UAVS FOR LABORATORY SAMPLE TRANSPORT IN MOZAMBIQUE

PILOT STORY

Start Date: February 2018
Completion date: Ongoing
Can an enabling environment be built in Mozambique for the testing of unmanned aerial vehicles (UAVs) in the tuberculosis sample transportation network?
**THE CONTEXT**

**The problem:**
There are an estimated 10.4 million new cases of tuberculosis (TB) every year. Mozambique is one of the most affected countries, with the third highest rate of new cases worldwide. It is also one of the countries most affected by “missing cases”, that is, cases of TB that go undiagnosed or unreported to the carrier. Given that someone with untreated TB can infect as many as 15 others, knowing when someone has the disease and treating them quickly is crucial to tackling the epidemic.

One of the main reasons for missing TB cases in Mozambique is the sample transport network. While it is often far for people to reach a medical centre for their sputum (or phlegm) sample to be taken, the majority of health facilities don’t have their own laboratory, meaning that samples have to be transported elsewhere. The journey between facilities is made by cars or motorbikes across low-grade roads, or by boat or plane.

By the time samples reach the lab, quality is often diminished to the extent that they cannot be processed by the lab. And at some times of the year, especially during the rainy season, health facilities are simply unreachable to conventional transport.

**The idea:**
Unmanned aerial vehicles (UAVs), or drones, can be used to leapfrog traditional methods of tuberculosis sputum sample delivery and become an important part of Mozambique’s laboratory sample transport network.

This idea is founded on assumptions surrounding stakeholder engagement, community perception and UAVs’ suitability for the task, which have not been widely tested in the Mozambican context.

If stakeholder buy-in can be ensured, then testing UAVs in Mozambique will be possible. If a community perception study can be made, concerns around using drones locally can be addressed. And if it can be shown that lab samples can be carried from a health centre to a lab by drone - both safely and reliably - project feasibility can be established before comparing and refining delivery models.

---

**The team:**

**The Pioneer:**
Etelvina Mahanjane

**The Implementing Partner**
VillageReach

**The Tech Partners**
Swoop Aero

**Independent Technical Expert**
Nigel Breyley

---

57% detection rate, Mozambique (World Bank, 2018)

15 Potential infections from one TB sufferer

80% of Mozambique’s roads are unpaved
The pilot started in January 2017 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:

**Secure additional investment**

After making a stronger, more in-depth project proposal, the project team secured additional funding from DFID Mozambique, to the initial sum of £236,000. The funding arrangement was made so that FTL pilot monies were used first as to reduce risk from the country office investment.

**Engage stakeholders**

The project team organised a workshop that brought together key stakeholders. This included representatives from the ministries of Health, Aviation, and Science and Technology. The purpose of the workshop was to achieve buy-in for the project, to build capacity and understanding through the sharing of information, and for the project team to establish contacts for future engagement.

To achieve these goals, the session was led by government stakeholders, which resulted in the initial plan for the workshop shifting in emphasis, to explanations of the problem and potential uses of UAVs more generally.

**Obtain project permissions**

Obtaining official support for the project also formed a part of early proceedings. The team needed to obtain written permissions to conduct UAV test flights, albeit in a less populous area, for which they needed to reach an agreement with the provincial Ministry of Health for Maputo. The request for permission required an additional review by the provincial government, which meant that it took 60 days to get the permission. A potential reason for this was because drones had not flown in Maputo province before, and so extra caution was needed. A useful addition at this stage was the assigning of a liaison from the provincial government to the project team.

**Gauge community perceptions**

It was necessary to obtain ethical and permissions study. The team obtained permission from the Institute for Health bioethics review board.

The qualitative study was undertaken at two locations in Maputo Province: the Provincial Health Committee and the National Bioethics and Health Committee. In order to gauge via 10 focus group discussions, both health care workers and the community members living within a 0.5km radius of the two health centres.

Data collection also included key informant interviews with 19 health workers spread between the two study sites to inform a community sensitisation of drone flights in populated areas.

The project team recognised that another community perception and as they moved to a more remote area.

**Develop study protocol**

The project team collaborated with officials from the National Institute for Health (INS) to develop a study protocol to assess the needs of the current TB transportation system, and compare it with transport by drone flights.

Additionally, this protocol described drone study flights would take place carrying positive TB sputum samples between the INS Lab in Marracuene Health Center. The project signed a sub-contract with the INS to conduct lab tests on the quality of samples flown by UAV.

The INS was seen as an important partner key to success. This was with the appreciation that engaging various tasks with external stakeholders could take more time to contribute to delays.

