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What should you deliver by UAVs?

The role of geography, product, and UAV type in prioritizing public health use cases for delivery by UAV

November 16, 2017

Matiko Machagge, JSI
Yasmin Chandani, JSI
Kameko Nichols, The Nichols Group LLC
Sidharth Rupani, LLamasoft, Inc.

Background

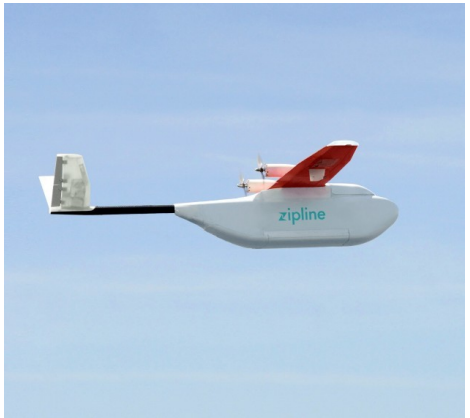
- Public health programs and supply chains face challenges that include high transport costs, chronic stock-outs, waste, and inefficiency
- UAVs may offer a last mile delivery system to address some of these challenges….but countries are faced with a variety of options to choose from
- Limited tools exist to help countries analyze and make informed decisions on how and when to integrate UAVs into public health programs and systems, as part of a holistic approach, to maximize health and logistics objectives
- JSI partnered with LLamasoft and Kameko Nichols to explore this question and develop a tool to empower countries in analyzing their options

UAVs in Public Health Systems

- What exactly is their potential?
- Where exactly do they provide a compelling advantage?

- Decision is not - “drones or no drones”
- Rather: in what specific niches in my public health system can drones provide a benefit?

- Drones will be integrated into the public health system
- Operate in parallel with and complement other forms of transportation



Goals of our project

- Create a first-pass screening tool for individual countries to:
  - consider their unique situations
  - rapidly prioritize potential use cases for UAV delivery
  - approximately estimate relative costs and potential benefits

- Extract and share general insights into factors that point towards UAVs offering a logistics advantage, their thresholds and limits of applicability

UAV delivery should support health and logistics objectives

- Overall **Health Objectives** (e.g. saving lives, ensuring care) are supported by **Logistics Objectives**

- What are select situations that UAVs offer advantage on:
  - Multiple logistics objectives simultaneously
  - Large advantage on at least one of the logistics objectives – enough to be compelling in terms of achieving overarching health objectives

Logistics Objectives

- Cost
- Service Level: Availability of Product
- Service Time: Speed/Responsiveness
- Risk or Flexibility *(accommodate unplanned events or risk e.g. unplanned demand variation, unplanned disruption of access to HFs)*
- Quality

Rules for Comparison

- Do UAVs offer advantage over **well-managed land transport** (not only to status quo)?
- Assess performance holistically - across the logistics objectives
- Consider not only direct transportation costs, but **wider system costs which may not be directly apparent** (e.g. inventory holding costs, capacity expansion costs)

To meaningfully assess and identify niches of potential UAV advantage, we need to look across three dimensions

Geography

- Health Facility Density
- Road network quality
  - *Circuity factor – road distance/straight-line distance between two points*
  - *Average travel speed*
- Health Facility Accessibility
  *(% of facilities inaccessible by road * % of year inaccessible by road) e.g. low in watery regions*

Product/Demand

- Weight
- Volume
- Financial Value
- Health Value
- Shelf-life/Difficulty to store
- Quantity of demand at individual facility
- Unpredictability of demand
- Current extent of stockouts

UAV Characteristics

- Payload Weight
- Payload Volume
- Range
- Reverse logistics capability
- Cost
  - *Fixed (minimum annual costs)*
  - *Variable (per-km or per-delivery)*

