How New Zealand's Dairy Industry Innovates

2020

LIC®

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Introduction – The more you explore technology around the globe, the more you realize how much innovation is happening outside the Silicon Valley Vatican.

Earlier this year, we **wrote a piece on dairy technology** in which we highlighted some startups that were considered to be "leading edge" by venture capital firms who invested in them. Shortly after our piece went out, we received an email from Wayne McNee, the chief executive of a publicly listed New Zealand company called Livestock Improvement Corporation (**LIC**).

Much of the so-called innovation happening in dairy startups was old news to Wayne, as his company is at the forefront of dairy tech innovation having worked in the space for over 100 years. He invited us to check out his operation in Hamilton, New Zealand, so we did. What we found was an exceptional amount of innovation that can only be attributed to the unique situation New Zealand finds itself in as being the only country in the world where farming isn't subsidized. In this report, we're going to look at nine companies that are leading innovators in New Zealand's burgeoning dairy industry.

The first six companies are all creating solutions around how to make raising dairy livestock a more efficient process while increasing output with a focus on food biosecurity.

LIC – A 100-year-old New Zealand company whose Innovation & Transformation Advisor, Dion Cawood, proved instrumental in making this report happen.

Halter – Arguably the most exciting agtech startup in New Zealand right now, Halter promises to transform the process of raising livestock.

UBCO – Hardware may be hard, but UBCO is building some nifty electric bikes that provide a wealth of benefits for farmers.

Techion – Keeping your herd healthy is critical for margins, and Techion has developed a microscope in the sky to improve the drenching process.

OnSide – Keeping food products safe for consumption is all about traceability. OnSide is developing an app to monitor food biosecurity.

Invert Robotics – When you're dealing with lots of milk, you need lots of stainless-steel containers. This company cleans them with robots and AI.

Synthase – Synthase has developed a proprietary bioactive that is being used for cow fertility, with potential applications in **the trillion-dollar longevity industry**.

The startups we've talked about so far help dairy farmers compete in an industry with shrinking margins and constant pressure to increase outputs while reducing inputs. One way to increase margins is by identifying value-added products to produce.

Quantec – Adding value to milk is about finding new applications for it. Quantec is using milk proteins to identify value-added products.

Lanaco – Even though cows dominate now in New Zealand, there's still a sheep industry. Lanaco's value-added sheep breed may transform the industry.

A collaborative ecosystem helps accelerate innovation, and New Zealand's national herd is producing more milk now than ever before. Being the small country of 4.5 million people that it is, the right people you need to speak with are never very far away. If you're an agtech investor whose historically been investing in places like San Mateo, you're missing out on some serious innovation that's presently on sale at half the valuations you've become accustomed to.

How New Zealand's Dairy Industry Innovates

As a 100-year-old company, LIC's employees have been innovating from day one. Back in the olden days, single girls in the village would vie for jobs riding horses across New Zealand's pasture lands collecting samples of milk from the local farm boys. This served as a mechanism for the girls to find the most suitable suitors marriage. By visiting all the farms in the valley, the girls could then try and woo the boys who had the best personalities. It's all documented in pictures that grace the halls of LIC's incredibly interesting headquarters in Hamilton where we sat down with some of their team including LIC's Innovation & Transformation Advisor, Dion Cawood, to talk about the fascinating business they've built over the years that is all powered by technology and data.

The Circle of Life at LIC

Birth seems like a fitting place to start when describing a year in the life of LIC. It all starts with semen and an embryo. The semen comes from a prized bull that lives the life of Reilly near LIC headquarters. The pampered beasts spend their time eating delicious grass, being towed around in little tractor trailers, and having lots of sex – or so they think. In an article on the Nanalyze website, we wrote about **the process of getting semen from a bull** and we'll skip just past that to when the "jump" makes its way into a room filled with people in white coats whose job it is to process the semen into one of two directions: fresh and frozen. Since fresh semen dies almost immediately, LIC developed a secret sauce that extends the life of fresh semen up to 3 days. This gives their technicians time enough to take the "sticks" out to the ranches and inseminate up to 80% of the national herd – about 5 million cows in just a few months' time. LIC's 2019 Genetics Catalog contains dozens of bulls you can choose from such as the ones seen below:

How LIC innovates in the dairy industry – Credit: LIC

517026 Howses **Springfield**

KiwiCross® F9J7

gBW $296/57% REL

Individually $31.55 +gst | Genomic Packs from $25.56* +gst

*Includes 10% InvestaMate discount

Breeding Details			
Breeder	B & W Howse		
Sire	Drysdales Sovereign	MGS	Arkans Boomtown
Dam	KLMH-13-10	MGD	KLMH-11-2
BW/Rel	209/67	BW/Rel	181/73

518016 Horizon **Ascott**

KiwiCross® F9J7

gBW $264/55% REL

Maternal grandsire of Ascott - Kraakmans Jaydie

Individually $31.55 +gst | Genomic Packs from $25.56* +gst

*Includes 10% InvestaMate discount

Breeding Details			
Breeder	M & P Scott		
Sire	Burmeisters Bandana	MGS	Kraakmans Jaydie
Dam	Astrid	MGD	HGMC-13-17
BW/Rel	219/64	BW/Rel	170/71

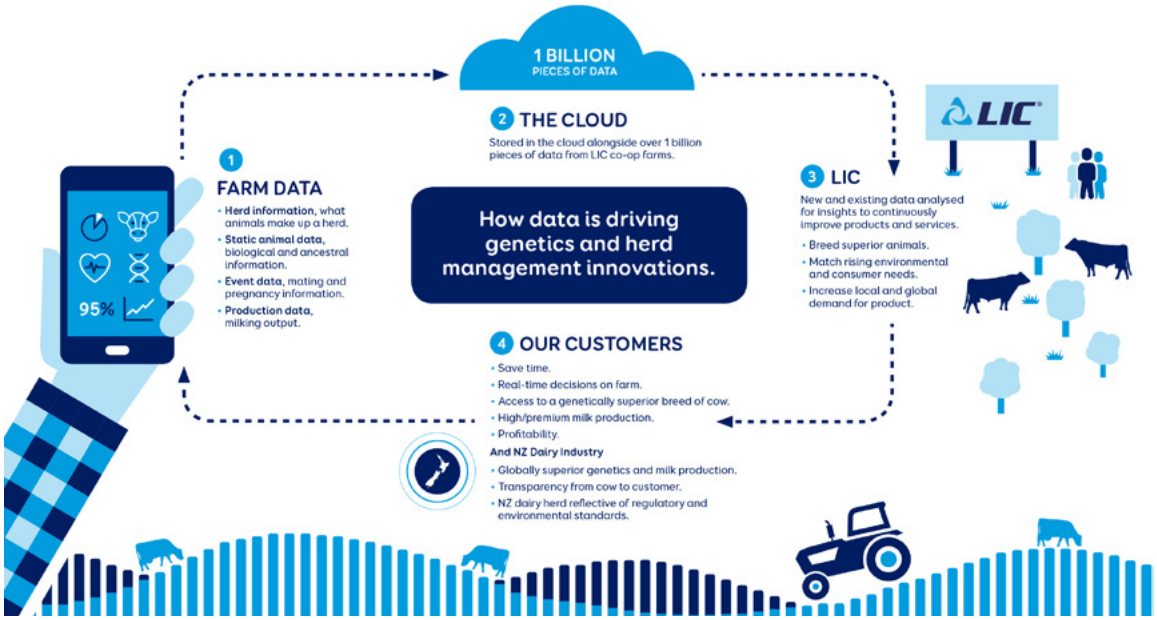
Credit: LIC

Right about now you might be thinking that genetics would be the perfect technology to apply here, and that's exactly what LIC does. A genetic profile of each bull and its offspring helps the company figure out the optimal way to breed cattle to produce the most output under various conditions. For farmers, the equation is quite simple. Grass goes in and dairy products come out. *(A lactating cow consumes about 100 lbs or 43 kilos of grass per day.)* LIC helps farmers optimize this equation using data, something that they're able to capture from 93.5% of cattle herds in New Zealand. The platform which collects the data is known as MINDA LIVE.

