[Transcript] FYI - For Your Innovation / Revolutionizing Logistics with Keller Rinaudo Cliffton

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Hi, everyone. Welcome back to FYI, Arc's four-year innovation podcast. I'm Tashakini, Director of Investment Analysis and Institutional Strategies at Arc. I'm here with my colleague, Sam Kors, Director of Research for the Autonomous Technology and Robotics Strategy, and today we're joined by Keller, the co-founder and CEO of ZipLine, a drone delivery logistics platform, and we're so excited to learn more about ZipLine today. Thanks for joining us, Keller.

I'd love to hear the founding story of ZipLine. What made you decide to start this company?

I think it's so cool that you guys have flown so many flights in Rwanda before moving operations to the US. Would love to hear more about that. How did it all get started?

When we started building everything that became ZipLine in 2013, our backgrounds were in software

and autonomy and robotics. It was becoming pretty clear to us around that time that someone was going to be able to build an automated logistics system for Earth. It seemed like the technology was ready to build something like that and that in fact the Earth, like the planet, probably required it just from a sustainability and zero emissions perspective. The thing that really excited us about that vision was that the more we learned about logistics, the more we understood that especially when it comes to the developing world, logistics is really not broadly available globally. Especially when you look at healthcare logistics, we really only do a good job of serving the golden billion people on Earth, like the richest billion people. If you're not in that golden billion, your access is probably crappy or non-existent. As a result of that, five and a half million kids lose their lives every year due to lack of access to basic medical products. A big part of that is logistics. If there was this opportunity to build a new kind of logistics system, it was really important to build the first logistics system that would serve all people equally. We wanted to achieve universal access to healthcare. We also wanted to transition the billions of instant deliveries that we see happening every year today. We wanted to transition all of those to fully zero emission rather than using a 4,000-pound gas combustion vehicle driven by a human to deliver something to your home that weighs five pounds. We also think that that needs to be zero emission. We started building the product in 2013 and then we signed our first customer contract in 2016 with the government of Rwanda. That was a contract to deliver blood to 21 different hospitals. We launched at the end of 2016, trying to use autonomous aircraft to transform the way that that healthcare logistics network worked by enabling what we talked about as teleportation, basically enabling the health system to send any units of blood really, really fast to any of those 21 hospitals. That's actually what we did for the first year of operations. Cass, what was it like working with the government of Rwanda?

Are there learnings just from how they structured the rules and regulations that you think the US can learn? Often with technology, you get leapfrogging from developing countries. Is that something that's going to happen with aerial logistics? That concept of leapfrogging is incredibly important. It's exactly what we've seen over the last seven years. I think a lot of people, especially maybe in the US, make this assumption that all advanced technology is going to start here and then over time it'll trickle its way down to developing economies. That is just not at all what we're seeing. Today, Zipline delivers 75% of the national blood supply of Rwanda fully autonomously outside of Kikali. We serve 4,500 hospitals and health facilities. Globally, the vast majority of those are in Africa, not in the US. Actually, some of these innovative, fast-moving, often smaller countries with fewer resources have been the ones to pick up the mantle here and show how you can use this disruptive technology to save health systems, millions of dollars, and save tens of thousands of lives. I think that the experience of working with the government, the government's been an amazing partner for Zipline for seven years now. Over seven years, we've expanded and expanded and expanded. I mentioned, starting by just delivering blood to 21 hospitals, the reason that was important is that the Minister of Health around that time was explaining to me, 50% of all transfusions go to mumps with Pusper and Hemorrhaging, 30% go to kids under the age of five. It's a really important product for family health when you need a transfusion. You really, really need it. It's incredibly urgent. You have all these different types, plasma platelets, cryoprecipitates, packed red blood cells. Each has different storage requirements and shelf lives, and then you've got A, B, A, B, and O, positive and negative RH factors. It's like a logistics nightmare. Once we had spent a year delivering blood to those 21 hospitals, we then expanded to all hospitals and health facilities in the country, that we were able to serve from a regulatory perspective. Then we expanded from just blood to many, many hundreds of different medical products, essentially everything that's in the global public health care supply chain. Then we expanded in 2020, the government said, great, now we're doing health care, but what about all of our other national priorities, whether that's childhood malnutrition or zero emission logistics or building a new national postal service or growing agricultural productivity in the country?
Those are now all things that Zipline serves. We deliver animal health care products. We are a large logistics provider of artificial insemination directly to farms and ranchers throughout the country. We deliver childhood malnutrition products. We're now delivering e-commerce products. We've just been following our customer's vision on this one, but it has definitely grown from something that was a very niche health care delivery product to then a very broad health care delivery product where you're doing everything for the health system. Then it's something that's bigger than even health care, where it's actually all about economic growth at a national level. I'd love for everyone to understand just how disruptive this is. Without Zipline, what would be happening in these markets for delivery? What are the options?
The way that delivery works in Rwanda is not that different than the way that delivery works in the US. The challenge is especially when it comes to instant delivery, there are a lot of products and use cases where we really want to send the thing when it is needed or when an order is placed, rather than having to stock it a month ahead of time at a specific location. That applies to a lot of different things in health care systems, like products that are cold chain dependent, short shelf life, urgently needed or very expensive, which by the way might