UAV Characteristics

UAV Configuration Types

lighter than air

heavier than air

balloon

blimp

fixed wing

small UAV

MALE

HALE

hybrid

VTOL fixed wing

tilt wing

tilt engine

tilt platform

multi-rotor

tri-copter

quad-copter

hexa-copter

octo-copter

single-rotor

conventional

coaxial

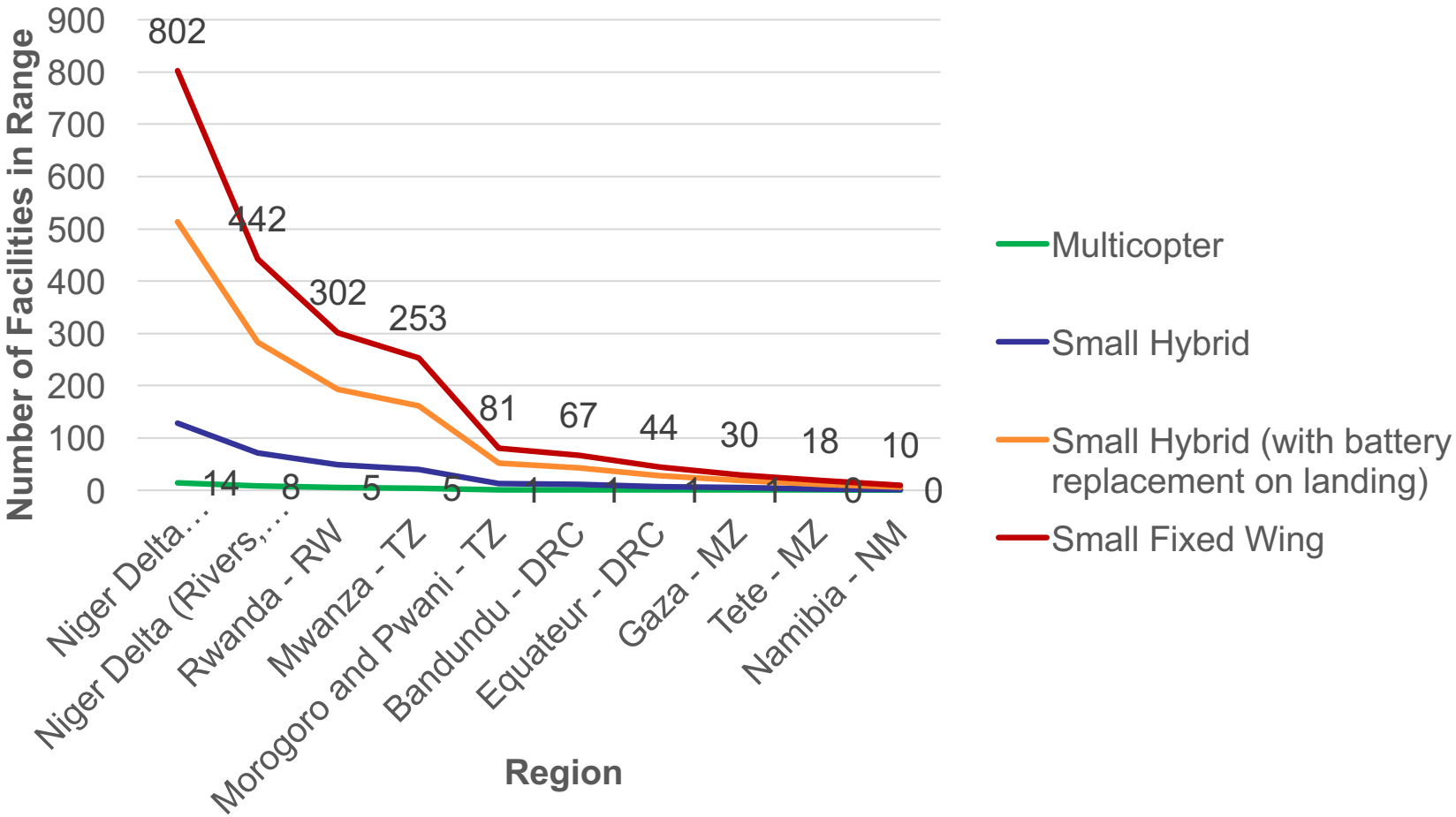
nano

flettner

MALE: medium altitude long endurance (15.000 – 45.000 ft.), HALE: high altitude long endurance (>45.000 ft.)

