Technical and Logistical Challenges Encountered During Test Flights in Malawi

Malawi Department of Civil Aviation, UNICEF Malawi, VillageReach - May 22, 2019
Round Table Agenda

Malawi Humanitarian Drone Corridor – Tautis Juskauskas, UNICEF Malawi

UAV Provider Presentations

Virginia Tech Mechanical Engineering - Kevin Kochersberger
UAVAid - Daniel Ronen
Globhe - Helena Samsioe
NextWing - Diego Miralles

Open Discussion
Humanitarian Drone Corridor
Malawi

Tautis Juskauskas
UNICEF Malawi
Drone Lead
FIRST HUMANITARIAN DRONE CORRIDOR IN AFRICA

- 40 km radius, 400 meters AGL
- Centered at a local airfield with a 1200 m runway
- BVLOS flights permitted
- 1 central hospital laboratory
- >300 schools, health centers, clinics
- National Park partially covered
- The confluence of two big rivers
- Population: 650,000 people
- 7 private companies
- 4 educational institutions
- 5 more entities planned for this year
- Serves as a technical entry for long-term projects
- Applications: imagery; delivery; connectivity; drone design and training; UTM
- Challenges: technical; logistical; operational;
Kevin Kochersberger
Virginia Tech Mechanical Engineering
Director, Unmanned Systems Lab
Good things

- Helpful and proactive UNICEF personnel
- Kasungu aerodrome has basic but adequate facilities
- Excellent variety of terrain and healthcare facilities to conduct operations
- Generally, our team had a good experience during the test activities
Many things are beyond our control, like

- **Power**
  - ESCOM blackout schedule not adhered to

- **Weather - not always ideal**

- **Kasungu is a major city, but not that convenient to get to**
  - Hotel space is limited
  - Transportation costs can add up

- **Some safety concerns with local residents**
  - Proximity to flights, curious children
Recommendations

- Work with the Malawi Defence Force to share Old Lilongwe Airport facility for drone work
- Establish linear test corridors within the main corridor that are designed to avoid overflights of communities
  - Node-to-node routing for delivery and imaging experiments
  - Operations that consistently occur over the same routes will test community acceptance of the technology
UPDWG
UAV for Payload Delivery Working Group

UAVAid

Daniel Ronen
Co-Founder
Unique Platform:
1. 50kg+ MTOW
2. First multi-role humanitarian drone to receive CertAW-EF in Europe (Nov 2018)
3. Multi-role capability: Payload delivery (parachute), Mapping, Streaming surveillance
4. Long range and payload – 300km / 10kg cargo
5. Reliable layered communications: Radio, 3G/4G, Satellite

Malawi Deployments:
1. Q4 2018
2. Q2/3 2019
INTO MALAWI
- Advised not to use land transport to/from neighbouring countries.
- Complexity due to unusual cargo.
  - LIPO batteries
  - IC engines and lines
- Airlines uncertain of handling permissions.
- Limitations with frequency of flights.
- Required freight forwarder / facilitator

WITHIN MALAWI
- Local freight forwarder essential.
- Road transport adequate.

OUT OF MALAWI
- Complexity as above
- Delays due to unusual cargo
- Local air freight authorisation challenges
MALAWI EXPERIENCE: FUEL QUALITY

Fuel Contamination
- Local gasoline contaminated.
  - Chemical
  - Particulate
- Restricted flight operations.

Solutions
- Implement new type of UAV fuel injector (higher contaminant tolerance).
- Source clean fuel within Malawi.
- Ensure all handling items (jerry cans) clean.
- Filter all fuel.
Local Framework and Support

- Clear application process from UNICEF / Malawi CAA
- Good support from Malawi CAA => documents from Revenue Authority.
- Good flexibility for demo range of applications with local stakeholders.

Local Engagement

- Important to engage with and support local community
- E.g.: private donations to local school
MALAWI EXPERIENCE: KASUNGU RUNWAY

- Needed clearing in some areas
- Aerodrome building power unreliable (need backup generators)
Helena Samsioe
Globhe
CEO/Founder
GLOBHE flights in Malawi June 2017 - Today

**Flights:** Around 120. Distance up to 66 km. In Kasungu Drone Corridor, Lilongwe Area and Blantyre Area.

**Drones:** Flypulse DeltaQuad, UCanDrone Nausicrate, Parrot Disco, Everdrone DJI Matrice 600, DJI Phantom 4 Pro, DJI Mavic Pro
Logistical Challenges Encountered

**Problem:** Lithium batteries above 160 Wh on airplane

**Solution:** Ground transportation from South Africa or merging of smaller batteries
Technical Challenges Encountered

GPS jamming: Only encountered minor interference once when flying DJI Mavic Pro, Lilongwe Area – but no severe issues
UPDWG
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NextWing

Diego Miralles
CEO
Logistical Challenges:

• It is hard to get to Malawi with direct flights. Prepare yourself for at least 3-4 flight hops and some flight time.