represent 10% of the volume, but is like 90% of the cost of medicine in these health systems, an important thing to know. So many of those products really want to move in a just-in-time instant delivery mode, rather than a traditional, we're going to show up and deliver this quarter's worth of vaccine that you need. Before Zipline launched, when taking blood, for example, the government would try to stock certain kinds of packed red blood cells, which is one of the blood components at hospitals, but then for the other blood components, platelets, cryopacipitids, and plasma, basically it doesn't really work to stock those products ahead of time, so they would keep those all in central regional blood facilities. And doctors, if they needed one of those products, but basically, oh, we have a patient who needs a transfusion of whole blood, so we need the different components, they would then need to get a nurse or a technician into a car, have that technician drive two to four hours to go pick up the, and then wait in line to get the product, and then get it loaded into a cooler, drive it back to the hospital. Obviously, a lot of times, when you get back to the hospital at that point, the patient may have expired.

A lot of these use cases are extremely urgent, and so it's kind of hard to understate the impact of saying like, don't do that anymore, now just press a button on a phone, and what you need is going to be delivered 10 to 30 minutes later. It has a gigantic impact. I mean, one example, just focusing on blood, and again, blood is now a tiny subset of the overall products that we deliver, but just focusing on blood, the University of Pennsylvania published a independent study about three months ago showing that Zipline has been able to reduce the maternal mortality rate in Rwanda at the hospitals we serve by 88%. So this has access to these kinds of products, has a gigantic impact on health care outcomes for health systems.

Yeah, so it's reducing the complexity in the system. It's making things happen faster. It's making the user interface better. It's reducing costs, but ultimately saving lives in the case of health care. And it reduces waste. That's kind of another key thing here, which may not be obvious.

If the only way you can deliver is via a large truck that delivers once a quarter to a facility, to a hospital, your instinct is figuring out exactly how much should you stock, is basically an impossible math problem. You will always, at certain facilities, have stock outs, and then you'll have patients going without lifesaving products that they need and possibly having bad health outcomes or losing their lives as a result, or being referred to another hospital that might have the product in stock, or you'll have other facilities where they have excess capacity, and they throw the product out when it expires a month later, or three months later, or a year later. And so we're playing this kind of impossible game from a supply chain perspective of trying to get the right product at the right place three months ahead of time. It just doesn't work. For a lot of those products that I mentioned, things that are short shelf life urgently needed, very expensive, or cold chain dependent, you really want to just send it on an as needed basis. And so the Lancet, a big medical journal, published a study last year showing that Rwanda has been able to reduce their national blood waste rate by 67% using Zipline and instant delivery for blood products. And it's not just about money. That is worth millions of dollars, but blood is actually a priceless product. You never have enough of it. So if you don't throw out blood in one place, that is basically a human that's getting a transfusion somewhere else in the health system. And then this is very clearly value add huge benefit, not just from the saving side, the life, the materials. What made it all possible

when you founded the company from a technology side? Why then was the right time? And what's been that evolution that now it's ready for prime time for delivery? Forget this, I'm not going down the street. I'm going to have a burrito delivered to me in a minute solution.

You know, when we were starting the company in 2013, I would emphasize you never know that it's going to work. It was not at all clear that it would work. And in fact, every expert in global public health care told us that it definitely was not going to work. We were assured again and again and again, you'll never make a vehicle that'll fly in that way. Even if you could do that, it won't be reliable. Even if it was reliable, the unit economics will never work. This will be way too expensive. You're never going to get regulatory permission for it. No government is ever going to pay you to do this. Even if the government did pay to do this, it won't even really solve the real problem in the health system. This is what the expert tells you. There's never a shortage of haters. Yeah. But I mean, these are people who we deeply, deeply respected. These are like published authors and people who really deeply understand. And I think luckily, we didn't listen to them, but we did listen to the ministers of health. The ministers of health and the doctors in these systems, the ones who actually knew what it is like on the ground to not have a product, to treat a patient when you need it, or what it's like to administer one of these health systems at a national scale. They were the ones who really shared the vision and in fact told us exactly what to do. We were not smart enough to know to start with blood. That was the minister of health saying, Keller, she basically looked at me for once. I was like, Keller, shut up. We're not doing the big vision. Just prove that you can do blood first. And that was brilliant in retrospect. That was exactly the right place to start. So I think listening to the customers and the doctors who are actually running the health systems wound up being super important. The other half of getting started, being told that by experts. And I think the other half is that I saw this flag in a gymnasium a couple of weeks ago that said, we do this not because it is easy, but because we thought that it would be easy. And I think there is something very fundamental about entrepreneurship in that flag, which is like, we probably would have been too scared to start zipline had we actually fully understood how hard it was going to be. And I also think that's a reason that often it isn't like global experts who start a company like this is people who are dumb enough to not know how hard it's going to be and to be a little bit naive. Like there was a little bit of naivete required. On the technology side, I do think there was like a confluence of factors, basically like the massive scale that smartphones had achieved from 2009 to 2013. We were looking at a lot of the components that went into that smartphone saying, hey, those are the main components that you'd need to make really capable robots. Whether it's an IMU or microprocessor or Wi-Fi or cellular antenna, all of those things are camera, all of those things, seeing global supply chains start to be able to build those things in a very power efficient versions, very small, very light, extremely powerful at low cost. It seemed like, wow, that was probably going to lead, at least our thesis was that that was going to lead to a revolution in robotics. And I do think in retrospect that has wound up being true. I think that a lot of the dividends of the smartphone revolution will play out in robotics over the next five to 10 years. And past the technology, the enablers of what enabled you to produce these drones and then ultimately, you're running the most successful, if not the most successful, drone delivery platform out there. You have more autonomous lights than anyone else commercially. Would you say that the technology hurdles are relatively low here and it's actually