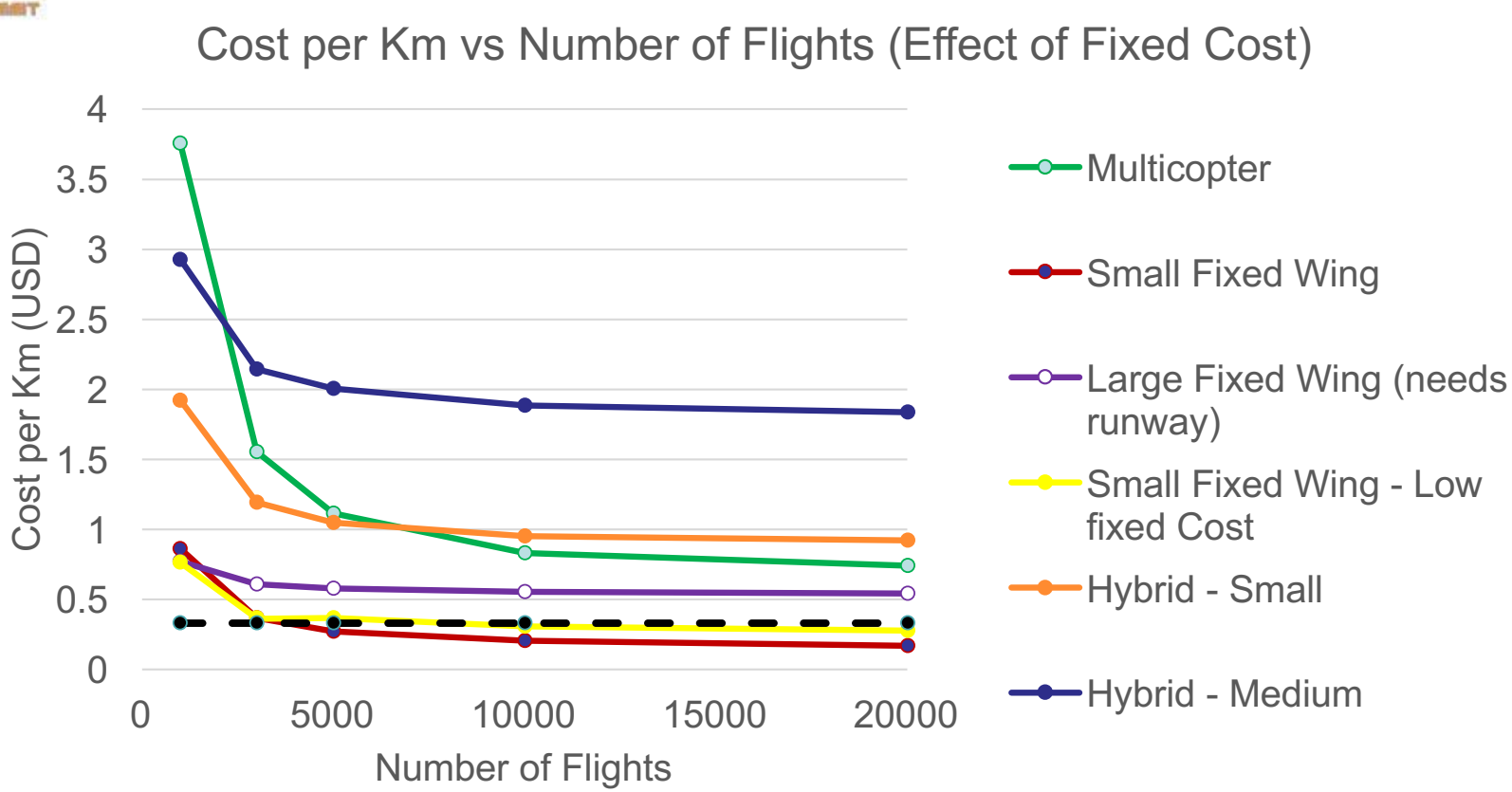
Source: Drone Industry Insights
www.droneii.com, June 2016

