

Case Study

Zipline:

Life-Saving Drone Service Redefining the Supply Chain



Source: Zipline

06/2023-6667

This case study was written by Luk Van Wassenhove, Emeritus Professor of Technology and Operations Management, Henry Ford Chaired Professor of Manufacturing and Academic Director of the Humanitarian Research Group, Loïc Sadoulet, Affiliate Professor of Economics, both at INSEAD and Anne Nai-tien Huang, INSEAD MBA'19D. It is intended to be used as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

The authors gratefully acknowledge the help of Boas Meijer, PhD Student in Technology and Operations Management at INSEAD, in developing the case.

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Introduction

Zipline's Mission: To Provide Every Human on Earth with Instant Access To Vital Medical Supplies

With its expansion to Ghana in 2019, Zipline became world's largest drone-based medical delivery service, reaching over 25 million people. Founded in 2014 by Keller Rinaudo (CEO) and Keenan Wyrobek (CTO) at Half Moon Bay, California, Zipline was different from its Silicon Valley peers, as Rinaudo explained:

*"There is a growing feeling around the world that technology is not benefiting the vast majority of people. Zipline wants to establish a new model of success in Silicon Valley by showing the world that the right technology company...can help improve the lives of every person on the planet."*¹

In June 2021, Zipline announced a funding round of USD250 million, seeking to finance the global roll-out of its healthcare logistics network and accelerate progress towards its mission, with a target of reaching 700 million people by 2024 with drone delivery.² It had already achieved nationwide coverage in Rwanda and Ghana in 2019 (Exhibit 1) and had expanded into Nigeria in 2021. The COVID-19 pandemic had accelerated official approval for it to operate in the US – delivering medical supplies in North Carolina. This was seen as a potential catalyst for expansion to other developed countries, where aviation rules were more stringent and air traffic much busier than in developing economies.

Zipline had identified an ongoing need to develop new technological features to achieve commercial success in advanced economies. But would this take away resources that had hitherto been devoted to reducing operational costs for developing countries? And if more profitable commercial opportunities came its way, would it be diverted from its medical mission?

Background

Development of Drone Technology

The exact origin of drones, or 'unmanned aerial vehicles', is unclear. Some claim they date back to 1849, with Austria's aerial attack on Venice using unmanned balloons stuffed with explosives.³ Others claim that they were built during the First World War by the US Army.⁴ To this day, the military applications of drones continue to develop, but it is their non-military use that is particularly on the rise, be it to monitor human activity on the planet, search operations after natural disasters, for filming, delivering parcels, and potentially carrying passengers. A report by Roland Berger in 2019 estimated the non-military drone market to be worth USD 5.5 billion

1 Dawn Kawamoto, *How saving lives served up \$190 million in funding and unicorn status for this Bay Area startup*, May 2019. <https://www.bizjournals.com/sanfrancisco/news/2019/05/17/medical-drone-delivery-lands-190-million-funding.html>

2 Ibid.

3 Murphy, Justin D. (2005). *Military Aircraft, Origins to 1918: An Illustrated History of Their Impact*. ABC-CLIO. pp. 9–10. ISBN 978-1-85109-488-2.

4 Imperial War Museum, *A brief history of drones*, accessed July 2020. <https://www.iwm.org.uk/history/a-brief-history-of-drones>

worldwide, and forecast 11% annual growth in the ensuing 5-6 years to reach USD 10 billion by 2025 (Exhibit 2).⁵

The Problem with Medical Supply Chains

*"Our contract with Rwanda didn't even mention drones. We're couriers. Drones were just the best way to solve the logistical problem of delivering supplies in that environment."*⁶

Keenan Wyrobek, CTO

The 'last mile' problem hampers access to medical supplies, especially in developing countries where insufficient infrastructure prevents delivery to remote areas in emergency situations. Rural clinics often lack the facilities to stock health supplies and the budget to afford short-shelf-life products that can expire before use. Health systems constantly battle between wasting unused expensive medical supplies or being short of the right blood type unit in an emergency. Developed countries may tolerate the high cost of medical waste, developing countries cannot afford it.

The Zipline founders observed this problem in Rwanda. It was not that the country lacked adequate medical supplies, but that they were stuck in a central warehouse and could not get to local clinics on time, and that large quantities expired before use. With insufficient road infrastructure in rural areas and a rainy season lasting months, truck delivery was inefficient and unreliable in emergency situations. After working with the Rwanda government to hone their understanding of the healthcare supply chain, they were convinced drone technology could solve the problem.