the logistics and the operations that are much more difficult on top of just getting past the initial reaction and regulatory response? What were the hardest pieces to building the business to the success that it is today? I mean, I think a lot of investors, for example, look at Zipline. In fact, Tosh, I think you asked me this question on our last call, which is like, people often find it counterintuitive because they're like, oh, but there's some really big, rich companies trying to do this at scale. And they've done basically, I mean, very few delivery. I mean, to put it into perspective, Zipline just crossed 40 million commercial autonomous miles. So those are miles that Zipline is doing and being paid for by customers. We have done over 10 times as many commercial autonomous miles as the rest of the industry combined. And I think a lot of people are like, why was it not like one of these really big, rich technology companies that everybody's heard of that succeeded at doing this? And I think on one hand, the answer is that technology is, I think, a lot harder than people realize. There's a lot of, I think people have this sense of like, oh, we'll just take a, you know, we'll buy a quadcopter from Best Buy and then we'll duct tape a Snickers bar to the bottom of it and then manually fly it when the weather is good and land it. And like, we just did drone delivery. It's like, I mean, technically, yes, but that's not what Zipline's customers are buying. Like what Zipline's customers are buying is a national scale logistics system that operates 24-7, 365 in rain or shine, including in really gnarly weather in a way that is reliable enough that families can bet on it with their lives and the lives of their kids. So that is a really different kind of product and, you know, the level of engineering that goes into not just the vehicle, but the overall logistics system to design something that is that reliable, that can fly 300 kilometers on a single battery charge, for example, that is fully autonomous, where the unit economics work so that this is actually, it saves money for our customers. Like these are, you know, turns out these are really hard technical challenges. I think the last, the last idea to share on that front is that a lot of people look at Zipline, they get very focused on the drone. It's like so exciting. It's an autonomous aircraft. It's so, you know, it's so cool and it is cool, but the reality is none of our customers care about drones. Like all our customers care about is teleportation and we talk about, you know, our product vision is to approximate teleportation. Anybody should be able to pull out a phone, press a button, you should be able to have what you need teleported to the GPS coordinates of that phone in five or ten minutes. And I think what we didn't even realize when we were launching in Rwanda in 2016 was that really like the aircraft is about 15% of the overall complexity of the solution that's required. You know, there's a huge amount of integrating software, ground systems, regulatory approvals, data logging solutions, multi vehicle deconfliction, computer vision based pre-flight checks, air traffic control software. All of these things need to be combined to enable this overall magical experience for customers where they don't have to worry about any kind of technology. All they want is for something to go from point A to point B, fast enough to save someone's life or to create a huge economic opportunity or an amazing customer experience.
It is super interesting to me to you, right? You talk about the competitors and, you know, not just for drone delivery, but you look at, you know, the emergence of all of these air, taxi, electric, vertical takeoff landing and just the diverse...
Oranges, look at autonomous cars.
And the diversity of designs for aircraft right now for drones is pretty wide ranging,