The number of facilities in range of delivery is an important driver of viability



- Can vary by a factor of 50+ by **UAV type (range)**
- Can vary by a factor 50+ by **facility density**

Fixed Costs need to be defrayed over a large number of flights for UAVs to cost competitive

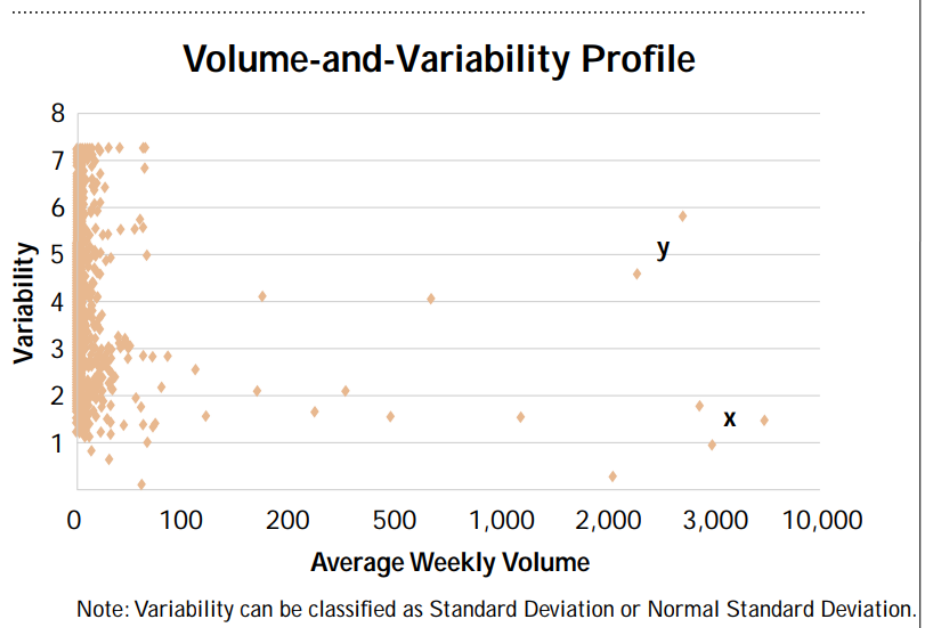


- If flight volumes are bound to be low, one should consider UAV systems that have low fixed costs, but closely examine their capabilities and overall cost-competitiveness

