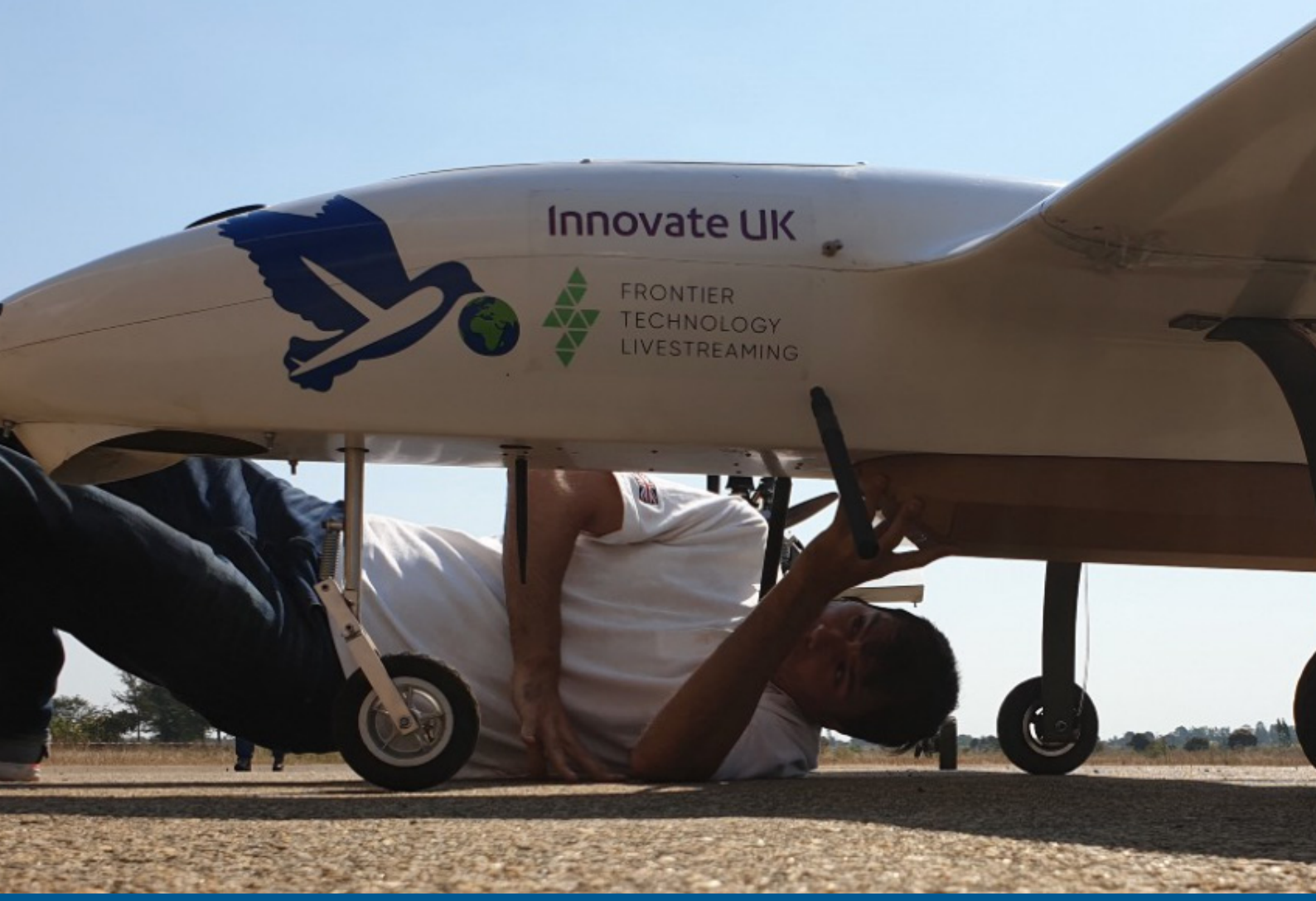


A LONG DISTANCE UAV FOR MULTI-ROLE HUMANITARIAN RESPONSE

CASE STUDY

Start Date: January 2018

Completion date: September 2019

FRONTIER
TECHNOLOGY
LIVESTREAMING

UKaid
from the British people

Can humanitarian emergency response be made more efficient by using an Unmanned Aerial Vehicle which can perform multiple functions?