• It is surprisingly expensive if you want to buy imported supplies during your stay.

• The accommodation is unexpectedly expensive for acceptable quality Hotel. You have to prepare yourself for a European prices.

• There are specific customs procedures, declaration documentation and other authority related issues for drone operation and temporary importing the equipment. For a mission you need local organization or local representative support to be successful.

The most important factor is having local knowledge and intelligence from local partner.
Drone Parts Supply Challenges:

- Battery supply problem due to transportation restrictions, only 160Wa allowed in airplanes.
  - Ship batteries by land with a special delivery options. Prepare at least 2 months for transportation and customs clearance.
  - Buy batteries from local supplier. Prepare at least one month and a half for the supplier to be able to import the batteries.

- Drone parts and supplies are very limited even for basic parts and spares.
  - Prepare for a field type operation, where you have spares and everything needed for repairs.
  - Find a local suppliers and local drone operators to be able to borrow or buy parts in need.

- Repair materials, tools and other electronics are hard to find.
  - Prepare all the materials you will eventually need for repair as well as instruments, glues and tapes.
  - If you need additional equipment like USB hubs and other computer electronics get them from your country.

You need local partner to get the batteries and list of different suppliers.
RF interference challenges:

- For unknown reason the power of the radio frequencies coming from the cellular towers is too strong and there are spills in other frequencies. This frequencies sometimes interfere with the GPS L1 band frequencies so the drone or other precise GPS equipment gets blocked for fraction of the second close to the tow on some occasions.

- Use at least L1, L2 band GPS
- Best option L1,L2,L5 band GPS
- Dual GPS setup is advised for best redundancy.
- Get information on the cellular tower locations along the route from local companies.
- Bring RF scanner with your toolset in order to see what is the real RF situation.
- Make sure your failsafe procedures are tested.
- Make sure your autopilot handles well the GPS loss failsafe procedures and recovery.

You need local partner to get all the intelligence you need from the cellular operators and from the ground.
Mission Preparation Challenges:

- The best transportation in Malawi is your own 4x4 pickup truck. Transportation could be quite hard to find. So make sure you rent one or have your partner supply one.

- Maps used in the drone ground station have significant offset in Malawi for precision landing. Make a good measurement with a precision GPS of your drone port pads coordinates and altitude. You have to physically visit each port and make the measurement. As alternative we can use precision maps sold by local suppliers of maps like the company Precision.

- Make sure you made a good scouting by foot to see all the towers and other obstacles along the routes.

Without a local partner and intelligence you are lost.
Discussion
Thank you!
Round Table Discussion

Unanswered Questions

Diego, the interference issues were related to your C2 links (which RF?) or with your GNSS?

For UAV aid, how did your multi layer RF system perform? Is there really 3G/4G coverage or where you on RF / Sat- link mostly?

Daniel Ronen (UAVAId): The Hansard UAV platform uses multiple layers of communications systems to ensure reliable and robust contact between the control base and aircraft. This incorporates dual radio systems, 3G/4G and Iridium satellite communications with live switching to ensure real-time contact with the aircraft is maintained regardless of changing landscape and network coverage, even at extremely long range. This provides for maximum safety at lowest cost and highest reliability.

What was the success rate of UAV deliveries in Malawi?

Tautis Juskauskas (UNICEF Malawi) - As we have not been doing real deliveries, we have only been conducting test flights. The success rate of the flights that have been conducted this year (past 4 months) was 66%.
Round Table Discussion

Unanswered Questions

What measures were taken to ensure safety of Malawian citizens during UAV deliveries?

Daniel Ronen (UAVAid): The safety of operations of the aircraft and systems is our foremost priority at all times. In addition to close liaison with local stakeholders, the development and adherence to a comprehensive suite of procedures and technical systems, the multi-role Hansard UAV has been awarded a Certificate of Airworthiness (EF) by Spanish Civil Aviation Authority. This required formal assessment of the technology and operational procedures of the Hansard platform by the official government aviation authority. To our knowledge, this is the first CertAW-EF ever to be awarded to a multi-role drone, by any EU CAA, and is an integral part of our commitment to safety.

Tautis Juskauskas (UNICEF Malawi) - The tests are preferably conducted over unpopulated areas, to minimize the risk for citizens and their properties. Additionally, extensive sensitization has been conducted at the district where the Corridor is, so that people are aware of the tests.

Any Issues with sensitization of communities?

Tautis Juskauskas (UNICEF Malawi) - No issues, as long as all relevant stakeholders (Ministry of Information, Department of Civil Aviation, District management, Traditional authorities, community leaders) are involved and engaged. Also, Police has to be always informed about activity to insure the general awareness. The sensitization was smooth and successful - people see the technology as a fascinating element that can contribute to their health system, and they don’t consider it as a danger.
Round Table Discussion

Unanswered Questions

Have any African groups used the corridor and if so who, for what, and what were their learnings?