The Ministry of Health suggested Zipline deliver blood units instead of the originally planned vaccines. Many potentially fatal conditions can be treated with a blood transfusion, such as haemophilia, thalassemia, immune deficiency, severe injuries and haemorrhaging in childbirth. While whole blood has a shelf-life of between 21 and 35 days⁷, blood platelets (that aid clotting) have five days.⁸ Patients cannot wait hours for blood in an emergency, and rural clinics cannot afford to store all blood types. According to a study by the World Health Organization, 33% of donated blood and 40% of blood plasma expires and is discarded, taking a heavy toll on any health system.^{9,10}

The value proposition of Zipline's on-demand drone delivery begins with their speed and range of delivery, and extends to the transformation of the structure of the medical supply chain and the way care is delivered. At scale, an on-demand delivery system using drones can enable a healthcare system to significantly increase access to medical supplies while simultaneously reducing product wastage and cost. At scale, it can obviate the need for decentralized storage of

5 Manfred Hader and Stephan Baur for Roland Berger, *USD 5.5 billion market volume for non-military drones globally*, February 2020. <https://www.rolandberger.com/fr/Point-of-View/Cargo-drones-The-future-of-parcel-delivery.html>

6 Miriam McNabb, *How Zipline Became a \$1.2 Billion Drone Company*, May 2019. <https://dronelife.com/2019/05/21/how-zipline-became-a-1-2-billion-drone-company/>

7 depending on what type of anticoagulant is used during the collection

8 American Red Cross Blood Service, *How can one donation help multiple people?* Accessed August 2020. <https://www.redcrossblood.org/donate-blood/how-to-donate/types-of-blood-donations/blood-components.html>

9 Yuyun Mmaryuningsih for World Health Organization (WHO), *Action Framework for Blood Products*. 2020.

10 WHO, *Global Status Report on Blood Safety and Availability of 2016*. 2017.

medical supplies and extensive cold-chain infrastructure, and allow the healthcare system to more fully utilize all end-points without suffering from a shortage of supplies needed for treatment.

How it Works

[Video Link \(Real Engineering Video on Zipline\)](#)

Both Rinaudo and Wyrobek had a solid background in robotics. Zipline drones went through several generations before the current model. Today, they can cruise at 110km/hr powered by batteries that last 160kms. 85km is the service radius of a Zipline distribution centre (DC), potentially covering millions of inhabitants, depending on population density, with the capacity to make several hundred deliveries per day. Each drone has a payload of 1.8 kg per flight, equalling three units of blood. By early 2021, Zipline was routinely flying more than 30,000km per day (accumulating over 2 million km since its first delivery) in Rwanda.

Zipline's drones do not have wheels (Exhibit 3), can only take off with a launcher and land with a specific mechanism at the DC. The partnering hospitals and clinics order a drone delivery through SMS or WhatsApp to Zipline. Usually, the supplies are ready for delivery within five minutes. The drone is placed on a launcher that shoots it into the sky at 100 km/h, where it flies a pre-set route to the partnering client. A crew member monitors each flight on a central dashboard (Exhibit 4), informing the client 60 seconds before delivery via text/WhatsApp message that the package can be retrieved from the rooftop or garden. The package is dropped by parachute and the drone flies back to the DC. The landing mechanism is a hook at the back of the drone which meets a wire that snags the drone out of the sky with centimetre-level accuracy (Exhibit 5). Hanging by the wire, the drone is retrieved by crew members, and returned for a round of check-ups, battery swap and next delivery loading. If, for whatever reason, the drone drifts out of the pre-programmed course, it will automatically deploy its safety parachute to land. The current design of Zipline has an exceptional safety record – there were no instances of uncontrolled landing or fly away.

Success Factors

The Technology

The Global Head of Regulatory Affairs, thought Zipline's drone design was key to its success for several reasons:

- First, efficient design. Traditionally, take-off and landing consume a lot of energy, while cruising does not. Zipline's launcher and recovery system allows the drone to fly up to 160 km roundtrip.
- Second, fixed-wing drones. Vertical take-off and landing systems are vulnerable to wind and rain, so cannot be a mission-critical piece of the medical supply chain, which is responsible for everything from routine resupply to emergency deliveries.
- Third, a simple low-cost delivery system. One could argue that not being able to pick up goods on the return trip is a wasted opportunity, but Zipline would need personnel to handle landing and takeoff functions at every third-party delivery location. It would be impossible to build

launchers and landing facilities with trained personnel in each of the thousands of hospitals Zipline serves. The current system keeps infrastructure, operations, and personnel costs low by using a simple parachute.

In recent years, interest in cargo delivery drones has increased considerably. Often financed by large tech or logistics firms, companies such as AerialMetric, Alphabet's Wing, Amazon Prime Air, Ehang, Flirtley, Matternet, Volansi and Wingcopter have built reliable cargo drones. They differ widely in design, services, and funding (Exhibit 6). Zipline is one of the only companies to be operational on a large scale.

Cost, Funding and Unit Economics

"Becoming self-sustainable is the only path to achieve our mission at a global scale."