Final approval for the complex study protocol was received from the Ministry of Health 9 months after initial submission and after going through a series of bioethics reviews, both at the INS and the National Bioethics and Health Committee.
**Perception**

Approval to conduct a community perceptions study required permission from both the National Health Board and the National Ministry of Health. The study was undertaken at two locations in Maputo Province: Marracue District, and Tenga Health Center. These locations were selected in consultation with stakeholders as areas where the drones would be deployed. Community perceptions were gauged via 10 focus group discussions (120 participants), made up of 10 individuals living within a 0.5km radius of the two health centres. Community correspondents were used first as to reduce risk from data breaches. For each location, they would have to do two additional community perceptions studies. Information was gathered to inform a community sensitisation or education strategy prior to the flight programme.

**Select partner and location to test**

A global call for proposals was issued for a technical partner to fly drones in the pilot study, with applications reviewed by an in-country selection committee. Swoop Aero was selected for the project, because of their experience using drones for delivering health products, including laboratory samples, as well as their drone design and technical expertise.

Initial test flights were selected to take place in Maputo province, in a training location held by Amovant. The area was chosen as a safe place to conduct flights without the presence of structures or people.

**Permission and prep for flights**

Alongside Swoop Aero and the Independent Technical Expert, VillageReach made an application consisting of a comprehensive safety package to the Civil Aviation Authority of Mozambique and the Ministry of Defence to conduct a first round of test flights, including Beyond Visual Line of Sight (BVLOS) flights which aren’t normally permitted by the Mozambique drone regulations.

The project team knew that informing as many safety features into this testing period was crucial in order to build the confidence of the National Aviation Authority. It took 3 months for authorisations to be given due to a slow time for the government during the summer period and the need for special permissions for BVLOS flights.

**Conduct test flights**

The flights with dummy cargo (empty containers) and technical demonstrations took place over three days, with the last in the presence of the National Aviation Authority, including its Director and Amovant. Swoop Aero facilitated meetings with stakeholders, which included the Director of Civil Aviation, representatives from INS and Tenga Health Center personnel. The technology was demonstrated, including safety features and software used.

Finally, 11 flights - including one Beyond Visual Line of Sight flight, was made. The session was seen as successful by Civil Aviation and enabled the project team to submit an application dossier for flights in more populated areas.

Following the successful initial test flights in March 2020, the official study flights were expected to happen in April 2020, however, COVID-19 disruption has caused them to be delayed until at least September 2020.
SPOTLIGHT 1: WORKING WITH GOVERNMENT STAKEHOLDERS

Working effectively with a wide range of stakeholders is crucial for a pilot project working with UAVs in the public health space. Stakeholders from many sectors of Mozambique’s national government were needed for obtaining necessary permissions, but also for co-designing the project.

A key moment in engaging stakeholders early on in the pilot was during the initial workshop. What was different from many technology-focused workshops was that government officials, such as from the National Institute for Health (INS), led the session. Because of this, the agenda for the meeting shifted from an immediate discussion of the proposed solution to talk more openly about the use of drones and the present state of infrastructure in Mozambique. It also meant that stakeholders were more energetic throughout the workshop, felt ownership in what was being discussed, and enabled the surfacing of understandings of local context and local knowledge on UAVs.

Consultation with government actors at all levels took time, but was necessary for ensuring their leadership in the project. Many departments had never had to engage with the ethical, legal, technical, and operational questions that rightly surround the use of UAVs. The project team understood that trusting relationships with stakeholders, as well as open dialogue, were important for project success.

Enabling agency and buy-in from all parts of government is the only way to scale and sustain adoption of new technologies in the long-term.
“The importance of stakeholder engagement is often emphasized, but how engagement occurs, and with whom, is not always straightforward. Our experience in Mozambique tells us that engagement with government and non-government partners is about listening to and using different perspectives to make our work better, and involves being willing to change our paradigm and our model.

If I believe someone is a stakeholder, then their opinion matters. Mutual listening leads to better outcomes.”

- Susana Moreira, VillageReach
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. 😐