Taутis Juskauskas (UNICEF Malawi) - There are 2 Malawian startups planning on coming to the corridor (both focused on drone deliveries), as well as there was one Kenyan company, that came to the corridor, however, was unable to fly due to technical issue with one of the drone components. Technical preparation is key for successful tests.

What were you able to do after testing that you would not have been able to do without the corridor? What exactly could only have been learned in Malawi’s corridor and no other corridor or other area?

Daniel Ronen (UAV Aid): The purpose of our programs in the Malawi corridor is to learn from the experience of deploying and using the system in a ‘use case’ context. This subjects the technology and organization to a range of constraints, including but not limited to logistical, technical and environmental that would be encountered in live operations, and therefore provide information and experience so that we are able to improve the technology, operational systems and organisation. This increases our capability and effectiveness in live operations and reduces the risks operating in remote and difficult to reach areas.

Taутis Juskauskas (UNICEF Malawi) - Malawi Humanitarian Drone Corridor has served as a testing ground for companies, that have planned to conduct more continuous drone projects in country. Therefore, the corridor basically serves as a place to prove the capability of technology, its readiness and reliability, so that the drone companies are authorized to conduct drone projects outside the corridor. It gives additional comfort for governmental partners, because the corridor is known as a tech-friendly environment, where experiments and tests can be conducted.

Any challenges are you having now in moving from testing to operations?

Taутis Juskauskas (UNICEF Malawi) - This year will be an important one in terms of scaling drone operations in Malawi. We have two long-term projects planned in Malawi this year, where drones will be used on continuous basis in a multi-month operation. The corridor will serve as an entry point for those projects, to obtain the Department of Civil Aviation authorization and prove the capabilities of those drone platforms at scale. Only after authorizations are granted, the projects will be allowed to kick off outside the corridor.
Round Table Discussion

Unanswered Questions

Could you share the overall costs from your travels to Malawi, and (to those that have been multiple times) how much were costs and challenges reduces after visit 1?

Tautis Juskauskas (UNICEF Malawi) - Things that have to be taken into account:
- Return flights
- Hardware Logistics (to/from Malawi) — carrier, freight forwarder, etc.
- Accommodation (average night per double room is 55-65 USD)
- Local sim card with data (50 USD per sim card per month)
- Local transport (pick-up truck price per day — 60-70 USD excl. fuel)
- Fuel price: 1.2 USD per liter
- Power generator (rental or buying)
- Food (15-20 USD per day per person) — in the corridor area; Lilongwe prices are higher
- Visa (50 USD per person); Vaccines (500-800 USD per person if all needed vaccines); Malaria prophylaxis pills (12 pills = 100 USD); International travel insurance;

What infrastructure requirements were needed to conduct UAV deliveries?

Tautis Juskauskas (UNICEF Malawi) - It is essential to involve the local District Hospital into the entire process, to ensure that they support the activities. Once they are on board, it is essential to ensure the safety of people and infrastructure surrounding the places where the package is delivered (if by VTOL), or that a dedicated staff can retrieve the package (if delivered by parachute-drop or similar). Depending on the communication protocol (in terms of VTOL), there might be a need to set-up a separate ground control system and antenna on receiving side.
For UNICEF: will these lessons learned from the companies be shared to prepare the new visitor companies? including contacts to the local providers, freight forwarders, etc?

UNICEF has a dedicate document that is shared with all incoming partners way prior their trip to Malawi. The freight forwarding and logistics is core partners responsibility and that is often done remotely, at the origin location. For other local providers – of course, UNICEF facilitates the entire process. The lessons learnt are constantly shared and will be shared via the upcoming RPA toolkit, that is now being drafted by the Village Reach, UNICEF, DCA, and other organizations and authorities.

My personal “wish list” in a corridor for drone delivery is to have remote landing/drop sites that differs in altitude but at least a few hundred meters. Barometers can have enough drift that requires operators to test.
Round Table Discussion

Answers in Webinar Recording

For nextwing: what maps specifically were used on GCS that had offset?

Was telemetry over SMS tested in Malawi?

Hello, we know 900MHz is used for 2G phone technology but what about RFD 868MHz Radio Modules? Have they been used? Are they allowed?

In some countries LTE telemetry does only work after the phone company has approved the Public IP address of the LTE system. (this affects WhatsApp for example)
Did you have the same problem in Malawi?

To the companies: how useful has your participation been overall in order to improve your product and business potential? do you foresee that with the lessons learned, you are equipped now to venture into other African continent and emerging markets?

How many flights have been completed to date in the Malawi corridor? How many of those flights were for deliveries of product to an end recipient?

Given the leaps in the distance and range of cargo drones, were the dimensions of the corridor optimal? Is there any learnings in the shape be preferable for long range drones in future test corridors?

For the tests that have happened, I’ve heard some of these have included dedicated local capacity building and sustainable technology transfer to local stakeholders. Would be great to learn more about this if possible.