Maggie Jim, Head of Finance

Zipline saw its costs drastically reduced as it scaled up its operations and engineered every element of the system for scale and dependability. The newest version was designed with reliability, simplicity and easy assembly in mind. Scale in demand also reduced operational costs by increasing utilization of the infrastructure. From its first DC in Rwanda to the current six operational DCs in Rwanda and Ghana (and four more under construction in Ghana), with hundreds of drones in service, it was able to cut cost per delivery by 86%.

Zipline has commercial contracts with government partners and health systems who pay for the service through a tiered subscription model. Even so, the establishment and operationalization of a distribution centre requires a significant up-front cash investment, which is not easy for a small start-up to take on. This poses difficulties for risk-averse, resource-constrained clients in developing countries, which is why Zipline sought other funding sources for its operations in Rwanda and Ghana – venture capital and philanthropic partners. The upfront set-up cost is subsidized by philanthropists dedicated to improving health care in the developing world (e.g., The Bill and Melinda Gates Foundation, Paul Allen Foundation and GAVI [the Vaccine Alliance]), while VCs fuel many of the technology innovations, R&D and growth (Exhibit 7).

Making its service more affordable is a top priority for Zipline to expand to new markets/countries. Jim was looking at the entire operation through the lens of unit economics¹¹ per flight with a goal to lower the cost of each delivery to single-digit dollars. Currently, the cost per delivery is on a par with motorcycle delivery, but much faster and more reliable.¹²

The team continued to redesign the system for greater efficiency, incorporating lessons learned from customers and internal operations feedback. Zipline also worked on innovative ways to make infrastructure set-up cost more efficient, such as a mobile DC that fits into a truck and can easily be set up anywhere.

11 Unit Economics is defined as "direct revenues and costs associated with a particular business model and are specifically expressed on a per unit basis".

12 Interview with Keller Rinaudo on CNBC, May 2019. <https://www.youtube.com/watch?v=vXed07DW5Qw>

Business Development and Regulatory Environment

Rwanda was the first country that took a chance on Zipline before it had a proven business model. It helped that President Paul Kagame was a technology enthusiast. With the support of the Ministry of Health, Zipline was fast-tracked to set up DCs and start operating.

But Zipline soon realized this was an exception rather than the norm. Every new country in which it sought to operate involved a long journey – to understand the regulatory environment and the pain points of the health system. Its Business Development team needed to approach the respective health authorities differently, and the conversation with financial partners also varied.

For every country, whatever the level of bureaucracy and regulation, confidence in safety was key. The Global Head of Regulatory Affairs observed that as long as Zipline provided a lot of information about its operations, explained what it did, how it worked, and how well people were trained, regulators were confident about making the decision.

Company Culture

The sense of mission among Zipline employees was a distinguishing characteristic. The philosophy was to hire people who cared deeply about the company's mission, since they in turn would only hire others who cared as much as they did, as the Global Head of Regulatory Affairs testified:

"I worked in Big Law for five years and got really burnt out. It's so amazing to now work with a team that is super inspiring and doesn't shy away from seemingly impossible challenges. I love the 'Hey, this looks impossible -- let's figure out how to do it!' attitude... It's so fulfilling and I just can't imagine doing anything else. I know a lot of people at Zipline feel this way."

From the employees' side, the General Manager of Zipline's Ghana operation observed a reverse pressure from employees to keep leadership accountable. The entire team in Ghana was Ghanaian – showing a willingness to invest in the local workforce and its intention to stay; it also meant local employees held the company accountable for bringing value to their country. She expressed a deep trust in Rinaudo, the leadership team, and her colleagues because she knew people had joined for the same reason as her.

Value Proposition in Rwanda and Ghana

We couldn't fully anticipate [Zipline's value proposition] until we started to serve customers. You would think an automated instant delivery system is about being fast, but it's not all about emergency deliveries. The real transformation is how it empowers health workers when they can trust that they will have access to anything they need, no matter when and where, to treat a patient.

Maggie Jim

During a congressional hearing in June 2020, Ghana's deputy Minister of Health, Dr Bernard Okoe Boye, reported that Zipline had delivered a total of 79,800 products to 925 health facilities by the end of June 2020, of which 47,100 were life-saving medical products, 31,400 were vaccines, and 1,264 were blood products.¹³ By March 2021, Zipline had expanded its vaccine distribution program in Ghana, which distributed over 1 million doses of vaccines in 2020, to include COVID-19 vaccine distribution to rural and exurban health centres.

In Rwanda, Zipline's two DCs covered almost the entire country. It had made 56,000 trips and delivered 81,000 blood units as of April 2021 (Exhibit 1). Over 75% of blood supply outside Kigali, the capital, was delivered by drone.