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DID POTENTIAL USERS ENGAGE WITH THE TECH?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The pilot project was successful in terms of engaging with stakeholders to create an enabling environment to test UAVs in the TB sample transportation network. The team wanted to engage with stakeholders as much as possible, including within the confines of the way these actors work. Additionally, the community perceptions studies have shown that there were few concerns about the use of UAVs in this use case, at least theoretically. Mozambique has established legislation on the use of UAVs, but only minimal experience with utilizing drones (mostly for mapping and not for transport) and thus it was helpful for government officials to be part of the panel evaluating UAV project proposals. More of the kinds of interaction we have seen from this pilot are therefore needed to alleviate concerns and design solutions in the following stages of the project.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TECH</th>
<th>DID THE TECH DEPLOYMENT WORK?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The technology was tried in a series of test flights, which went well. However, these were fairly short flights and not in populated areas, so much more remains to be proven regarding the full potential of Swoop Aero’s technology and its potential for speeding up transport of lab samples in Mozambique. The crucial test for the project will be testing the assumption that UAVs can safely and reliably deliver health products over long distances in populated areas of Mozambique, and comparing TB sample delivery with the baseline assessment.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GROWTH</th>
<th>WHAT IS THE LIKELIHOOD FOR SCALE UP?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional phases of this project have been decided to define specific use cases of UAV transport, as well as conduct a cost-benefit analysis of using UAVs in the sputum sample network. A key question for these future phases is, therefore: how will a UAV network be supported once its effectiveness has been validated? Operation and maintenance of a UAV sample transportation service are key considerations that must be taken into account if the pilot is going to scale up in the future. This is particularly true as testing moves away from Maputo Province to a more remote Province in the future. Second, scaling up also requires Civil Aviation, the Ministry of Health, and local governments to be onboard with the project in the future. Current laws regarding Beyond Visual line of Sight flights, for example, are still restrictive, but exceptions can be obtained if the drone company can make a compelling safety case. Finally, in terms of sustained funding and government involvement, it has been noted that the Ministry of Health may have other priorities such as infrastructure, equipment and supplies, as more immediately desired over high-tech solutions. The benefits of UAV technology as leapfrogging existing tech in reaching hard-to-access areas and providing good value for money are therefore crucial for their adoption.</td>
<td></td>
</tr>
</tbody>
</table>

FRONTIER TECHNOLOGY LIVESTREAMING: CASE STUDY
WHAT LEVEL OF POSITIVE SOCIAL IMPACT OR INFLUENCE HAS BEEN ACHIEVED?

In theory, the potential impact of UAV technology for sputum sample transportation is great. However, there has been limited immediate impact from the FTL pilot to date because it has only helped to create the enabling environment for testing. Nevertheless, in terms of sensitising government stakeholders and incorporating their ideas, the pilot has had an impact on future UAV projects in Mozambique (including the continuation of this project by VillageReach,) because these avenues for engagement have been established and exposed. The real impact of the pilot has therefore been helping to surface the possibilities for and potential benefits of adoption of UAV technology in the long-term.

OPPORTUNITIES FOR SCALE

Has it attracted any co-funding or follow on investment?

Co-funding from DFID Mozambique that has risen to £300,000.

BY THE NUMBERS

9 months for bioethical approval

11 short range test flights

3 months for civil aviation approval

1 BVLOS flight
**Sweat the soft stuff**

One of the things the pilot has highlighted, and is of relevance for the majority of teams working with UAV technology, is that the personal and professional interactions with government officials, the “soft stuff”, are really important for project success.

These are the things not necessarily translated into milestones or events, but should be considered when forming a project team. Identifying early government “champions” is even more important when your project involves the engagement of many stakeholders from various institutions (e.g. Civil Aviation, Ministry of Health, Department of Defense, National Health Institute, Maputo Provincial Health Division, etc.). Being deliberate about who, when and how to engage, and empathetic to the needs and concerns of different stakeholders, was crucial to progress in this pilot.

**Don’t underestimate the role of an independent technical expert**

As already mentioned, implementing partner VillageReach had great experience working in the health sector in Mozambique and coordinating with local actors. But they also knew the limits of their knowledge on UAV technology and regulation. It was therefore crucial for the project to incorporate the knowledge of an Independent Technical Expert (ITE) for ad hoc support, and as an informal advisor. The ITE was engaged in the selection of the drone company, as well as helping to craft customized applications to the Civil Aviation Authority. If expertise lies in the health and supply chain, for example, but not drones (unmanned aviation), bring in someone who can give you that technical detail.

**A marathon or a sprint?**

Different stages of project development means that it’s sometimes hard to work in lean ways. In this particular pilot, the team was aligned in understanding that government buy-in was the most critical assumption for this idea to work in the real world. However, this assumption took many months to validate, meaning it was hard to stick to a lean methodology, which relies on rapid feedback loops between testing, learning, and iterating.

Feedback loops in this pilot took a long time because they followed a multi-stakeholder approach and were working in what was new territory for the Mozambican authorities. It therefore may not be possible to test certain hypotheses quickly, and we must factor this in when we design a pilot project.
“The framework that you're working in matters: the regulations, the processes, the customs, all of which have to be respected and incorporated. But also all the individuals that collaborate to make a new initiative like this happen: their curiosity about a new way of doing things, the urgency of the health need in their communities, how much time people are willing to spend thinking about how to implement these innovations most effectively, and getting actively involved.

And how interested they are in whether this could be a good fit for the local context - can this really solve the problems on the ground?”

- Luciana Maxim, VillageReach