Big Data from a Big Community

Farming communities often form co-operatives – or co-ops as they're often called – which allows many small entities to collaborate such that they can all enjoy economies of scale. It's the very essence of how LIC describes what they do – "a herd improvement and agri-technology co–operative that empowers farmers through the delivery of superior genetics and technology." What this also means is that members of the co-op are shareholders in the operation so that everyone has some skin in the game. LIC counts around 11,000 farmers as members of the collective – about 93.5% of the national herd. By belonging to the co-op, farmers can take advantage of everyone's data. Data is at the core of how they innovate.

About five years ago, LIC decided to move away from the animal and focus on the bigger farming picture – literally. At first, they tried using drones to survey their undulating grasslands but learned quickly – **as they did in Indonesia** – that operating drones is a logistical pain in the rear. Instead, they turned to satellite photos that are being processed by a company called FarmShots. It's now a service offering called SPACE *(Satellite Pasture and Cover Evaluation)* which uses daily **satellite imagery** to accurately calculate how much feed there is – in other words, grass – something that farmers used to do manually. In New Zealand, the grass produced is unlike anywhere in the world due to the country's favorable geography. This means nearly all the cows are outside munching on grass that's consistently found year-round in great quantities. While venture capitalists spend billions of dollars figuring out how to turn plants into milk, cows have been doing it for 10,000 years.



Big Dairy Data – Credit: LIC

Got Milk Samples?

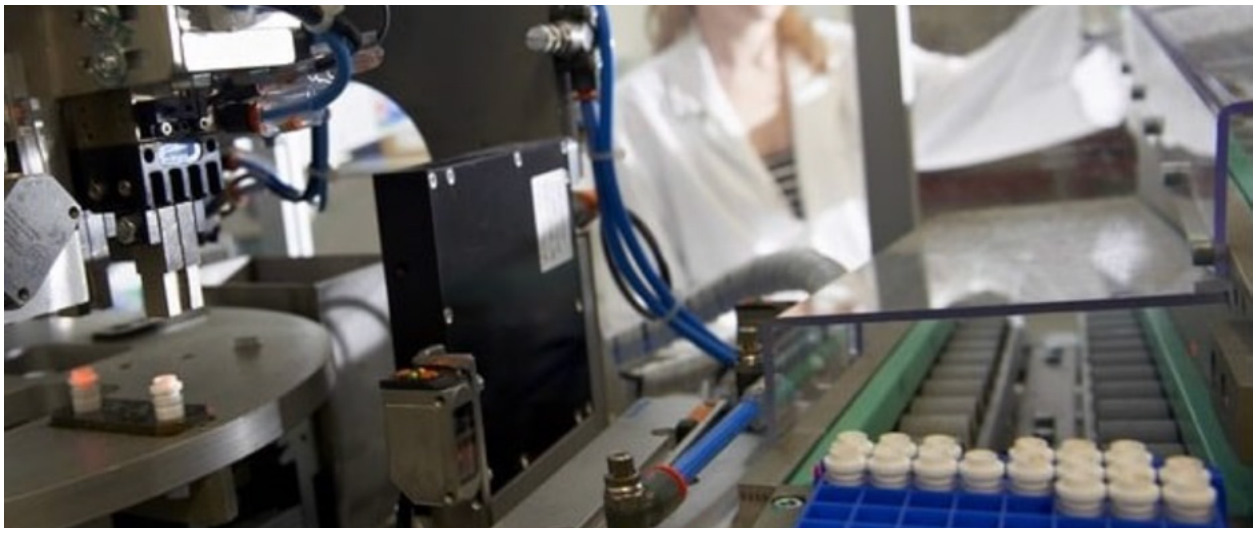
So far, we've looked at how farmers get the cows to begin producing milk, and how we gather data about the disparate farming environments scattered throughout the country. But we're missing one vital piece of data – information about the resulting product. There's an entire division of LIC that's focused on collecting milk samples from dairy farmers – typically taken twice a day – and then analyzing them to identify any number of things including:

- high producers you can use for breeding
- poor producers that need to be dried off or culled
- animals with mastitis that need treatment, drying off or culling

We toured their sampling facility as trucks arrived dropping off samples, and robotics technicians wandered taking notes as new automation technologies processed the samples quicker than ever. Around 75% of all cows in New Zealand have their milk analyzed in the modern facility, which processes 11 million milk samples per year.

Each sample contains half a dozen data points, and all this "big dairy data" gets fed back into the closed-loop system so that the company can figure out how to make the operation even more efficient. It's all made possible by a new automation system that uses a combination of laser light measurement, barcode scanning, mechanical rotation, and syringe liquid transfer.

The five custom-designed machines, which were developed over the past three years to replace a 50-year-old manual process, represent the future of the industry. LIC invested $3.2 million in the project and expects it will result in recurring savings within two years and more importantly, benefits for their customers like increased accuracy. Eventually, the time lag will be removed and the milk tested right when it comes out of the cow at the point of milking. It's that



Credit: LIC

constant move towards greater efficiencies that makes LIC a world leader in dairy technology. It's a trend you'll see across New Zealand's farming and horticulture industries, and it all stems from a lack of subsidies.

Competing in a Global Market

No conversation about dairy or beef can be considered complete without addressing the elephant in the room – the billions of dollars investors are committing to **alternative dairy** and **plant-based meats**. LIC is in an excellent position to weather any downturn because of two main reasons: New Zealand's national brand and lack of farming subsidies.

exposed to world market forces. They receive no subsidies from government and have to compete with subsidised production from other producing countries."

When you're forced to compete against regions of the world where farming is heavily subsidized – like the European Union and the United States – you need to create extremely efficient operations and a brand that sells itself. New Zealand's "**Silver Fern**" country brand graces everything from **All Blacks' jerseys** to **jars of Manuka honey**.

It's a recognized global brand that any New Zealand business can apply to use provided

Examples of the "Silver Fern" brand – Credit: Amazon

Politico published an interesting article **way back in 2002** titled **"Farming without subsidies – a better way. Why New Zealand agriculture is a world leader,"** which helps explain why New Zealand farming and horticulture is at the frontier of innovation, and it mainly has to do with a lack of subsidies. Says the piece:

"Uniquely among developed countries, New Zealand farmers are almost totally

they've been exporting a product or service for a minimum of 12 months. It's known the world round and is especially popular with the Chinese who consume 30% of New Zealand's dairy exports. China is the second-largest dairy market after the United States which, unlike other parts of the world, **is expected to grow meaningfully** in the coming years. Other New Zealand startups **like Quantec** are also taking advantage of this trend.

While the rest of the countries with sizable dairy and beef exports look on with horror as people stop drinking milk and substitute beef patties with pea patties, LIC sees a market that's growing in the face of these plant-based headwinds. LIC told us about one unnamed New Zealand butter producer selling into Texas and outselling butter from Texan cows. That's not just the Silver Fern brand at work, it's also the appeal of "grass fed." **ESG types** eat that stuff right up. While the global industry may be shrinking, LIC sees an opportunity to capture market share. Being the most efficient at what you do is how great companies are made in not so great times.

A Collaborative Ecosystem

It would be hard to find somewhere else in the world where such a comprehensive herd management dataset is being collected in such a closed-loop system. Mr. Cawood says this is why LIC is the perfect place for startups to come and test their innovations. We spoke with a number of agtech startups that counted LIC as an investor, and they're all part of a tightly knit community where most founders know each other. One of the companies that everyone could barely contain their excitement about was Halter. To find out why, we traveled to the Lincoln University Dairy Farm outside of Christchurch, New Zealand.