These figures testified to the number of patients helped directly by Zipline's service. However, the indirect benefits were arguably more important to the national health system – Zipline changed the way they managed healthcare stocks. The presence of a reliable medical supply delivery service meant stocks were available to all health facilities nation-wide, urban or rural. No one had to hoard supplies at the expense of others. (And it was difficult to pinpoint where the available stocks were because records were paper-based). It also meant fewer emergency deliveries and less unnecessary waste of expired blood and vaccines – hence millions of savings every year.

The Global Head of Regulatory Affairs described trust in the health system as a system-wide benefit of reliable delivery of supplies. Without trust and satisfaction, patients would not leverage the health system, even if they had the money. Why go to the local clinic if experience tells you there is seldom enough medication? Patients tended to postpone treatment until their condition worsened, forcing them to go to a hospital in the city. This increased the burden on the health system and the patient's health and finances.

They also observed a positive impact on long-term control of specific diseases such as TB and HIV. Patients sometimes abandoned treatment because it was expensive and/or difficult to get to a major city from their village. When they finally returned to the doctor, they needed more invasive treatment, which was more expensive. With Zipline, people sought treatment early-on, leaving hospital beds and specialty medical staff available for those who really need them.

Accelerated Expansion

Latest Funding Round

In June 2021, Zipline announced its latest funding round of USD250 million in venture funding, bringing total funding to more than USD520 million and its valuation to USD2.75 billion. Its backers included prominent venture capital firms such as TPG's The Rise Fund, Goldman Sachs, and Temasek (Exhibit 8).¹⁴ This would support its global expansion across Africa, South Asia,

13 [www.abcnewsgh.com](https://www.abcnewsgh.com/covid-19-zipline-to-the-rescue-delivers-more-than-2500-samples-to-noguchi-kccr/), COVID-19: Zipline to the rescue; delivers more than 2,500 samples to Noguchi, KCCR, July 2020.

14 Including Baillie Gifford, The Rise Fund (which is TPG's global impact fund), Temasek, Alphabet's investment arm GV and Katalyst Ventures <https://www.cnn.com/2019/05/17/zipline-medical-delivery-drone-start-up-now-valued-at-1point2-billion.html>

Southeast Asia and the United States, pushing it closer to its goal of serving 700 million people in the next five years.

COVID-19

[COVID-19] has really shown several countries, and to the public, the real value of Zipline's solution – there is tremendous value with contactless delivery where humans are out of the loop.

Global Head of Regulatory Affairs

Contactless delivery suddenly became invaluable when the COVID-19 pandemic hit. Zipline partnered with Novant Health Care¹⁵ to deliver personal protective equipment (PPE) and other medical supplies in North Carolina. Aviation regulations added another level of complexity and restrictions compared to any other country Zipline had worked with. Zipline was already participating in the Integration Pilot Program¹⁶ hosted by the Federal Aviation Administration (FAA) that allowed the authorities to assess the feasibility of drone approvals. It was able to leverage this to become the first authorized long-range commercial drone delivery service in the US.

Reverse logistics was another application tested during the pandemic. In Ghana, local clinics delivered COVID-19 test samples to Zipline DCs and Zipline drones flew them to testing centres in major cities. In May and June 2020, Zipline delivered 2,573 COVID-19 test samples to the Noguchi Memorial Institute for Medical Research in Accra, and Kumasi Centre for Collaborative Research (Exhibit 8).¹⁷

Mobile workers like truck drivers are spreaders of infectious diseases, as they come into contact with people in different geographies. By utilizing drones to deliver supplies to high-risk zones such as hospitals, Zipline reduced the spread of COVID-19 and other diseases by mobile workers.

With support from Gavi, the UPS Foundation, and other partners, Zipline began delivering vaccines via drones across Ghana in 2019. Since then, it has delivered more than a million doses of vaccines to rural healthcare centres, many hard to reach over land.

Zipline is also supporting COVAX vaccine distribution in Ghana. The country became the first country outside India to receive COVID-19 vaccine doses shipped via the COVAX facility, as part of an unprecedented effort to deliver at least 2 billion doses of COVID-19 vaccines by the end of 2021. Zipline's technology was deployed to speed distribution to remote areas, where 2.5 million vaccines were delivered this way. Building on the collaboration with Gavi, Zipline partnered with a leading manufacturer of COVID-19 vaccines to add ultra-low refrigeration capacity at its

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- 15 Novant Health, 2019 Fact Sheet. <https://www.novanthealth.org/>. Novant Health is an integrated network of physician clinics, outpatient facilities and hospitals present in North Carolina, South Carolina, Virginia, and Georgia. The network consists of more than 1,600 physicians and over 29,000 employees that provide care at over 640 locations, including 15 medical centers and hundreds of outpatient facilities and physician clinics, serving more than 5 million patients annually.
- 16 Officially named the Unmanned Aircraft System (UAS) Integration Pilot Program (IPP) was a program launched the US Federal Aviation Administration (FAA) in 2017 to bring state, local, and tribal governments together with the UAS private sector, to test and evaluate the integration of civil and public drone operations into the US national airspace system assisting US Department of Transportation (USDOT) and FAA in crafting new rules for UAS operations. https://www.faa.gov/uas/programs_partnerships/integration_pilot_program/
- 17 www.abcnewsgh.com, COVID-19: Zipline to the rescue; delivers more than 2,500 samples to Noguchi, KCCR, July 2020. <https://www.abcnewsgh.com/covid-19-zipline-to-the-rescue-delivers-more-than-2500-samples-to-noguchi-kccr/>

distribution centres and conduct end-to-end thermal validation to ensure vaccines remain within required temperature range.