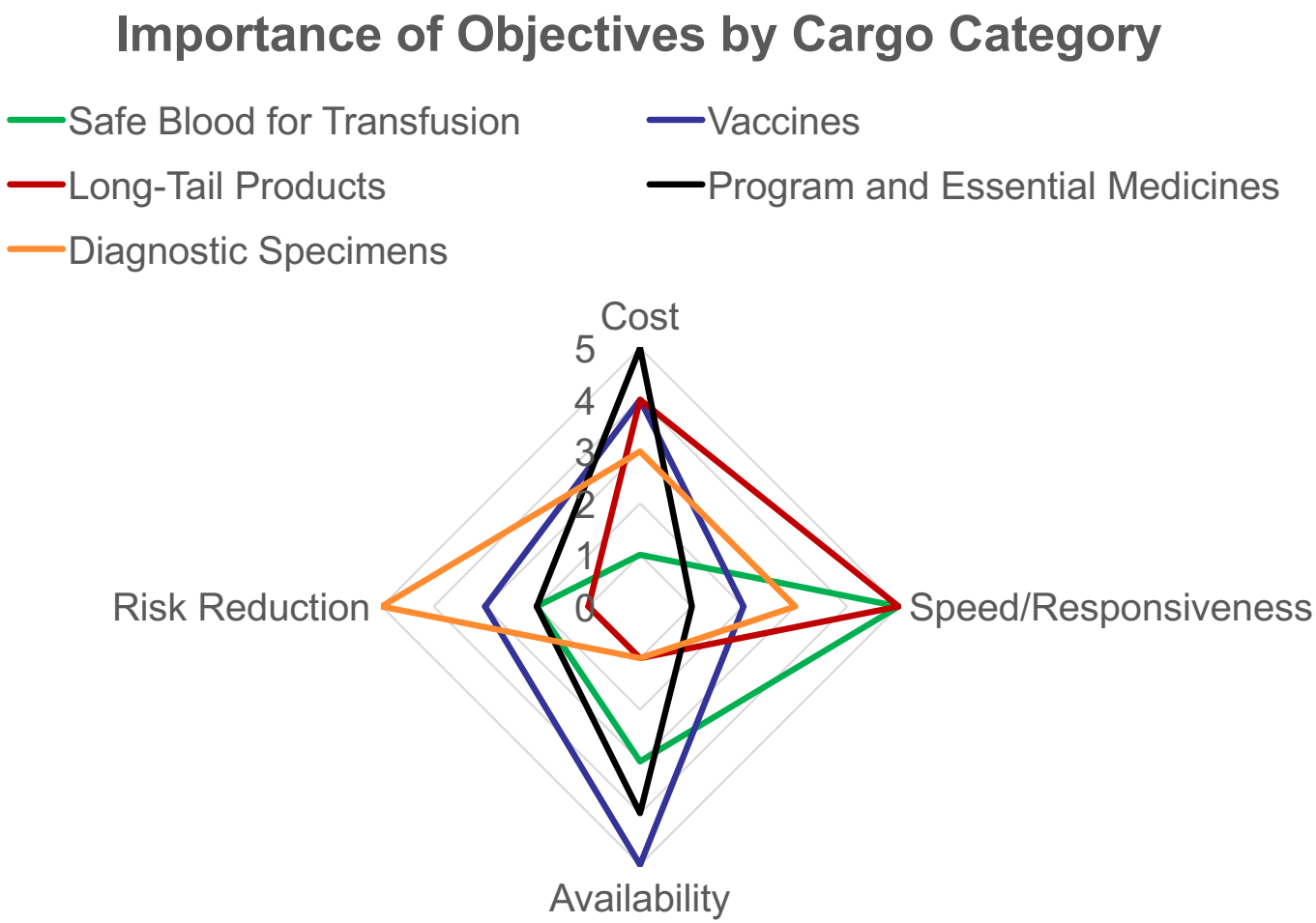
Product/Demand

- Wide range of product categories considered
  - Safe blood for Transfusion
  - Vaccines
  - Long-tail Products
  - Program and Essential Medicines
  - Diagnostic Specimens

- Data for health facility level demand obtained from three SSA countries (supplemented by public data) and analyzed to obtain indicative demand quantities, variability, stockout rates etc.