Credit: Silver Fern brand

Credit: LIC

HALTER

Halter – AI to Guide and Monitor Herds of Cows

Cattle rustling is back, says **an article by National Geographic**, and it's become a lucrative side hustle for meth heads in the state of Oklahoma. Desperate junkies have figured out that loading up a few cows in the middle of the night and selling them hours later for thousands of dollars at an auction is a lot easier than stripping copper out of abandoned homes. Since many cattle ranchers have such large herds, they're only able to detect missing cows after days have passed. Sure, it's just a few cows, but with margins tight already, these ranchers are feeling it in their pocketbooks.

Even with the resurgence in cattle rustling, humans have come a long way since the days of cowboys tending small herds of cattle to the present day where **nearly 1 billion cows** grace the surface of our planet.

While the cow population has increased dramatically alongside human population, the labor needed to manage these bovines has plummeted. We're now able to devote all that free time to study interesting topics such as "**The Psychology of Cows**," an academic paper published by some people with lots of time on their hands. Throughout the paper, it talks a lot about how cows exhibit a reasonable level of intelligence and are fairly emotional creatures. Consequently, developing technical solutions for them can be difficult as the cows will always tend towards the behavior that suits them best. One New Zealand startup called Halter thinks that a solar-powered cattle collar is the way forward.

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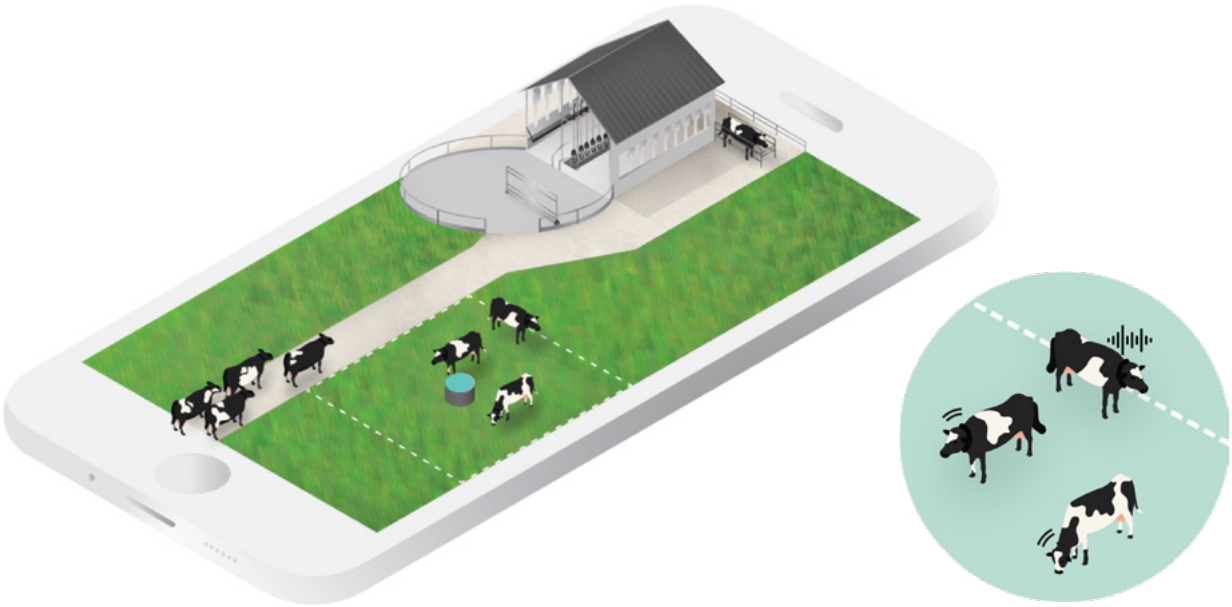


Solar-Powered Cattle Collars

Founded in 2016, Auckland startup Halter has taken in around **$5.2 million** in funding so far from investors that include famed Kiwi entrepreneur **Peter Beck of Rocket Lab**.

The founder of Halter, Craig Piggott, grew up on a dairy farm and thought up the idea while attending university in Auckland. Upon graduating, he did a stint at Rocket Lab where he started developing his product. That's when Peter Beck learned about it, immediately becoming an investor and calling it "a billion dollar idea." The wearable component of the platform is a solar-powered cow collar that uses GPS to track the animals while monitoring their health using AI-powered "cowgorithms."

Credit: Halter

The coolest part? The device uses sound and vibrations to get the cows to move as if they're being remotely controlled. One of their investor demos involved a herd of cows standing in a field at 4 AM in the morning on Skype while a would-be investor picked one out of the lot. Halter then used their device to separate the cow from the herd. It's something farmers call "drafting." Just imagine having a collar that tells you when a cow is in heat and then automatically guides the cow into a barn so that it can be **artificially inseminated**.

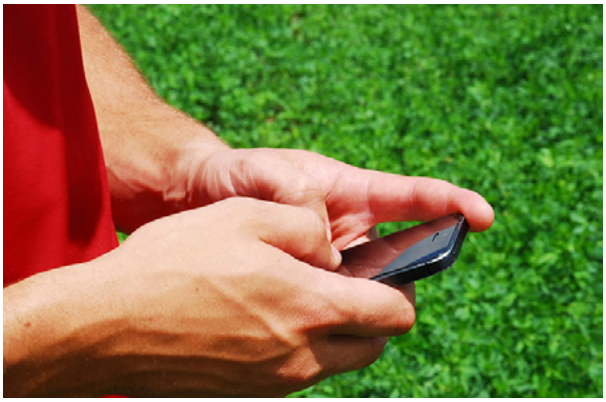
What about saying goodbye to fences? You can with Halter, as it allows you to set up invisible boundaries around cows. This is particularly useful for farmers who sometimes need to do "break fencing," which involves creating temporary fences to make sure cows feed from the most optimal spaces. Below, you can see where a virtual break fence has been set up and all the cows are staying on one side of it.

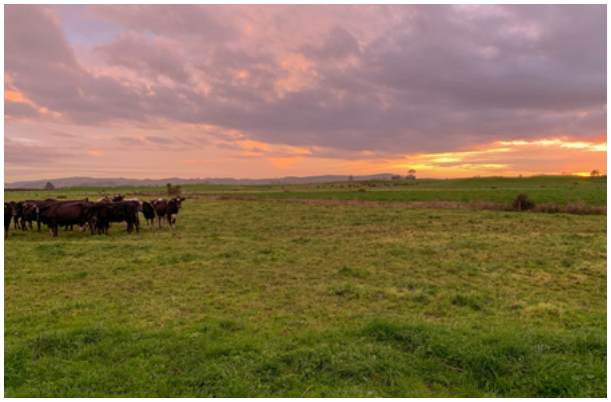
Getting one or more cows to go anywhere you need them to using an app is remarkable, but it's just one feature. For every single cow, the farmer can monitor emotions, behavior, and health – such as when a cow is in heat or calving – all from a smartphone, 24/7.

The solar-powered collars use **LoRa** to communicate, and the amount of big data they're generating is perfectly suited for AI algorithms to then start optimizing things and connecting the dots. Everyone we spoke to in the New Zealand agtech space is excited about Halter. The idea sounds exceptionally good on paper – 3-4 hours a day time savings for a farmer – but it's impossible to quantify the value proposition without understanding a bit more about a farmer's pain points. So, we visited a dairy farm.

Cows that Queue

Let's say you decide to leave your unfulfilling middle-management career in the corporate world and pursue the idyllic life of a dairy farmer. *(You'll find some similarities between the two occupations. In both cases, you're tasked with getting moderately-intelligent emotional creatures to do things for you while trying to avoid killing them.)* In order to better understand what it takes to manage cows, we traveled to the **Lincoln University Dairy Farm** outside of Christchurch, New Zealand to visit with Demonstration Manager Clare Buchanan who showed us around the commercial farm, which operates in the top 2% on profitability by employing some of the industry's best farmers and utilizing technical input from seven different organizations.





