dorset

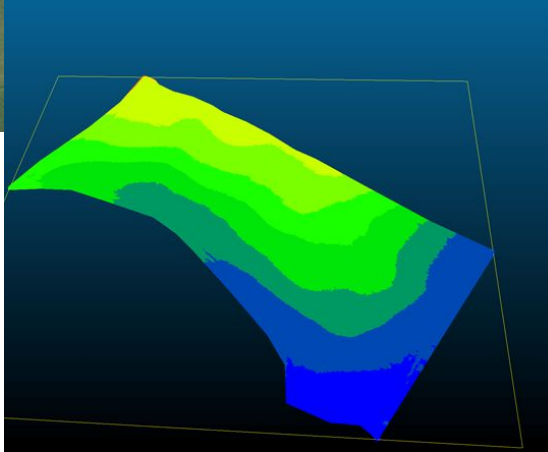
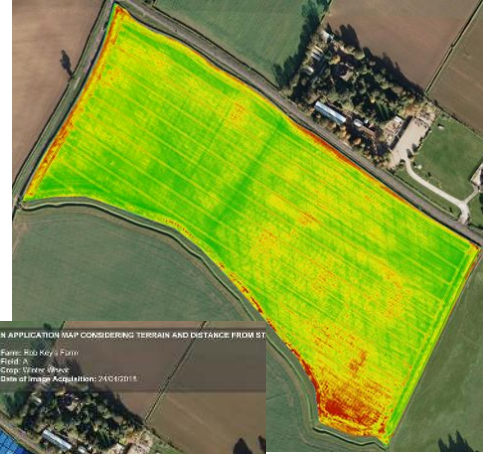
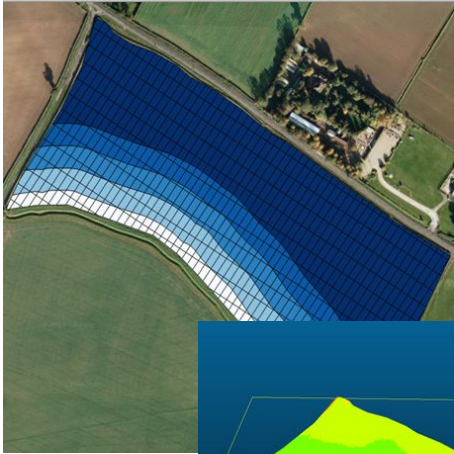
“The shapefile download enables me to easily input application plans into my machinery.”

Farmer, Worcestershire

“With Hummingbird we are farming to potential, not hope.”

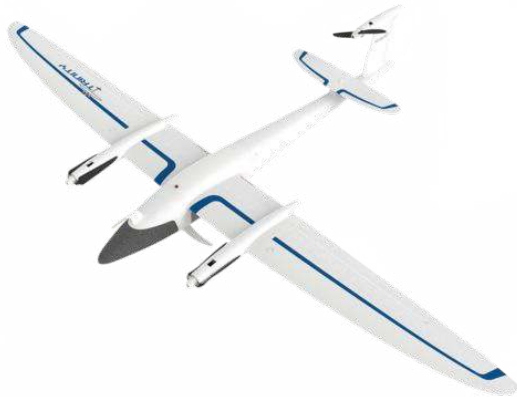
Farmer, Lincolnshire

Reduced Chemical Leaching



Current UK Operations

- **Multispectral camera:** Micasense RedEdge
6.9cm GSD @100m
- **RGB camera:** Sony A7r 1.5cm GSD @100m
- 4.5kg Max takeoff weight (550g payload)
- 5km Transmission Range
- PPK onboard, 10cm accuracy data
- ADSB-in for tracking air traffic.



- **VLOS 750m**
- **120m altitude**
- **Single pilot per drone**
- 1 Hour flight time
- Sensible restrictions on visibility
- 12 Quantum Trinity
- 15 Sensefly eBee
- 10 DJI multi-rotor

Example Pilot Mission



Software

- Multiple fields in one mission
- Geofenced work area
- Route efficiency planning options.
- Multiple take-off and landing points.
- Large amounts of travel time
- Fully autonomous flight from take-off to landing
- Automatic sense and avoid (ADSB transmitting aircraft only)
- 200-350ha/day

Current Ops Limitations

£1.5/ha average data collection costs

Under our current 750m VLOS:

Factor	Limiting Factor?
Drone battery life	Low
Drone transmitter range	Low
Drone level of autonomy	Low
Labour availability	Medium
Farm field layout	High
Camera technology	Low
Restricted airspace	Low



Currently technology is currently not a limiting factor in our operations, performance of drone technology has far exceeded current limitations

Impacts of Current Ops

- Only large estates and agricultural cooperatives have the quantity and density to make current UAV operations worth the cost of the flight
- Small farms are far too costly to justify UAV flights (some over £5/ha)
- High cost makes it hard for all farms to justify with the goal of responsible chemical usage
- Pilot fees have to be lower than market average to allow for ROI. (limits pilot progression and further training)

Ukraine

Quick background on BVLOS operations in Ukraine:

- Full BVLOS on <7kg UAS
- 500m height limit
- Very light air traffic
- Currently exactly the same equipment as the UK
- 1500ha/day compared to 300ha/day in the UK.