THE CONTEXT

The problem:
One of the main challenges in conducting international aid is logistics: conflict, natural disasters and disease epidemics all need a fast and flexible response, but by their own nature often lie in areas that are difficult to access. Less immediate aid is also hampered by a lack of infrastructure for delivery.

Unmanned Aerial Vehicles (UAVs) - or "drones" - have been suggested as helping to combat the difficulty of accessing such hard to reach places. In doing so, UAVs could make humanitarian aid more time efficient and cost effective. There have been explorations into the range of UAVs that development agencies should prioritise strategically, but this has been relatively broad and has generated further questions on their applicability. DFID in particular has previously engaged with UAVs for use in conflict settings, but decided to shift their focus onto other humanitarian use-cases.

The idea:
A high-payload, long-distance drone can perform multiple logistics functions for humanitarian work, while significantly reducing delivery time. By testing such a vehicle, we can help influence international aid organisations, especially the UK Department for International Development (DFID), on the development of UAVs.

The team:

The Pioneer:
Sam Sherman, Jon Barden & Dan Lihou

The Partners:
UAVAid

ITE:
Nigel Breyley

$27.3bn
Humanitarian budget in 2017

>60%
of aid budget is logistics

$10bn
funding gap in 2017

THE JOURNEY

The pilot started in January 2018 and ran sets of experiments - called Sprints - which tested key assumptions. For each chapter there is either a pivot point ⬚ or a significant event ★ which influenced the programme. Here's a storyboard describing the main steps in this pilot's journey:

Test the tech "at home"

Northern Spain was chosen as a location in which to test the operability of the Hansard V model, because it has a more similar climate to Malawi than the UK. An aerodrome for UAV testing, as well as UAVAid's drone technical partner (Magline) was also based in Spain.

There were, however, unexpected changes to EU regulation, which led to major disruption to this first suite of testing. The pilot team was surprised to find that the length of this stage spiralled, to last over six months. It was reflected after the pilot that certification was perhaps not necessary to test the operability of the UAV in the Kasungu Aerodrome in Malawi.

★ Change of EU regulations

★ Certificate of Airworthiness-EF granted to Hansard UAV, by Spanish CAA (AESA).

Identify and overcome logistical challenges

There were initial challenges in terms of transport and shipping for the project. The team learned that routine shipping organisations were extra cautious about the contents of technical equipment flown into Malawi, as it is not a regular destination. On return, there were problems with transporting the equipment out of Malawi, as airline carriers were reluctant to accept locally generated paperwork for technical and safety critical cargo. This significantly increased the cost of transportation as alternative routes/methods had to be used.

Transporting the UAV and its associated material were reflected by the cost of entry and return, which came to c.£28k and took over weeks (excluding admin time). In the second deployment to Malawi, the time taken came down to eight days, with total cost c.£7k.

It is argued that once the UAV is fully deployed over a longer period, its value for money would be more compelling, although the cost of local transport would still remain.

⬚ Revise cargo and hand luggage procedure to reduce friction

⬚ Sourcing of clean fuel

Refine the tech for the local context

When deployed in the field, the Hansard model needed calibration that was not able to be done in Spain. Such calibration needed fine weather conditions, which delayed in-country testing.

The condition of the runway was not the level expected by the pilot, which caused damage to the UAV on its first take-off attempt. This was rectified by making the vehicle more robust: altering the suspension system and lowering the ground speed for take-off and landing.

Most significantly, the pilot then encountered an issue with the widespread contamination of fuel within Malawi. This stopped the UAV from flying safely. By the time the issue was discovered, the diagnostic process had resulted in damage to the engine, which required additional repair and stopped any further testing on the field mission.

⬚ Fuel injectors, based on standard motor car types instead of UAV standard

⬚ Re-engineering to find robus technical solutions

Engage Donors

The pilot team had attempted to build towards a showcase event, which would include presentations and flight demonstrations to potential donors for scaling up. This event was cancelled after problems with the first experiment in Malawi.

It was noted that DFID CHASE - who respond to humanitarian need and related risks from conflict and natural disaster - shifted their policy on the use of drones, making the pilot less relevant to their work. Further, it was determined that DFID Malawi would be a better agency to engage with in a newly-aligned proposition, with several use cases identified where UAVs could deliver impact (e.g. medical supply delivery, flood modelling).