In February 2021, Zipline signed a deal with Kaduna State in Nigeria, which among other use cases will position Kaduna to distribute COVID-19 vaccines without significant state investment in cold-chain storage. Zipline's end-to-end cold-chain distribution capability would allow Kaduna health facilities to bypass the need to purchase ultra-low-temperature freezers and enable on-demand deliveries of precise amounts of COVID-19 vaccines.

US and Developed World Expansion

*"People think what we do is solving a developing economies problem. But critical-access hospitals are closing at an alarming rate in the US too, especially if you live in the countryside. Life expectancy there has declined over the past several years."*¹⁸

Keller Rinaudo

Contrary to the assumption that advanced economies have no problem with access to medical supplies, there is a critical need, especially for supplies with an extraordinarily short shelf-life such as platelets (5 days) and compounded cytotoxins or isotopes (a few hours after composition). The amount of blood units wasted in developed markets is just as high, if not higher than in developing countries, simply because they can afford higher wastage. But for how long?

Besides reducing potential waste, another benefit is that patients can stay at home, tele-consult with a healthcare provider, and receive medical supplies delivered via drone. Indirect benefits from this scenario include less pollution and time saved from traveling to health-care facilities in urban areas.

Additionally, consumer businesses in US and developed markets are feverishly investing in supply chain solutions, especially for faster and more convenient last-mile delivery. In mid-2020, Zipline signed a partnership with Walmart to pilot home delivery of health products and by early 2021 had begun construction on a Zipline drone port co-located with a Walmart store in Arkansas – a preview of what the future of on-demand instant retail delivery could look like in the United States.

However, it faced major technical challenges in scaling up in the US. The drones needed a (collision) detect-and-avoid system. Because Zipline drones do not have cameras and are designed to fly on pre-planned routes, a detect-and-avoid system is critical to navigate in busy air traffic in developed countries. Currently, no one has this technology and developing it would require millions in investment. Delivery precision also needed improvement. Currently, Zipline deliveries could drop a package within an area the size of several parking bays, but in dense urban areas this level of accuracy is not sufficient. Zipline envisioned a future where apartment residents can step onto the balcony or reach out of the window to receive their delivery.

Zipline can succeed in the US if these technical breakthroughs occur. This would also prove that Zipline can adapt to other markets and other problems in advanced economies like Israel,

¹⁸ Lora Kolodny, *Zipline, which delivers lifesaving medical supplies by drone, now valued at \$1.2 billion*, May 2019. <https://www.cnn.com/2019/05/17/zipline-medical-delivery-drone-start-up-now-valued-at-1point2-billion.html>

Australia and Japan, which face similar challenges and aviation regulations. Its funding structure would also be different with users and investors.

Looking to the Future

What Next?

The Global Head of Regulatory Affairs broke down the next steps into three stages:

- **Immediate term:** continue to roll out new flight routes in Rwanda, Ghana, Nigeria and in the US.
- **Near-to-medium term:** get full commercial certification with the detect-and-avoid system rolled out in the US and operating at scale.
- **Medium-to-long term:** roll out additional platforms for different delivery scenarios and scale up to more countries.

Jim hoped for several breakthroughs in Zipline's operations: a faster set-up time for the DCs and bringing the cost-per-delivery into single digits. This could unlock new markets and demand, hence higher utilization, feeding a virtuous cycle. The first Distribution Center in Rwanda took two years to ramp up to full-scale operations. Zipline could now do this in a matter of 10-12 weeks. One day, it hoped to be able to get a GPS coordinate and map out a flight path within five minutes – another breakthrough that would accelerate the goal of reaching 700 million users worldwide by 2024.

Technology

There were various debates around technology development and management. The ability to detect-and-avoid manned aircraft was considered the primary challenge to enabling large-scale commercial drone operations in the US market. This implied millions in R&D spending, and diverting engineering brain power away from expanding to other developing countries. The new technology might need a very different set of operating systems to cope with it – operating two types of drones could challenge the scale economies Zipline was hoping for to drive down costs and might prove more expensive to operate. Balancing the needs of both markets would be challenging.

Zipline had been working on technical improvements such as enhanced weather resistance (for the monsoon season in India), different storage boxes for different products (some requiring near-absolute zero temperature), and increased landing accuracy through aerodynamic engineering of the parachute.