Potential Operations

£1.5/ha data costs drops to £0.2/ha with current equipment. >80% reduction

With BVLOS above 120m:

Factor	Limiting Factor?
Drone battery life	Low → Medium
Drone transmitter range	Low → Medium
Drone level of autonomy	Low → High
Labour availability	Medium → Low
Farm field layout	High → Low
Camera technology	Low → High
Restricted airspace	Low → Unknown

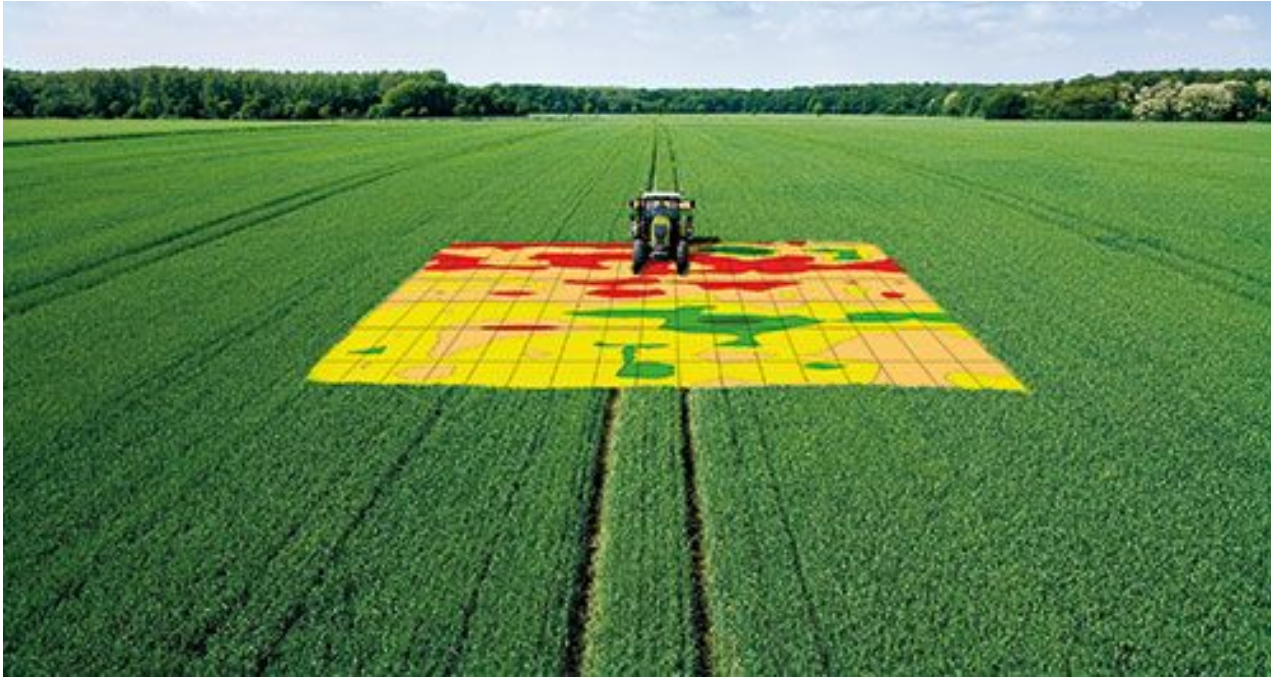
If solutions to BVLOS were found then camera technology and UAV sense and avoid become limiting factors to area coverage and reduced costs.

Impacts of BVLOS

- Costs drop by 80% down to £0.2/ha
- Higher cost saving can be passed onto the farmer therefore increased food security
- Opens up drone enabled analytics to 80% of arable farmers not just the largest 20%
- Promotes safe and responsible use of chemicals, lower cost makes it more justifiable for farmers to use UAV flights to aid compliance
- Pilot investment could increase, would allow for fewer, higher skilled, higher paid pilots raising safety standards.

Agricultural Technology

Agricultural equipment limitations, variable rate technology and resolution



Future

- Sense & Avoid- too expensive, not ready, and not certified
- ADSB- not scalable and not mandatory
- USpace software- 2+ years away for the software, no current solution to connect all air traffic such as gliders, light aircraft, etc...
- Investment is high risk due to unknown BVLOS requirements and low probability of success
- When the BVLOS is a reality we would change our operations to either larger higher flying UAVs or smaller fully autonomous UAVs to match regulations.