Setting up a virtual break fence – Credit: Agweb.com and Halter

Dairy operations are interesting places to visit if you get a chance. We were there when all the cows were queuing up to get milked. That's right, the cows queue in an orderly fashion that would rival any of Hong Kong's recent voting queues.

about? We posed that question to Peter Hancox, Farm Manager at Lincoln University Dairy Farm for the past 15 years, and someone who has been dealing with cows his entire life.

Seven organizations working with the SIDDC farm – Credit: Nanalyze

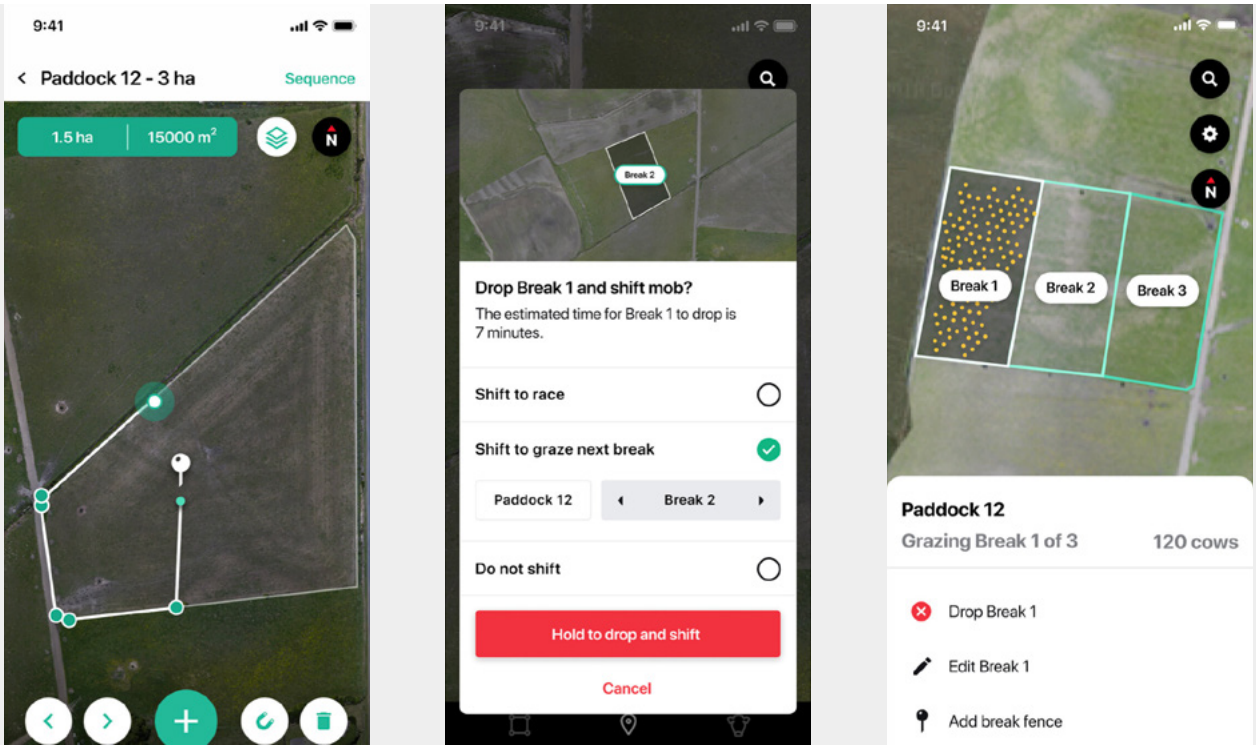
When you approach the cows, some will walk up and stare curiously while others will get upset and scamper away. *(That's a bad thing on a dairy farm because cows that get stressed produce less milk.)* Each cow eventually makes its way through the queue up into a small cage where a human attaches the milking device on the cow. Once the milking completes, the cows mosey off and all walk – again, in an orderly queue – out to the pasture to eat grass. They love eating grass so much that they behave in a manner that lets them get back to eating grass as soon as possible. The cows know the milking has to happen, and they want to get it over with ASAP.

Now, a few things came to mind immediately. Firstly, this is a perfect place for Mainland Chinese tourists to visit and learn how queuing systems work. Secondly, if these cows are trained so well, why do we need collars to make them move

Gimmick or Game Changer?

Being the skeptics that we are, we initially asked Mr. Hancox if he thought Halter's solution was a bit long on features and short on practicality. He emphatically disagreed, and you could see his excitement when we started to talk about some farmers he knew that were testing the product. The capabilities are nothing short of game-changing.

He had nothing but favorable things to say about the feature set, so we honed in on any concerns he might have. The first was the form factor which he thought might be too bulky. While that's certainly not a show-stopper, his other concern could very well be. Halter plans to sell their device on a subscription basis – "cow-management-as-a-service." The price point is critically important



Screenshots of the Halter app – Credit: Halter's Blog

to spur adoption, especially in the face of a competing solution Mr. Hancox currently uses that offers some of Halter's functionality.

Competing Against Merck

It all starts with an Israeli startup called SCR which developed its first collar tags for cows back in 1998, and then began mass-marketing them in 2006. That's according to a **2014 article** by the Times of Israel which talks about how SCR was then acquired by a U.S. firm called Allflex whose origins go back to back to 1955 when they were founded in Palmerston North, New Zealand.

Today, Allflex belongs to holding company Antelliq, which **was acquired earlier this year by Merck (MRK)**, a $221 billion pharmaceutical company, that said this positions them as "a global leader in animal health digital tracking, traceability and monitoring technology." At the moment, that might be a good thing for Halter.

Acquisitions typically don't bode well for larger companies, and most of the time all those "2 + 2 = 5" synergies aren't realized. **A study by KPMG** on blue-chip M&A activities over a two-year time frame showed that, "only 17% of deals had added value to the combined company, 30% produced no discernible difference, and as many as 53% actually destroyed value." As a startup, Halter can certainly be a lot more nimble. They can also learn from what others are saying about the competition.

Mr. Hancox bemoaned not being able to find experienced farmhands who would stick around