Many changes to ameliorate Zipline's service were operational – how the whole system worked rather than changing the actual technology. Would Zipline be able to adapt to new market needs with its current operating mode, or were developed countries too different for the current drone system to succeed?

New Delivery Items and Pricing

Currently, Zipline focused on delivering medical supplies, but as it expanded to new markets, demand for non-medical supplies could increase. Would Zipline deliver whatever customers were willing to pay for? Would it diverge from its initial mission? Rinaudo reflected:

"We believe there is a moral imperative to get healthcare delivery right before using our infrastructure to serve other use cases. As Zipline begins gradually expanding the scope of the services that we provide, we will do so because increased scale will help us to reduce the price of our service to all Zipline customers, making our product more accessible for countries that otherwise cannot afford us."

Jim added:

"Going outside of healthcare would feed back into getting to scale, ultimately making every delivery cheaper, so we can achieve our overall mission."

Pricing had been fairly standardized, but in the future Zipline saw a possibility to differentiate pricing for rush orders and different types of deliveries. This reorientation was exemplified by Zipline's partnership with Walmart.¹⁹ In the initial phase of operations, Zipline would operate from a Walmart store in Arkansas and deliver selected health and wellness products to some of its customers.

Conclusion

Imagine a world where doctors no longer need to face the heart-wrenching situation where they cannot save a patient's life for lack of the right blood type, or where elderly citizens receive medication in the comfort of their home, avoiding long drives to city centres. Zipline could transform access to high-quality health care, bringing it closer to patients and driving efficiencies across the healthcare delivery landscape.

Pressure to succeed not only came from investors, but from employees and clients – the hospitals, health workers and patients who depended on its delivery system. It was this sentiment that motivated the commitment to reaching its 2024 target and mission, as Jim put it: "We do what we do because we know that every delivery matters, and every delivery has a story."

Going forward, how could Zipline balance resources to develop applications for potentially more valuable contracts in developed countries versus driving down current service prices to serve more people? If handling two different technologies, could it maintain its efficiency and continue to cut costs as it grew in scale? How could Zipline stay mission-driven and deliver the impact that was so important to Rinaudo, Wyrobek and the rest of the team when willingness to pay might be higher for non-medical deliveries?

19 Walmart and Zipline Team Up to Bring First-of-Its Kind Drone Delivery Service to the United States, September 2020. <https://corporate.walmart.com/newsroom/2020/09/14/walmart-and-zipline-team-up-to-bring-first-of-its-kind-drone-delivery-service-to-the-united-states>

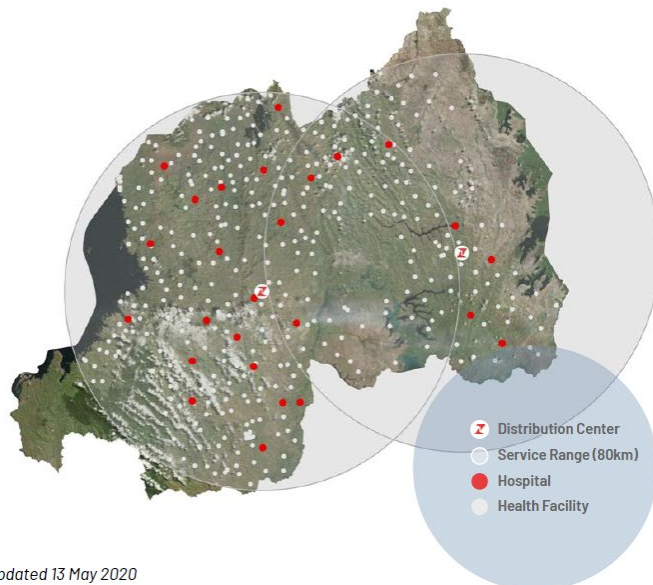


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Exhibit 1

Zipline's Service Network and Results in Rwanda

Zipline Rwanda: World's first national drone-based medical supply chain



Updated 13 May 2020

Source: Zipline Presentation, *Strengthening Health Systems and Delivering Support for COVID-19*, May 2020