right? Everyone's got very unique designs. You know, Zipline just released, not just anymore, but, you know, a new design for this door-to-door delivery. You know, how do you come to that design? And why is it different from a lot of the players out there? What led to that optimization?
Yeah, what Zipline announced about six weeks ago now, I guess, you know, it's our home delivery service. So what we've been operating at scale over the last seven years is really our enterprise service. It was designed to serve hospitals, health facilities, businesses. It's really good for flying far and delivering, you know, into, like, basically covering an entire country.
What we heard, I mean, the nice thing is Zipline didn't have to be that smart. By virtue of operating in eight countries, serving 4,500 hospitals and health facilities globally, is that we didn't have to guess. Like, our customers are telling us where they want, you know, what they want the product to do and where they want us to go. And it has been clear for three or four years that really, like, the Holy Grail here is enabling teleportation directly to homes. And so that is what we announced six weeks ago. It's a product that is specifically designed to enable health care systems and businesses and governments, if necessary, to, you know, you can basically enable teleportation from any building, any hospital, any warehouse or any store directly to a home in a way that is 10 times as fast as traditional instant delivery where we're using a human driving a 3,000-pound gas combustion vehicle to deliver something that weighs five pounds, where it's significantly less expensive and it's fully zero emission. So that's what we announced six weeks ago. The, you know, the overall design of that system, I think it comes from a number of things that we think are super important and maybe are not yet obvious to people who aren't operating at these kinds of systems at multinational scale. The things that became obvious to us from operating at that scale was that this kind of a system is going to need to be able to deliver with, like, dinner plate level accuracy so that we can deliver either to a front doorstep or a driveway or a side table on a backyard or, you know, into a little parking space, for example, for an apartment building or onto the roof if the apartment building has roof access. We need to be incredibly precise in the way that we deliver so that we can serve 99% of addresses in any country where we operate, whether that's Ghana or Rwanda or the U.S. or Japan. And we need to be able to do that in weather that's so bad that it's, like, breaking branches off of nearby trees. We also think that that delivery experience needs to be silent. We don't think, like, our goal wasn't to build the best drone delivery experience on Earth. Our goal is to build the best delivery experience on Earth. And the only way we're going to do that is if we can deliver to homes in a way that you don't just love it, but your neighbors also love it. So that means it has to be silent. And so ZipLine has an incredibly talented team of not just mechanical engineers, electrical engineers, firmware engineers, software engineers, but also aerodynamicists and folks who are experts in aero acoustics so that we could design something that would achieve those parameters. And yeah, it turns out, you know, designing that kind of a vehicle at scale, I mean, it's a hard technical challenge. But the exciting thing is, you know, we announced a lot of big, a lot of national partners and customers for that product when we announced it's just six weeks ago.
Next week we'll be announcing three more national scale partners. I think it is suddenly becoming clear that this is moving from science fiction to, like, something that is just completely obvious and, like, why would you ever live without it?
And what do you think competitors might be missing as you have all this great customer input?
You know, it noises a clear, you know, something that's always been talked about,

you know, across drones of all different shapes and sizes. You know, you also have this droid design that seems unique to you. What do you think are some of the challenges that may not be super apparent to others in the industry? I think that by far, you know, it's not a fancy answer, but I think by far the reality is that when we launched in 2016 and really started serving customers at scale, we learned a huge amount of counterintuitive boring things about how to operate

these kinds of systems reliably at scale and really bad weather, how to get regulatory permission for them that you can really only learn by doing. And I do think one of the core, you know, one of the core takeaways was that the vehicle is 15% of the complexity. I think there are a lot of, not just in our industry, I think in robotics generally, I think that folks tend to stay in, you know, an academic kind of building mode or, you know, working in an ivory tower or research and development lab too long and have this sense of like, oh, we're going to build this vehicle and the vehicle is going to be so cool. And when it's ready, customers are going to love it. The reality is like we more came at it from the perspective of like, our first product is going to suck. We should get it into the real world as quickly as possible so we can learn from customers why it sucks and then improve it over time. And I think there are only a few companies that have really done that extraordinarily well. I think Tesla is a company that we use as a role model on that front. I think Tesla has done that extraordinarily well, like get a product out fast and then learn by doing and learn from customer feedback. It's a hard thing to do when it comes to robotics and hardware. But that is how ZipLine has grown over the last seven years. And again, it doesn't sound like, oh, it's like this, you know, incredibly profound idea. I mean, it's like, duh, that seems obvious. But if it, although it might sound obvious, it is shocking to us how few companies in this general industry have done that. I think very, very few companies have actually forced themselves to go out and operate a service commercially and ask customers to pay for it and then learned from customers and gotten customer feedback. So although that sounds extremely unfancy, I do think that that has been ZipLine's core DNA and that has been our core fundamental advantage. It has resulted in us doing thousands of little things from an operations, from an engineering, from a regulatory perspective that others aren't doing and I think don't yet know to do. But the reality is all of that stems from just this sort of like humble approach to product development of like, let's not sit in an ivory tower and try to guess at what customers want. Let's get things into the real world quickly and learn by doing. And then one thing, you know, you've mentioned a number of times, but we haven't gone into detail yet here is what is the regulatory