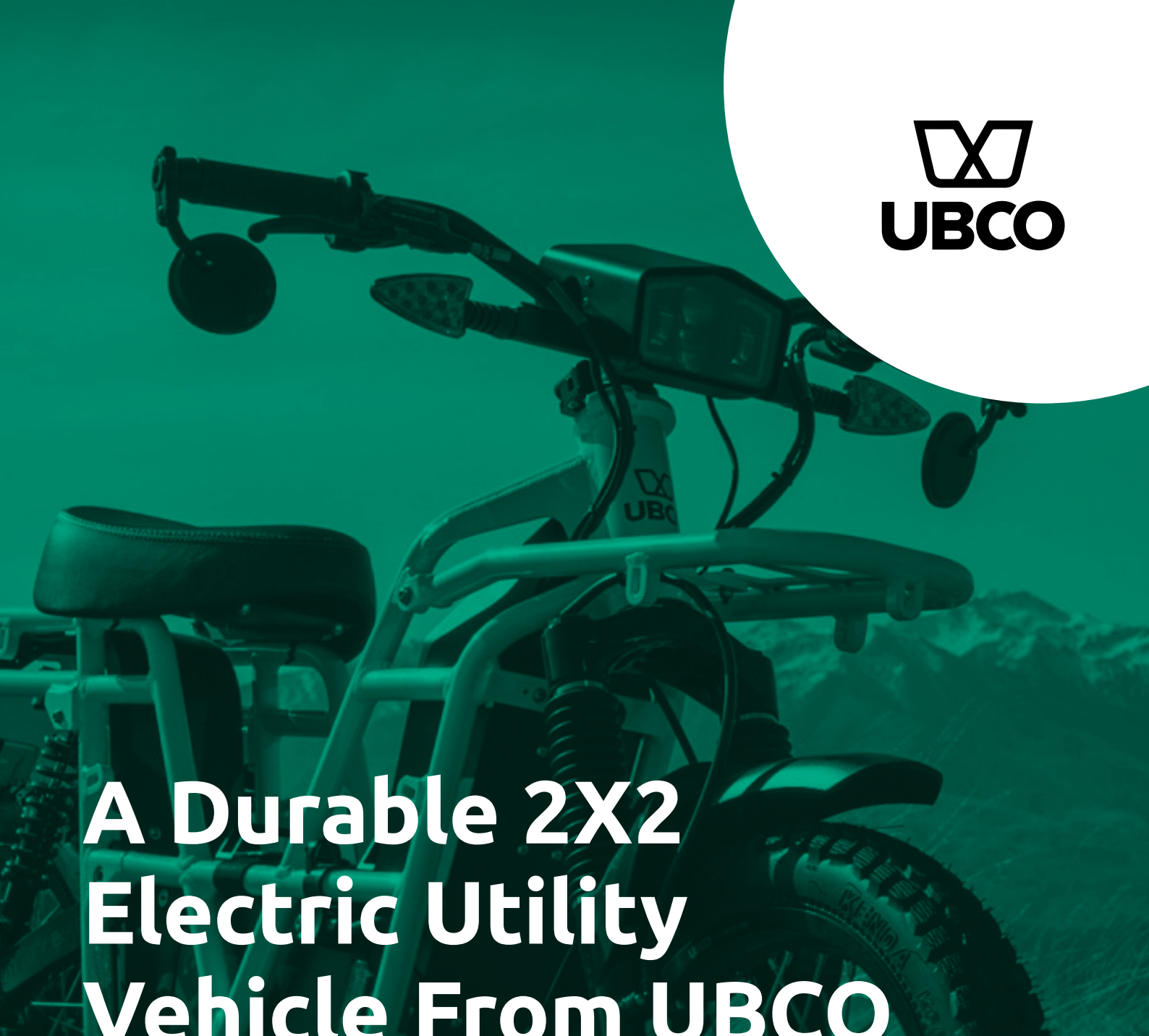
Credit: SCR Dairy

long enough to learn things like how to tell when a cow is in heat. Because of these labor constraints, his team has been trialing SCR collars for a few seasons, though having them on only a portion of the herd hasn't been as beneficial as hoped. They are in the process of assessing the different options out there and intend to get monitoring devices on the entire herd in the next season.

The batteries have a shelf life of about five years *(the new ones seen above, seven years)* which means he'll have to plan to buy replacements. Not having to buy Halter's collars is a perk he said, but it all comes down to how much Halter plans to charge for their "as a service" business model.

Since Halter is well aware of all the competing solutions on the market, the whole thing is playing out like a Harvard Business School case study. How will the competition react to the added functionality Halter plans to offer? Will they sacrifice margin to compete on price? Maybe they're not even going to compete that much. With one billion cows scattered around the world, there's enough total addressable market for everyone. Merck also has deep pockets – $8.8 billion in cash as of year-end 2018 – so they can just kick the tires until there's enough traction, and then boom, there's your exit. In the meantime, Merck will be focused on realizing synergies they need to justify their acquisition and appease shareholders.

Lately, venture capitalists have been spending billions of dollars figuring out how to turn plant products into meat – something that cows have been doing for centuries. Trying to guilt people into not eating beef might work well in places like 'Murica, but we still need to consider the other 95.65% of the world's population that might not be able to afford over-priced pea protein patties nor want to eat them. *(That being said, people in India have been substituting beef with vegetables for centuries now.)* Cows aren't going anywhere, and companies like Halter are making the process of tending to them more efficient, which means less resources are needed to raise cows – not just human resources but natural resources. Another company that's helping make it easier for human resources to navigate the fields is electric vehicle startup UBCO.



A Durable 2X2 Electric Utility Vehicle From UBCO

A few years ago we did **a piece on electric motorcycles** which proved to be quite popular with our readers. In that article, we looked at the Harley Davidson electric bike *(now available for $30,000), the world's fastest motorcycle which happens to be electric (built to order according to your specs and starting at $38,888)*, and some off-road electric dirt bikes from a company called Alta Motors *(apparently* **they went bust**). If you happen to be an experienced motorcycle rider who has done hard time on the streets and trails, you know that this electric bike stuff is cute and all, but only a total tool would be seen riding one. That's what we thought anyways, until we came across an interesting startup in New Zealand that's selling an electric utility vehicle that appeals to some real-world use cases where having an electric bike actually makes more sense than having a gas-powered one.

About UBCO

We did a few searches on "electric utility bikes" and came across a bunch of overpriced junk that hipsters use to cart their groceries around some gentrified neighborhood. That's not what we're talking about here. The reference to a "utility bike" implies that it's used by someone who showers after work, not before. That's what UBCO's electric bike is all about. Founded in 2015, New Zealand startup UBCO has taken in just over **$7 million** in funding to develop their electric utility vehicle which was originally formulated for use on dairy farms.

We weren't overly familiar with how dairy farms operate until we spent some time at the **Lincoln University Dairy Farm** outside of Christchurch, New Zealand. A couple fellows on some tattered Kawasaki motorcycles were tooling around the farm doing dairy farmer stuff while we talked to the farm manager about milk production. Turns out that milk production declines when the cows get spooked. The sound of a motorcycle engine isn't exactly calming. Instead of driving noisy motorcycles around all day and disrupting milk production, dairy farmers can now opt for an electric bike that provides a better alternative to gas-powered bikes for any number of reasons. We stopped by the UBCO shop in Tauranga, New Zealand to speak with one of the engineers and check out the bikes.

The UBCO 2X2 Electric Utility Vehicle

First thing you'll notice is that this bike doesn't have a whole lot of moving parts. No clutch or drive-train, no emissions, and no noise. Each wheel contains a self-contained 1 KW motor that together provide the bike with electric power coming from both wheels. You can swap the battery in a matter of seconds if you need a fresh charge which will transport the 143-lb *(65 kg)* bike almost 75 miles *(120 km)*. The color scheme for the bike was chosen by the company since no other major motorcycle manufacturer colors their bikes black and white. Accessory lugs allow you to attach anything to your bike from a holster to a trailer to storage bags.

Credit: UBCO

It's as modern as it is basic. There's a digital panel on the bike that interfaces with an app on your smartphone. The bike's battery also has a USB charger for your phone and a 12V outlet that will let you use power tools in the field.

After many design iterations based on customer feedback, UBCO has managed to create a durable electric utility vehicle that anyone would want to own. The question is, how much will one of these bikes set you back? They're not exactly cheap at around $7,000 greenbacks. That's only $750 less than a brand new gas-powered 2019 **Kawasaki KX 250**, but you need to consider what you're using it for. If cows get spooked when farmers use gas-powered motorcycles, then for around the same price, they can use electric bikes that are arguably easier to maintain and likely cheaper to operate. Farming isn't the only use case, and they're using these vehicles now for all kinds of different outdoor applications where electric power provides a better experience.

Credit: UBCO

Use Cases

We've talked about the farming use case, and the engineer we spoke with said that farmers beat the living hell out of these bikes and they run just fine under such abuse. No smoke, noise, chains, gears, or clutch means a whole lot fewer moving parts to worry about. One obvious use case that comes to mind is hunting. Spend some time in rural parts of America, and you'll see dozens of men with rifles wearing orange vests, tearing around on four-wheelers and motorcycles looking for large animals to shoot at. If you're one of those people, then you're probably thinking this is a perfect way to avoid alarming those large majestic creatures before you blast them to smithereens. Likewise, the people who spend time in the national forests making sure there are plenty of animals to hunt – park rangers and conservationists – would find these vehicles useful for the same reasons.