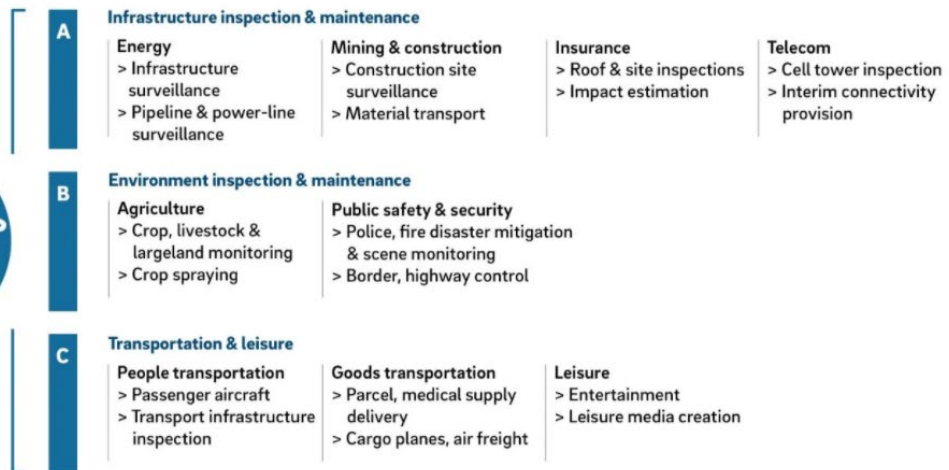
- **2 DCs**, operational **since 2016**
- **10+ million** people covered
- **29,000+ deliveries** till date - 40% emergency, 60% stockout resupply
- Initial focus on blood delivery - **52,000+ blood units** delivered to date
- In early 2019, **product mix expanded to 172 medical products**, including blood, medicines and vaccines
- Expanding to serve **500+ health facilities**

Exhibit 2

Non-military Drone Applications is a \$ 5.5 billion Dollars Market

Non-military drones account for a market volume of USD 5.5 bn globally – Manifold applications possible

Global market
volume
USD 5.5 bn¹⁾



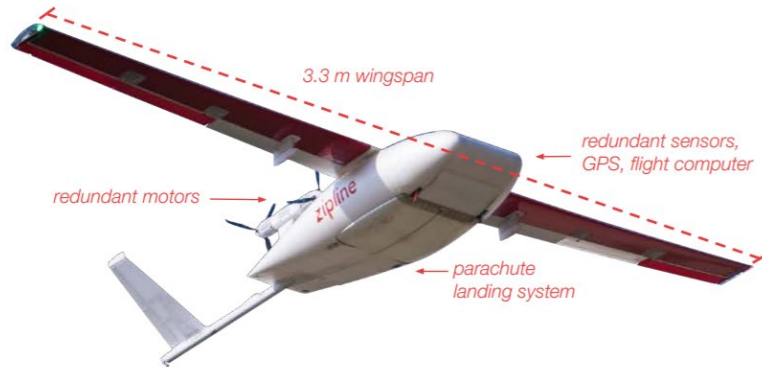
Source Roland Berger ¹⁾ Market volume of consumer and commercial drones in 2019



Source: Manfred Hader and Stephan Baur for Roland Berger, *USD 5.5 billion market volume for non-military drones globally*, February 2020. <https://www.rolandberger.com/fr/Point-of-View/Cargo-drones-The-future-of-parcel-delivery.html>

Exhibit 3 Zipline Drones

"Zips" deliver quickly and autonomously from DCs to health facilities

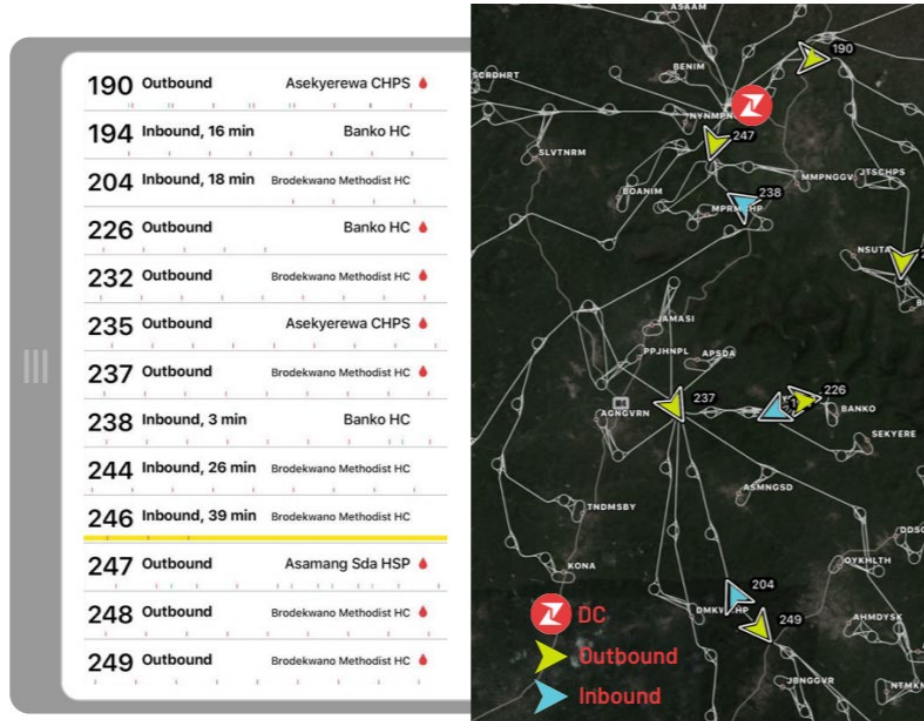


- **85 km** service radius (one-way)
- **110 km/h** cruising speed
- **1.8 kg** payload
- **Best-in-class safety standard** rooted in design, protocols, and flight experience
- Consistently reliable in **strong winds, heavy rain** and **high temperatures**