Given the operational constraints of the project, and the increasing realisation of the difficulty of using a UAV in challenging, crisis conditions, the team decided to demonstrate more routine use-cases with the Hansard V model.

⬚ reduction in external engagement for scaling-up

⬚ move from humanitarian response to general, multi-role development use cases

Refocus and apply knowledge

On return to Spain, energies were put towards improving the ability of the UAV to meet the challenges of the first Malawi trip, and to reconfigure the model to it's new use-cases. Additional testing, which took the form of over 150 test flights, was undertaken to demonstrate the UAVs ability to take multiple flights in one day, deliver a parcel drop by parachute, conduct aerial photography and surveillance, and for drone function to be easily reconfigured between flights. The under-carriage of the vehicle was also redesigned, to better support landing on tough runways. These changes were made with support and guidance from Nigel Breyley, an Independent Technical Expert on UAVs.

Conduct use-cases

On return to Malawi, the focus of the pilot had shifted towards more routine development use-cases. Local public services took part in real-life UAV testing, which allowed for learning about user and community acceptance as well as capability.

Through three different examples, the team explored the potential for public service to be conducted using a multi-role drone. The drone delivered 5kg of medical supplies (Malaria treatment, IV fluids and ORS) to the Lifupa clinic at 40km, well beyond visual line of sight (BVLOS) of the on-the-ground drone pilots. It was then integrated into an anti poaching activity in Kasungu National Park, with Rangers based in the ground station controlling the onboard camera. Finally, a mapping exercise was made over a 7x1km remote area of Kasungu District, generating 10,000 images over a period of two hours.

★ 5kg of medical supplies delivered in 30 minutes

★ Exploring drones for more routine development objectives

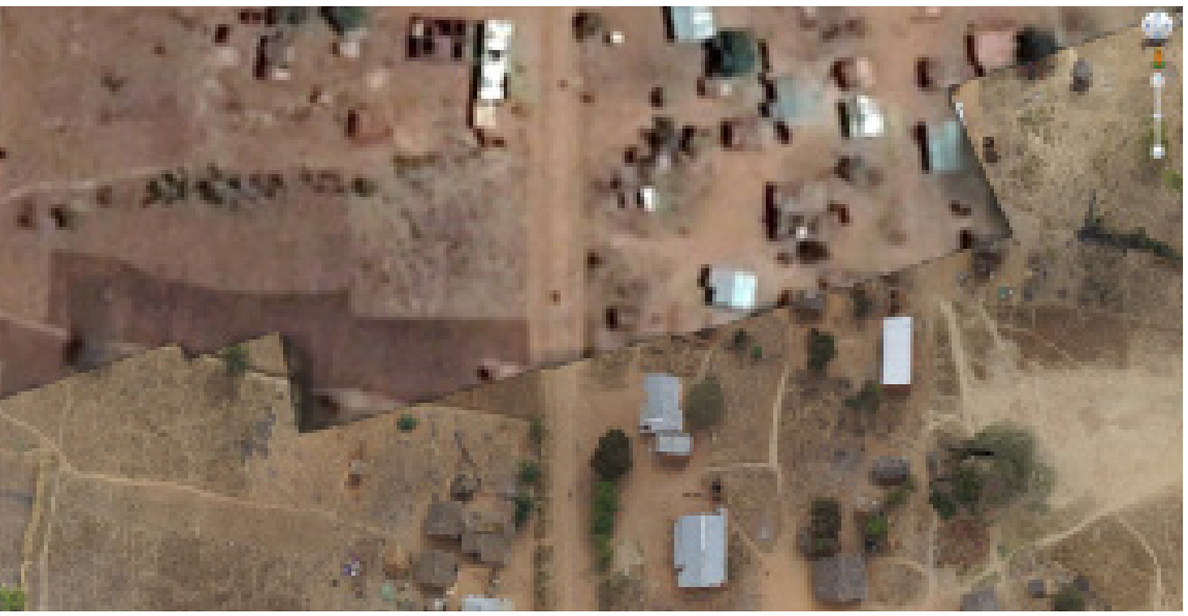
★ Live surveillance and photography flights undertaken