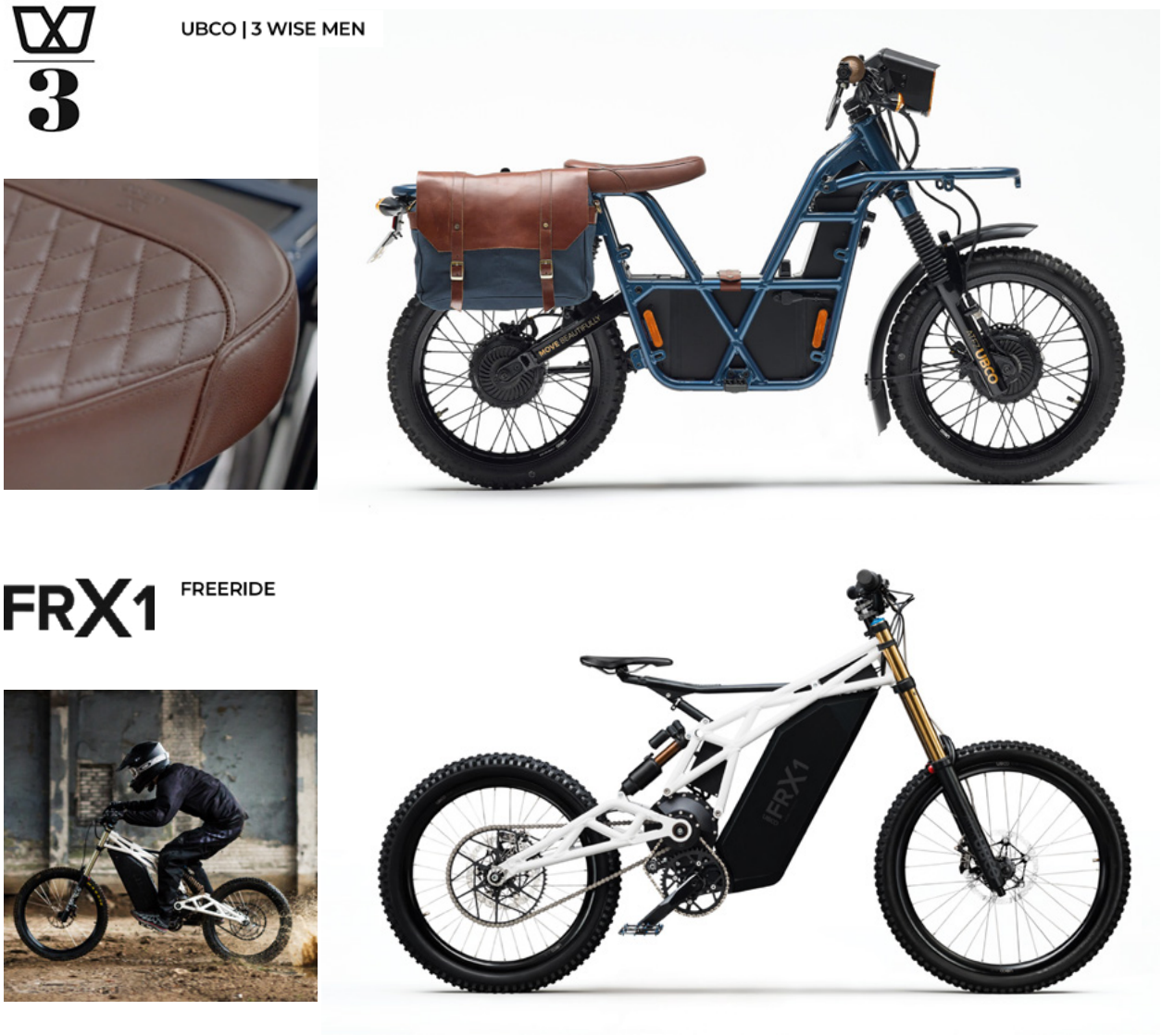
The guy on the left in the below picture uses the utility bike for pest control – shooting possum, rabbits, and hares – giving him the advantage of near silence during pest eradication. The two guys on the right are a couple of conservationists in California that use the bikes to do conservation-type things. Other use cases the bikes are being used for include recreational applications like outdoor tours or as the perfect accompaniment to that overland vehicle you're building. And don't discount these rides as possible transportation for environmentally conscious hipsters. The 2018 2×2 is a road registrable vehicle. In addition to utility bikes, UBCO is testing the waters with a few other vehicle types. They partnered with hipster fashion company 3 Wise Men to produce something a little sexier for the road, and there's also a free-ride version which looks kind of fun, but perhaps not as fun as **a new KTM 4-stroke 250.**

Their goal is to have a standalone power supply in the market this year, and a 4-wheel electric utility vehicle in the market next year to complement and extend their existing product range.

Going back to what we said earlier, there are much better alternatives for off-road bikes and street bikes than electric. It's the use cases where gas motorcycles don't offer optimal performance that have made these electric utility bikes successful. There is also a niche market of less hardcore riders who are willing to sacrifice performance in favor of perceived **sustainability** benefits, and UBCO may be in the right place at the right time with these new models.