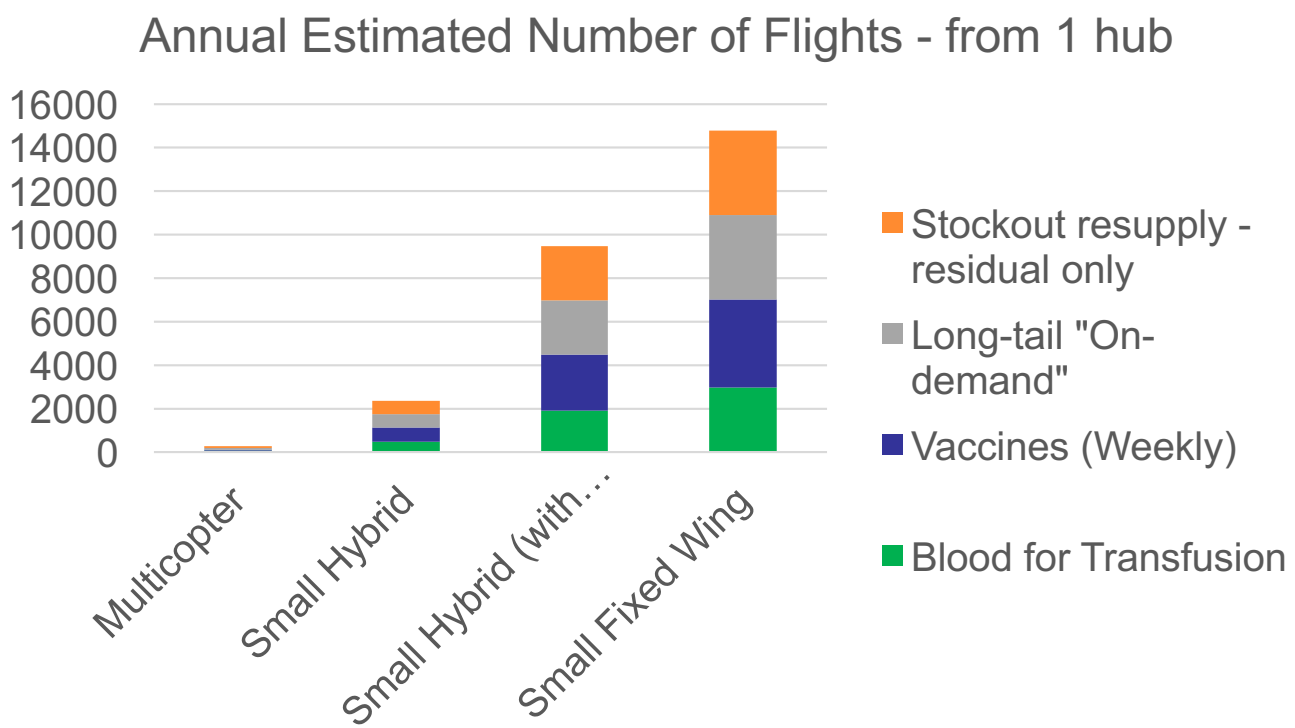


Cargo categories vary on product characteristics as well as on importance of logistics objectives



To effectively use this new transport mode, need to consider layering use cases across programs to build flight numbers

- Roughly estimating the numbers of flights for different use cases in a region with the facility density of Morogoro and Pwani in Tanzania (not very dense, quite rural)



- We acknowledge difficulty of layering use cases. Land transport is having difficulty integrating across programs, so this is not trivial. But important to consider.

What is the role of UAVs in public health systems?

- **Should we be delivering Product Category X by UAV?**
- Answer will depend on **your specific combination** of:
  - Geography
  - Product/Demand
  - UAV Characteristics
- Could certainly offer benefits, **analysis is needed**

Broader conclusions and considerations

Cost-effectiveness can be determined in large part by maximizing the number of flights per day, driven by any/all of the following:

•A large number of facilities in range
- High facility density
- Increased range of UAVs

•Use cases that cut across multiple health programs rather than one program-specific approach

•Expanding the list of potential clients to include non health use cases

How to engage us?

- While ideally a country would consider cross-program involvement and participation, any one program can be an entry point for the discussion

- Consider leveraging existing activities, such as System Design workshops – include “what about UAVs?” as part of discussion.

- With screening excel tool, we can help a country look across programs, prioritize use cases, and estimate level of benefits, with ~ 1 week of effort

THANK YOU!

Please reach out to us

Matiko Machagge: matiko_machagge@tz.jsi.com

Sid Rupani: sid.rupani@llamasoft.com
globalimpact@llamasoft.com

Yasmin Chandani: yasmin_chandani@jsi.com

Kameko Nichols: kameko@thenicholsgroupllc.com