Source: Zipline Presentation, *Strengthening Health Systems and Delivering Support for COVID-19*, May 2020

Exhibit 4

Zipline's Real-time Drone Monitoring System



Source: Zipline Presentation, *Strengthening Health Systems and Delivering Support for COVID-19*, May 2020

Exhibit 5

The Zipline Drones Landing Mechanism



Source: Zipline Presentation, *Strengthening Health Systems and Delivering Support for COVID-19*, May 2020

Exhibit 6

Comparison of Zipline, AerialMetric & Volansi

Company:	Zipline, founded in Half Moon Bay, United States, 2014	AerialMetric, founded in Madagascar, 2005	Volansi, founded in San Francisco, United States, in 2015
<i>Service:</i>			
<i>Funding:</i>	Upfront set-up costs in Rwanda and Ghana financed by philanthropic organizations (BMGF, Paul Allen Foundation, GAVI). Technological innovation, R&D and growth covered by venture capital firms. Total financing of USD 243 million.	The technological innovation and set-up costs were covered by a joint innovation grant with PSI from USAID. They have not had any other large-scale investments.	Venture capital firms such as Lightspeed Venture Partners and Icon Ventures financed the development of several UAVs and a number of customer projects. Total Funding of USD 75 million.
<i>Cruising Speed:</i>	110 km/h	100 km/h	100 (120) km/h
<i>Range:</i>	160 km	200 km	80 (560) km
<i>Payload:</i>	1.8 kg	10 kg	5 (9) kg
<i>Take-off and landing:</i>	Catapult and catchment system	Vertical	Vertical
<i>Delivery:</i>	Airdrop	Airdrop and landing	Landing

Source: Zipline Presentation, Strengthening Health Systems and Delivering Support for COVID-19, May 2020



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Exhibit 7

Zipline's Investors and Philanthropic Partners



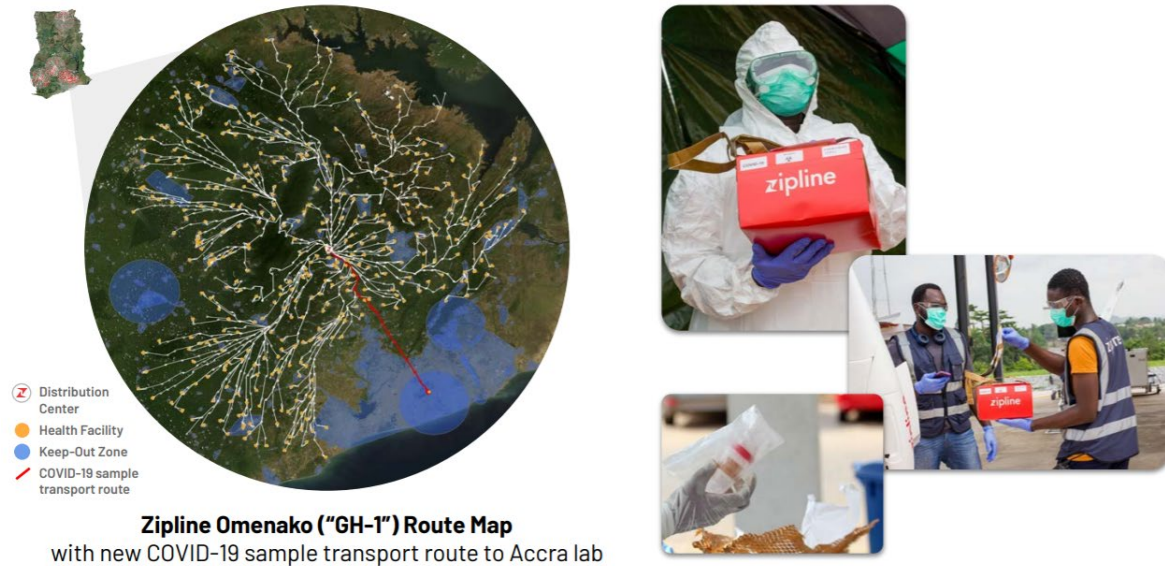
Source: Zipline Presentation, *Strengthening Health Systems and Delivering Support for COVID-19*, May 2020

Exhibit 8

Map of Reverse Logistics for COVID-19 Test Samples in Ghana

Sample transport from rural areas to urban labs:

First-ever urban deliveries unlock faster test turnaround time



Source: Zipline Presentation, *Strengthening Health Systems and Delivering Support for COVID-19*, May 2020