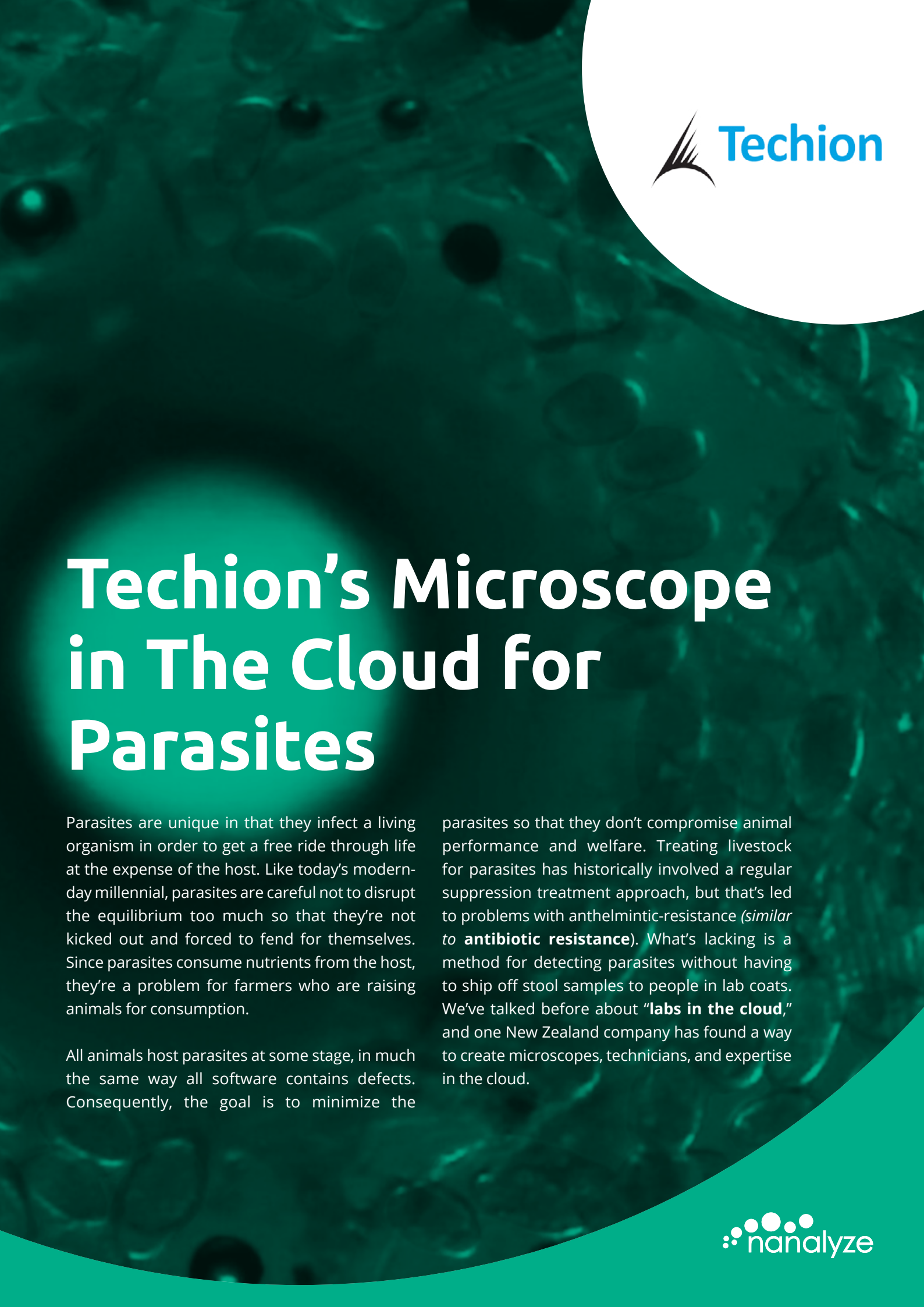
Pest Control

Conservation



Credit: UBCO

The company's expansion into the United States and Australia shows that there's a market for their white electric utility bikes outside the Land of the Long White Cloud. They can't keep them on the shelves at the moment, and it seems like this growing Kiwi startup has designed the first electric utility vehicle to go mainstream. Speaking of clouds, our next startup is building a microscope in the cloud.



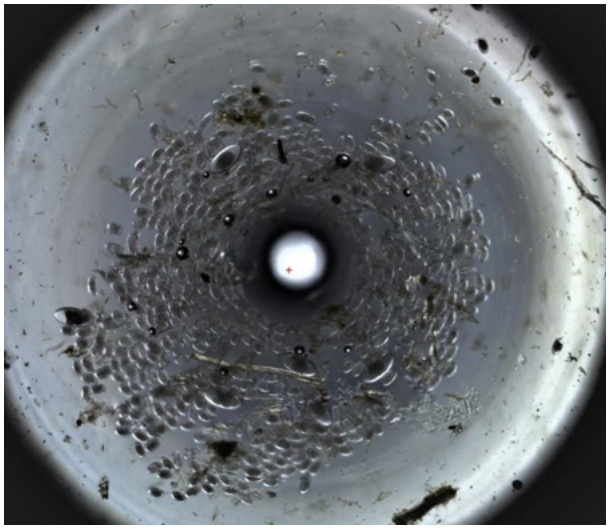
Techion's Microscope in The Cloud for Parasites

Parasites are unique in that they infect a living organism in order to get a free ride through life at the expense of the host. Like today's modern-day millennial, parasites are careful not to disrupt the equilibrium too much so that they're not kicked out and forced to fend for themselves. Since parasites consume nutrients from the host, they're a problem for farmers who are raising animals for consumption.

All animals host parasites at some stage, in much the same way all software contains defects. Consequently, the goal is to minimize the parasites so that they don't compromise animal performance and welfare. Treating livestock for parasites has historically involved a regular suppression treatment approach, but that's led to problems with anthelmintic-resistance *(similar to* **antibiotic resistance**). What's lacking is a method for detecting parasites without having to ship off stool samples to people in lab coats. We've talked before about "**labs in the cloud**," and one New Zealand company has found a way to create microscopes, technicians, and expertise in the cloud.

A Microscope in the Cloud

Founded in 2011, New Zealand startup Techion Group has taken in around **$5 million** in funding so far to develop a technology that allows microscopic images of very small things to be captured and then transmitted over the cloud for analysis and interpretation. The ability to transmit images over the cloud isn't new, nor is the ability to take microscopic images. Along with a clever imaging device, what Techion has developed is a novel method of accumulating particles out of a sample so that they can be easily analyzed. A good analogy is how driftwood accumulates around an island beach. In this case, it's not driftwood being collected, but rather parasite eggs.



Credit: Techion

As well as analyzing the images, the Techion system also records the results so they have a data warehouse showing trends in parasite development and resistance.

Given New Zealand's strong **history of agtech innovation**, it's no surprise to see that Techion's first commercial application is in livestock.

It also happens to be an area of expertise for the founder, Greg Mirams, whose experience as a sheep and cattle farmer helped him create the technology platform out of an industry necessity. We sat down to talk with Mr. Mirams about how Techion is helping livestock farmers around the world save money and combat anthelmintic-resistant parasites.

Drenching Your Herd

Farming of all sorts is far more difficult than most people think. Animals, like people, have all sorts of medical issues you need to watch out for. It's a bit gross to think about, but all animals have worms at some stage, in much the same way all software has defects. They just need to be managed so sustainable production can be achieved. After nutrition, parasites affect an animal the most when it comes to the amount of meat they yield for consumption. That's why livestock farmers use a process called "drenching" to administer anthelmintic drugs to animals that help kill parasites. Animals that suffer from parasites can have growth rates reduced by 30-50%, or in severe cases, animals can die. In a business with increasingly tight margins, that's a meaningful loss of value. Then there's all that extra feed the farmer needs to purchase for a bunch of free-loading parasites.

The Old Way

The drenching process has largely been a "guess or regularly treat" approach where animals get treated with limited knowledge if they actually needed it or did the drug work effectively. Some farmers have attempted to move to an evidence-based approach by sending a stool

sample to a lab which is then tested for the level of parasites. Based on those results, the farmer may then continue to administer treatment or wait and re-test until treatment is required. It's about as cumbersome as it sounds, given the logistics of posting stool samples to a lab and the time required for testing before the results are available. Techion recently concluded a four-year study with U.K. supermarket giant Sainsbury's which showed some alarming numbers about how anthelmintic drugs are failing among their livestock farmer suppliers. Around 37% of farmers in New Zealand and 84% in the U.K. were found to be regularly using an ineffective drench. That extrapolates to a $19 million yearly cost to the Sainsbury's lamb supply chain.

The New Way

The ability for a farmer to test their own samples means the decision to drench is based on fact, not assumption. Now, there is a device that lets them do this on farm, or by dropping samples to their local vet or retail store. The hardware is purchased up front and then a yearly subscription allows the farmer to receive up to 100 tests per year. The process involves obtaining a stool sample, weighing it, sedimenting and filtering it, then filling some wells in a cartridge, and then placing the cartridge into a cloud-connected imaging device.

The secret sauce is the device's ability to accumulate the parasite eggs to the top of a liquid meniscus so that pictures can be taken of them and sent through the cloud to a laboratory analyst who can interpret them for the farmer. Nobody in the world is doing parasite testing this way, but the innovation has only just started.

The Newer Way

Right about now you might be thinking that some machine learning algorithms could help automate the interpretation of this imagery since they're already outperforming humans in imagery use

Credit: Techion

cases ranging from **x-rays** to **mammograms**. For the past four to five years, humans at Techion have been analyzing the imagery as it's uploaded to the cloud. That presently means a turnaround time of one hour for farmers across the globe, 24/7, as Techion has operations in both the northern and southern hemispheres.