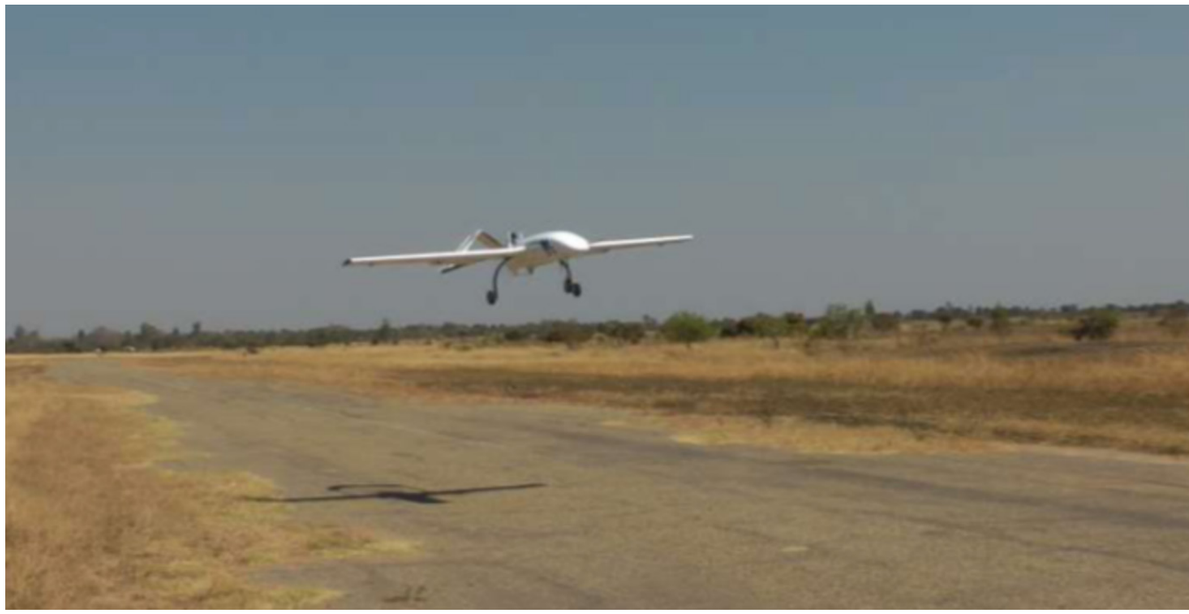
SPOTLIGHT: THE CASE FOR MULTI-ROLE UAVS

The pilot initially looked to demonstrate the viability of a multi-role UAV for emergency aid delivery, as well as surveillance and mapping, using Beyond Visual Line of Sight capabilities. The rationale was to combine multiple functions on a single vehicle, to provide a cost-efficient model. As the pilot continued, it became apparent that the UAV should also be tested for non-emergency responses, thus increasing the usefulness of a single vehicle. Operating a range of non-emergency functions might also generate revenue from different donors, host governments and the private sector.

A long-range multi-role UAV, such as a fixed-wing Hansard V, can reach a larger customer base, as well as provide a payload size suitable for the delivery of lightweight essential supplies up to 10kg. (e.g. medical supplies). Other uses of multi-role drones include HD mapping and live video surveillance, as exhibited by the anti-poaching use demonstrated at Kasungu National Park.

The ability to combine multiple services on a single UAV flight, as well as the rapid potential for their reconfiguration, helps to justify the large capital expenditure required to procure, transport and maintain an Unmanned Aerial Vehicle. It is the unique combination of capabilities demonstrated by the Hansard V in a developing country context that can be considered a significant point in the exploration of multi-role drones.





SPOTLIGHT: MALAWI: BEYOND HUMANITARIAN AID

Malawi was chosen as the location for the pilot study because of its regulatory assistance and programmatic support. A DFID priority country, Malawi is home to the Kasungu Drone Corridor, which has been run by UNICEF, in cooperation with the government of Malawi, since 2016.

However, Malawi may also benefit from a multi-role UAV in the future. It is a low income country, with 41% of its population living in poverty. Malawi's population is also 83% rural, which provides logistical challenges to emergency aid, which is usually relief from droughts and flooding (both of which, sadly, happen on a routine basis).

Malawi faces issues other than natural disasters that are often more routine. Access to medical services and the provision of medical supplies, for example, are often constrained by transport. Motorbike taxis transport blood samples, for instance, but their reliability is often to be desired. It can take months for test results to make their way back to citizens.

Poaching is also a significant issue. Kasungu National Park is the second largest in the country. Rangers have a difficult task in patrolling the park and its rugged terrain. The park is therefore becoming more open to technological solutions, in order to maintain control of the site and combat poaching activity.