landscape out there? How has that evolved? You know, initially, I imagine it was very difficult. Are people starting to compete to gain, you know, companies to start testing in their geographies or is it still fairly guarded? I think, you know, look, I mean, it's, this is aerospace. So we want regulation. We do not just want anybody to basically go into whatever they want. In fact, I think when you look at kind of the, I mean, you know, we have had a fair number of challenges on the kind of recreational drone side of people just like flying drones over airports and things doing things that are like really important not to do. I think the good news is on the commercial side, you know, people, companies aren't going to, in general, I think are not going to do things that are like profoundly irresponsible regulation. The challenge has been for regulation to catch up to the technology and to know,

like, you know, sometimes I think some of the conversations we'd have five years ago would be like, you know, talking to a regulator and they'd be like, great, but like, where does the pilot go? And it's like, well, there is no pilot. It's like, oh, but the rule says, like,

we have to check off like something about where the pilot goes. It's like, okay, well, maybe we should change the rule. You know, some of this is just literally like,

it's written in a certain way and we need to use our practical problem solving and judgment to realize like some of these regulations are going to need to be evolved. The good news is that there were, you know, a lot of our early customers, Rwanda and God, I think are good examples of this,

were moved quickly from a regulatory perspective to create either exemptions or sort of special regulatory processes where they could, where they could basically learn how to regulate the industry

in partnership with us by doing. I think that is like a really profound lesson about like the right way to win as a country when it comes to a market that you're going to want to regulate, but it's also new technology. It's like, don't try to like sit in, you know, what we don't want, our regulator is sitting in an office trying to write rules for technology that they've never touched, never used and don't understand. Like that's not a good outcome. What you want is to get started, learn by doing then create an exemption process, like do something a little bit more scale, learn what you need to learn, then like, you know, you want the regulation to evolve along with the technology basically. Right. It sounds like a similar strategy to what you were saying with how you roll out products, right? Get out there and test it and see what makes sense.

Yeah. And so the cool thing is that a lot of these countries, I mean, we've now been operating in Rwanda for, you know, almost seven years. And so a lot of these countries that we operate in, we have built these deep relationships and deep trusting relationships. I mean,

Zipline just crossed 40 million commercial autonomous miles and we've had zero human safety incidents. So that's something we're immensely proud of. And it's very powerful to be able to share that gigantic amount of data with regulators so that they can see. And so for example, the progress that Zipline's been able to make with the FAA in the US, it really comes from the fact that so many players had come to the FAA and said, Hey, like give us an approval and then we'll go find out if it's safe. The neat thing is in this case, Zipline has been able to go to the FAA and say, here's a technology that is proven to be safe at multinational scale over tens of millions of commercial autonomous miles. Like let's kind of agree on, you know, how we can make sure that the US doesn't fall behind in this critical area of technology over the next five to 10 years. And I have to say, I think the really good news on that front is, I mean, we think the US government and the FAA particularly are actually on exactly the right track right now. I think that the US, although not like the very first country, I mean, that designation goes to Rwanda and Ghana, but the US is definitely being a fast follower right now. And I do think it's likely that if we stay on the current path, the US is going to be one of the primary beneficiaries of all of the economic growth and job creation and economic efficiency that this technology can provide globally.

I'd love, you know, it seems like drone delivery is capable of so much and you have these three markets, healthcare, food, any commerce. What are, I mean, what are the limits? Like how far do you

see this going? And how will drones work within today's existing delivery systems? Like what

might make more sense for, you know, a robot on the ground to do versus something in the air like what are sort of the prime use cases? I think there's a lot there. I mean, interestingly, you know, when we launched seven years ago, it was like every delivery was costing us so much money. It was so challenging to do these deliveries. It was really good that we started with a life-saving application, you know, a life-saving use case that was so obvious and clear that even though Zipline was going through many growing pains, which we did go through many growing pains for three or four years, it was still like so profound to the team and to our customer and to the regulator, like we got to make this work because it's, you know, it's saving lives. Today, I think the technology over the last seven years, by virtue of operating it at scale for seven years, the technology has now gotten to a point and this is really, you know, why we announced our home delivery service six weeks ago. The technology has now gotten to a point where it is fundamentally out-competing the way that we do instant delivery today. And so, you know, instant delivery, you know, think of whether it's food delivery or quick commerce when you, you know, open up an app and order something really quickly from either a store or a CVS or, you know, any one of the marketplaces. We are using, we have seen demand for instant delivery go completely exponential over the last five years, partly as a result of the pandemic, but just also as a result of, like, demographic change. And, you know, the next generation doesn't own cars as much and they don't really feel like, like, getting into a car and driving and parking in a store and spending an hour shopping. I think it's kind of the Amazonification a little bit of the economy where people are very used to convenience and having things delivered to their home. So we've seen this total exponential growth of instant delivery and yet we're using technology that is a hundred years old to solve that problem. Which is basically, we pay humans to get in a three to four thousand pound gas combustion vehicle, drive to the store to pick up that thing, which by the way weighs on average five pounds, and then drive that vehicle all the way out to a house to deliver it to somebody. That is surprisingly slow. It's terrible for the environment and it's very expensive. So the technology, just I would say in the last year or two has gotten to a point where it's like, that is fundamentally going to change. Like, automated delivery technology is now ready to take technology that is modern and solve that problem in a way that is 10 times as fast, less expensive and zero emission. And then, and so I think that's where we are today. And then I think if you ask me to look out where we are five years from now, I mean, I think the really, and I know you, you know, I know ARC talks about this a lot and I think has it exactly right. Like, when you look at this industry at the highest level, you know, logistics has been built on inflationary cost inputs for the last 100 years. You know, we use labor and gasoline. These are the two fundamental kind of inputs to logistics. And the cost of those things has been generally going up over the last 30 years. So we have an inflationary cost model. And I think it is inevitable that logistics is going to transition to a deflationary cost model, which is basically circuit boards and electricity. And, you know, circuit boards and electricity have been getting less expensive over the last 30 years. And so I think, you know, that is like the really exciting promise here. It's that as logistics transitions toward this deflationary cost model of circuit boards and electricity, I think it is going to become, I think it will fundamentally out compete basically every

other mode of logistics. And the important thing too is to realize that like this is, the market is so gigantic and the demand is actually vastly exceeding what there are enough humans in the world to do. So this is not really about, I think so many people worry about, oh, but like, what if this automation, you know, what if like jobs go away? I mean, there are not, like these companies cannot hire enough humans today. So this is not about like robots or humans. This is 100% about robots and humans. And, you know, zipline is not going to be delivering a flat screen TV anytime soon. So, you know, you're still going to want all the traditional logistics systems doing what they do today. We just think that once a teleportation like service is available, people are going to really use that a lot and rely on it. Like once people are used to teleportation, being able to push something on a phone and have something teleported to their GPS coordinates, five or 10 minutes later, I think that that has a lot of pretty profound implications for how people are going to, you know, live their lives. And maybe, you know, as you said, when we go out and we talk to a lot of people about this, I totally agree with what you're saying, right? We're entering the age of abundance as, you know, electricity costs come down, other logistics costs come down. It really changes the dynamic in which we're living. But you go out there and you always get the skeptics. And I think these are probably the four most common questions that I've heard. It's the, okay, my cell phone loses service. What happens when the drone loses service? How does it keep flying? What about bad weather? You know, is this drone going to fall on my head? And there are cameras on these, like what are the privacy implications?

Yeah, we, I mean, definitely the good news is like, I do think those questions are now basically like conclusively answered, you know, we've been answering those questions for seven years now. When it comes to like the safety of the system, again, you know, we've just crossed 40 million commercial autonomous miles. We've had zero human safety incidents. Yeah, that, you know, that second part of like, what happens if you lose service? These aircraft have cell modems in them. You know, we are at that. That's the main way that we're communicating from the aircraft home. That's how we're sharing telemetry and how we can issue high level commands to a vehicle if we need to vehicles lose service all the time. Cell service isn't perfect. And so, you know, we have, we have backup communication systems and the vehicle can actually fly with no communication whatsoever. Like communication is a nice to have for the aircraft, not a must have. It's not like the aircraft will stop flying if we lose the communications link back, back to the home. So, you know, flying in weather, I mean, as I mentioned, it's not very compelling to say, you know, hey, you know, you can rely on us with your life and the lives of your kids when the weather is good. Like, you know, if this is going to be a system, I mean, which it very much is. I mean, today, you know, zipline is an integrated part of national healthcare systems. We have to be able to operate 24-7, 365 in gnarly wind, rain, lightning storms, and we do that every single day. So, hardening the system to weather is a fundamental part of the challenge. And the last thing you raised about cameras, you know, I think to a certain extent, you know, we're not alone in that respect. Like, there are a lot of companies. I mean, you know, we now have a camera and a microphone that sleeps basically in our beds or on our bedside table right next to us, right? I know that sounds kind of creepy, but the reality is that there is already like other technology companies that have way more of like, you know, a challenge to solve on the privacy side of like making sure

that you're a trusted brand where people are comfortable like having a camera in like intimate and private places. It is really important. Zipline works with every country that we operate with from a privacy perspective. We're incredibly careful. We don't gather that much data, but we're incredibly careful with the data that we do gather when we're flying routes. And obviously, that's a conversation with regulators. It's a conversation with the country where we operate. But, you know, so far, I think that's one of the easier problems to solve on this front.