THE RESULTS

All of the critical assumptions behind this idea were tested and proved ✅ or disproved. ❌
We gained insight on all the assumptions, but some had questions remaining. 🤔

VALUE	DID USERS ENGAGE WITH THE TECH?	
	The original hypothesis was tested, as were those that concentrated on long-term development outcomes. The anti-poaching surveillance activity in Kasungu National Park can particularly be associated with the independent utilisation of UAV technology by local actors. Furthermore, given that the project was essentially testing, any evidence produced will likely be incorporated into agency decision making regarding the potential usage of UAVs, including DFID. Overall, further testing likely needs to be made within the system, to engage local actors and validate the multi-role usage of the UAV.	✅
TECH	**DID THE TECH DEPLOYMENT WORK?**	
	An additional phase of experimentation was required to get the Hansard V off the ground in Malawi. This included calibration to make the overall system more robust. The major issue in this early phase was the quality of fuel used, which highlights issues of testing in a developing-country context. It remains to be seen whether the solution to the fuel issue - that of special procurement - is scalable. Overall, three use-cases were successfully completed, including demonstration of high-definition photography, multiple flights of 5kg cargo, and the covering of distances below 100km. The maximum advertised range (10kg, 300km) has not been tested.	✅
GROWTH	**WHAT IS THE LIKELIHOOD FOR SCALE UP?**	
	The success of the final tests have increased the likelihood for scaling up of the product. Nevertheless, issues remain as to the appetite to scale up any one UAV model: there are wider issues surrounding UAV suitability in particular contexts, as well as whether users wish to meet the capital expenditure and operating costs associated with models such as the Hansard V. It finally needs to be borne in mind that regulation on UAVs (ability for parcels to be dropped without landing, and the acceptance of Beyond Visual Line of Sight capability,) is crucial for their uptake.	🤔
IMPACT	**WHAT LEVEL OF POSITIVE SOCIAL IMPACT OR INFLUENCE HAS BEEN ACHIEVED?**	
	While the immediate impact of the pilot was minimal, the project has helped generate invaluable learnings on the subject of UAVs for multi-service delivery. It therefore could contribute greatly to improving the impact of development and humanitarian actors in challenging areas. During testing, the UAVAid team combined their test flights with meeting some genuine needs of local communities, government authorities and a UN agency, demonstrating the potential social value and impact of multi-role drone if deployed more routinely.	🤔
OPPORTUNITIES FOR SCALE		
Has it attracted any co-funding or follow on investment?	Seed investment for integration of the drone platform with AI camera monitoring (wildlife monitoring applications), with a partner based at the Harwell campus in Oxfordshire	

BY THE NUMBERS

3
uses-cases tested, based on need

1
live anti-poaching surveillance exercise

5KG
of medical supplies deliverd to Lifupa medical centre

10k
hi resolution images made in one journey

REFLECTIONS FROM THE HUB

Insights on UAV Tech

Engage local stakeholders. Early.
Local experts are crucial to the success of a project, because they may understand the realities of regulation and customs in the country, as well as be able to assist in logistics. Contacting such people early, for their access to networks and the identification of risks, is invaluable.

Assume nothing about tech-transferability
Key-up on as many technical and logistical tips as you can from those who have already tried similar projects.

Produce an absolute worst-case scenario for each section of the vehicle, relative to how it may function in a frontier environment. Become aware of potential pathways to tackle technical issues, even if they seem unlikely. If you can, go to the new context as soon as possible, to assess the site and identify where problems may lie.

Finally, try to mitigate problems by focusing on the robustness of the drone design, potentially over one that is more optimised or achieves certain metrics. This could take the form of a minimum viable product that is rugged enough to meet a wide range of physical conditions, which can then be optimised in accordance with local needs.

Follow the pathway: Problem -> Solution -> Scale
Try not to be too tech-driven early on. Concentrate on a particular problem that you need to tackle, or outcome that you would like to achieve.

The technology should be catered to the context and the problem. Be lean in your approach to experimentation, which means not to focus on obtaining certification if it may not be needed.

Test the technical capability of the drone in a specific use-case before engaging in opportunities to scale up.

“There were some really big opportunities for this type of drone to do more routine stuff in development... We pivoted the overall aims of the pilot: it still has the same functionality but addresses different needs.”

- Daniel Lihou, DFID Pioneer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