And going back to sort of this, you know, age of abundance deflationary environment, I think is a really timely topic because, you know, this week, Uber and DoorDash, you know, we saw that they're holding onto markets that people thought would just totally fall down after the COVID boom. So we already see, you know, the demand for systems like this are there. But delivery today for at least instant delivery is pretty expensive. And you expect to reduce that cost. So just would love to hear sort of more about how you think those dynamics will evolve. I think, you know, I mean, it's just not that surprising if we're if we're having to pay a human to deliver something, you know, in a three to four thousand pound gas combustion vehicle that weighs on average five pounds, I mean, it's just it's a it's basically like the most expensive way you can possibly imagine of delivering that thing. Like if you were to ask a kid to imagine a way of delivering like every idea they share would be, you know, at least when you use your imagination, it's kind of like the worst of all worlds using a vehicle that is very bad for the environment, very expensive, surprisingly slow, extremely heavy. So I think that and I think people really underestimate how much it costs. That's another thing, like a lot of times you go to an app, and you only like find out when you get to like the last screen, and you see, you know, regulatory response fee, expanded range fee, priority fee, service fee tip, like, and you're like, Oh my God, I'm paying, you know, $30 or $35 in fees. It doesn't feel very good as a customer experience when that happens. I think probably a lot of people, you know, that experience will resonate. And so I think the reality is that we haven't quite realized that the way we're solving this problem sort of prices out, like a huge percentage of humanity who would love to use the service, but like, there's no way you could afford, you know, to pay those delivery fees.

And so the reality is that it's not going to be very hard on a unit economics perspective, from a unit economics perspective, for zero emission, autonomous vehicles that weigh 50 pounds to outcompete, you know, 4,000 pound gas combustion vehicles driven by humans. It's like, it's pretty obvious, actually, I think why the unit economics, they're going to be very favorable. And then what, you know, to, for our listeners, when do you think that they will first experience this? So, you know, Sam and I are in New York City, it's already happening. But I assume you mean in the US, because that's the important context. That's the depressing context you have to add here, because it's like, well, actually, if you live outside the US, like, it's already a national scale, people think it's like completely normal and boring, you know, like, right now, we actually have, we have like another national delegation from a country in the Middle East, who basically saw the announcement and was excited. And so they actually flew a bunch of their ministers to Rwanda.

And so they're there right now, doing a big tour of our distribution centers, because, you know, they're going to bring Zipline into their country. And, and so I, you know, they were basically

shocked. They're like, wait, what? I mean, this is operating at national scale here, you know, we have no idea. And so I think, you know, there's this phrase that, you know, the future is here, it's just not evenly distributed. I mean, it's like, that is very true. And it's true in a way that is very counterintuitive, because people thought, oh, it'll be like the rich people living on the coast of the US that have access to this technology first, very much not the case. Like, it's actually been developing economies, which by the way, did the same thing, you know, Sam, you brought up leapfrogging, did the same thing with cell phone networks, you know, leapfrog right over land lines and went straight to the cell, you know, cell networks. We see the exact same thing happening with instant delivery. Now that it's coming back to the US, you know, zipline operates three distribution centers in the US, one in Charlotte, one in Bentonville, Arkansas, and one in Salt Lake City. And so, you know, if you live in Bentonville, for example, you can be receiving deliveries in this way day in and day out. In fact, families are service has like crazy high net promoters score. Families are ordering many times per month on average. So it's just, yeah, it's, it's, it's funny. I mean, I have to say, it's amazing to me because, you know, we now serve many, many tens of millions of people. And it's, it takes about seven days for people to go from science fiction amazement, like, so cool. We have drone delivery to our home now. And then on day eight, they're like, completely bored of it. They don't care. They treat it like running water. It's like, yeah, of course we, of course we do it that way. How else would you solve that problem? You idiot, you know, and, and people don't take it totally for granted and just order, you know, once a week or a couple of times a week. And why is that a special? Why is that weird? Of course that works. It's amazing to be humans go from science fiction to entitlement in approximately seven days. And that is, I think, the beauty of technology. It's like technology should just fade into the background. It's not about like, Oh, it's really cool or it's really sci-fi. It's just like, makes people's lives better. And you don't have to worry about it. And it's vastly more affordable and convenient than the way we were solving the problem previously. I like that. That's a good, a good name for the book when it comes out. Sci-fi, sci-fi to entitlement in seven days. This is a fine story. It's a little tongue in cheek, right? Like, we don't actually think our customers are entitled. It's something I love about humans, which is that like, what do they call it? I think they call it like hedonic adaptation. I think that's a scientific concept, basically, which is like, if you make someone's life significantly better, it will only take them like 24 hours to be like straight back to baseline and like, you know, and then just like expecting, you know, like someone buys a yacht and then they like find something that makes them deeply unhappy about the yacht. So it's like, I think that's the cool thing about abundance and technological progress. Like humans will still find, you know, like, luxury becomes necessity. Yeah, exactly. Luxury becomes necessity. So it's like, yeah, it's tongue in cheek to say entitlement, but it's actually something that I think is profoundly amazing about humans, which is that like, you know, we can, we'll create it abundance and humans will still, you know, we'll just take it for granted. And I think that's actually kind of like a beautiful outcome for technology. And Keller, for those of us who don't live in Bentonville or Salt Lake City and want to follow along, see when we'll have access, follow along with all of the updates from Zipline. What's the best way to go about doing that? Probably, you know, follow us on Twitter. We, you know, we post, we're, I mean, there's a huge

rollout happening in all the countries where we operate. I mean, we're not, we're still expanding in Rwanda where we've been operating for seven years, but we are expanding exponentially in the US over the coming three years. We're adding, we'll be adding many tens of metros a year. It's kind of how to think about it. So if we aren't in your metro, you know, this year, there's a good chance we'll be, we'll be there next year. And, and we're doing that in Japan as well and a number of other, a number of other countries. So, you know, high level, we think that there's a tremendous opportunity to build automated logistics for humanity. And we think the really exciting thing about that is that it's going to be the first logistics system that serves all people equally. It's going to enable universal access to healthcare, and it's going to transition logistics to zero emission, which we think these are all really, really important goals for, for Earth. Great. So it's, it's, you know, it's not when it's happening now. It's, it's one for me and as soon as I get it, I'll soon take it for granted. Yes, exactly. But, you know, we'd only, we'd only be so lucky to have, you know, drone delivery be that pervasive. And that's the ultimate goal. So for, just for, you know, convenience and cost to be affordable for everyone and this technology is making it possible. Yep. Amazing. Thank you for joining us, Kelly.

Yeah, it's a big honor. Thanks for having me. And then, you know, last, last, last question here potentially not included. But has there been any issues with, like, intercepting drones? Has anyone tried to drone Jack? Everybody always asks that question. It's actually mainly in the U.S. where people are always like, you know, can you shoot it down? Like if we have a symbol of gun culture in the U.S., we're so interested in shooting them down. But no, it's never happened. That's kind of the example of like, it's just better to get into the real world and see what actually happened. Because for example, weather is an extraordinary pain in the ass. And we spend a

huge amount of time focusing on weather. And we spent seven years battling weather, hardening the system to rain and lightning and different kinds of dust storms. It's been a gigantic engineering undertaking. And then we really thought we had it figured out. And now we're like ultra focused on solar weather. Because it turns out that, you know, solar weather basically ebbs and flows in a 10 year cycle. And we are in the maximum, maximum degree of scintillation, which is basically like radiation coming from the sun hitting the atmosphere. It causes GPS uncertainty. It's actually been a significant challenge for us in Rwanda over the last, which, you know, it really only affects places on the equator. But like scintillation, especially in the twilight hours, actually causes GPS to be very unreliable. And so you just giving that to you as one example of like, you just don't know until you guess, like, I didn't, you know, I didn't, you told me, oh, you're going to be thinking a lot about scintillation in seven years, Keller. It's like, we never would have known. But like, so people shooting us down, not so much solar weather and scintillation and like 10 year cycles of, you know, interactions between solar radiation and Earth's atmosphere turns out to be like a really big consideration and super important and something our engineering team is spending a lot of time on. So you just can't predict this stuff. It's better to learn by doing. And then maybe for those of us who joined on YouTube, we're on the factory floor here, can you give us like a 30, 30 second walkthrough of what we're looking at here?

Yeah, sure. I mean, it's a little hard for me to move around. But, you know, this is upstairs is where zipline, you know, all of engineering, operations, finance, go to market, we, you know, we're a very in person culture. And then downstairs is all manufacturing. We also just had to rent

we rented the big warehouse next door. And now we're renting an even bigger, you know,
manufacturing facility, just a little, just a half a mile up the road. But we build everything
in house and zipline is a very, we're a full stack engineering team. So we design the avionics
from scratch, we design the aircraft or mechanical engineering team designs the aircraft, we do
all the aerodynamics analysis, we are doing a huge amount of sort of wild innovation on the
air acoustics front, as we talked about, to make sure that these vehicles are actually
silent for the customers that we're delivering to. We write all of the software systems,
whether that's flight control algorithms, all the way to communications architecture,
computer vision based preflight checks, you know, data logging, air traffic control software,
customer ordering interfaces, all of that is built in house by zipline. And,
and yeah, and so right now, you know, downstairs, you can actually see, you know,
these are a few salages. This is final vehicle, basically,
preflight checks so that we can guarantee a vehicle is going to preflight check,
pass preflight check when we send it to a distribution center, you can see wings here
and wing manufacturing right behind me. Yeah, so come visit sometime in person.
We'd love to. We'd love to. Yeah, see that Tesla verticalization model in action. So thank you.
For sure. All right, well, thank you so much for joining us today, Keller. I think we're all
going to, you know, go look up scintillation and what we all need to know about it and those effects,
give our listeners some homework. And we learned a lot about zipline today and we're super excited
about your story. So thanks so much for sharing it. Yeah, thanks for having me. Have a good
weekend.
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