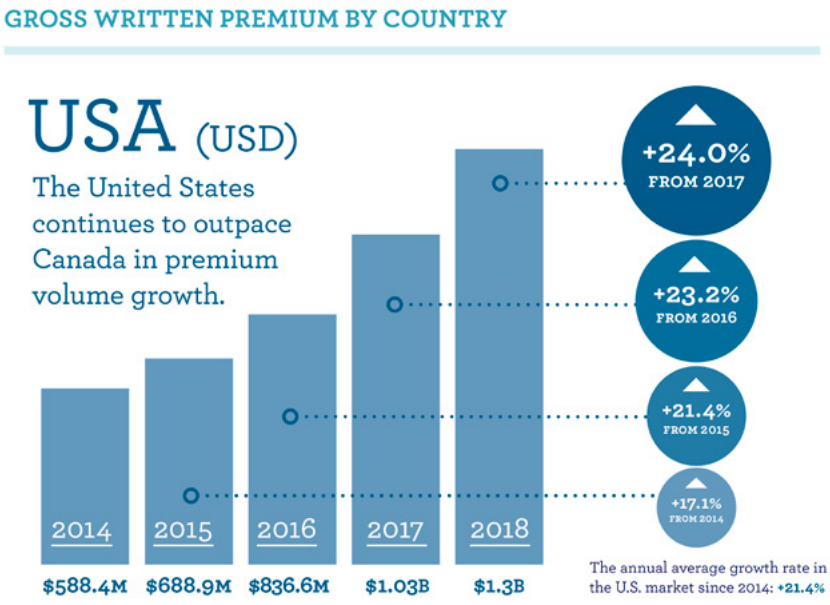
In the next few weeks, they're deploying an upgrade where AI algorithms will achieve an accuracy greater than 90% with **humans in the loop** to handle the boundary cases. The turnaround time will then move to minutes, and that automation will help them provide their customers with a real-time, point of care solution. Techion's FECPAKG2 platform has allowed the company to build the only global parasite disease database. That enables the development of surveillance, disease trend, and drug resistance profiles that it uses to provide local and regional alerts to customers. This data also creates valuable disease management information that it is aggregating and selling to industry stakeholders.

By 2022, the common practice of preventative treatment with antibiotics *(and likely anthelmintics)* will be banned in the European Union, and medication will only be allowed if the animal has been properly tested and there is evidence of disease. These regulatory changes will be one driver of the growth of this application in a B2B total addressable market for ruminant animals, which sits at around $5.88 billion *(NZ, AU, US, EU, SA only)*. In addition, researchers and scientists around the globe are using the platform for testing other animals like alpacas, cattle, horses, zoo animals, etc. Animals are a pretty enticing market, but only the tip of the iceberg when it comes to future applications.

Future Applications

One huge potential market for Techion's platform is domesticated pets. Society is doing so well now that people can actually raise animals for no purpose other than to simply exist, provide companionship, and annoy the neighbors. The latest trend is to buy your pet health insurance, an industry that's growing incredibly fast.

To put that number in perspective, there's an estimated 2.3 million insured pets in North America out of around 176 million total pets, which translates to only 1.3% market penetration. This rapid growth means there's a surge in insurance-mandated health checks. Drug resistance in companion animals is also an emerging issue due



Credit: The North American Pet Health Insurance Association (NAPHIA)

Credit: Techion

to the blanket treatment approach widely used. That's where Techion can step in. Why not equip every veterinarian with the ability to perform these tests in their clinics instead of shipping stool samples off every day? Since most of the large animal test processing facilities are located near FedEx or UPS terminals, this platform can help save on transportation costs, which also makes **the ESG types** happy since less carbon is being generated. Another application right up this alley is helping humans.

In other parts of the world, people can't afford to raise animals for fun because they're more concerned with trying not to die. That's where the Bill and Melissa Gates Foundation is assessing if Techion's platform is able to address one of the world's biggest causes of childhood morbidity globally. According to the World Health Organization, soil-transmitted helminths, commonly known as intestinal parasites or worms, affect more than 1.5 billion people, about 24% of the world's population. The end result of worms is malnutrition, stunted growth, intellectual difficulties, and cognitive deficits. Future applications for Techion technology include looking for any parasite that passes eggs, or oocysts of which there are many – giardia, liver fluke, coccidia – and the list goes on.

Beyond Drenching

Like all growing startups, Techion Group is going through a realization of who and what they are. They're a data and info business that represents a shift in thinking about how we address the world's disease challenges across both animals and humans. As a society, we can't manage disease the way we have been. That's why Techion is looking for partners who can help them apply the technology to other applications such as the pet market or human market opportunities. There's a sustainability and biosecurity element to the whole thing as well. Why spend all those resources shipping biological samples all over the place when they can simply be processed at the point of collection and analyzed using the cloud? Most importantly, Techion Group is helping collect big data that can be used to improve herd health at a national level. Another startup that's pushing forward with an innovative biosecurity solution that focuses on managing things at a tactical level is OnSide.

OnSide - Managing Biosecurity in the Livestock Industry

If you thought taking care of a pet was a big responsibility, try caring for thousands of animals as if your livelihood depended on it. It's what livestock farmers do every day across the globe, and it's an occupation that's coming under increased pressure from all angles. A decrease in demand for dairy and meat, large corporations that undercut on price due to economies of scale, and an ever-increasing number of rules and regulations all make it very difficult to make a living raising livestock. The last thing livestock farmers need to worry about is having a disease wipe out their herd or put them in a position of liability when they can't trace the origins of a biosecurity problem. Swine flu, bird flu, mad cow disease, they're all communicable diseases that need to be controlled at a tactical level before they can cause meaningful damage. And one New Zealand tech company is working on a way to do just that.

About OnSide

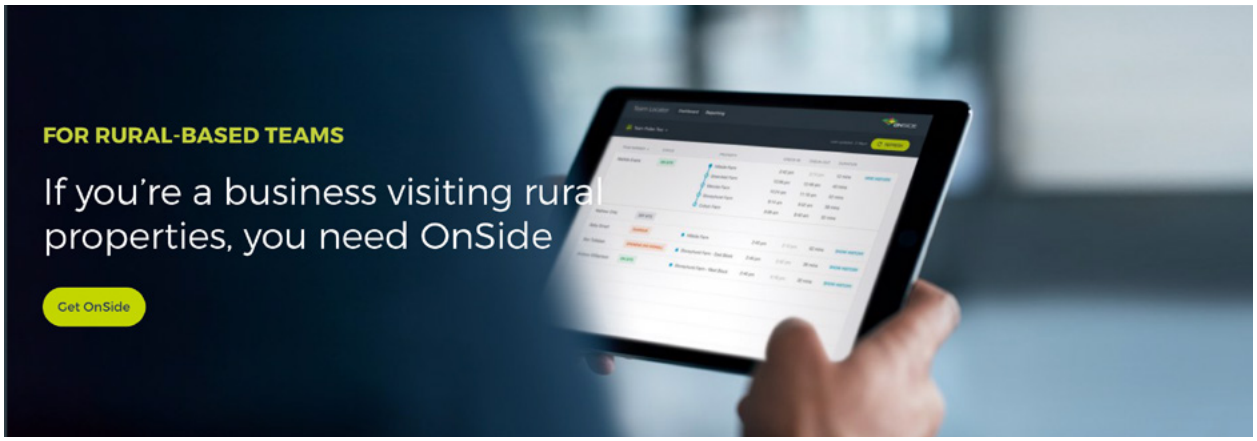
Founded in 2015, New Zealand tech company OnSide has taken in over **$3 million** in funding to develop a platform that provides transparency around who is doing what on farms. The solution consists of a cloud-based offering which includes apps or an electronic kiosk that allow farmers to track the movements of people who visit their properties for any number of reasons. Sounds simple, but spend some time on a farm and you'll see just how much really goes on. With OnSide, people can instantly check in, notify property managers, and record where their team is, in real time. The obvious use cases for such a solution include the usual health and safety stuff on a farm, and they aren't the first company to offer such a solution. What really starts to get interesting is when you take a look under the hood and see how the company is using the solution to improve biosecurity.

The Biosecurity Use Case

We sat down to talk with Ryan Higgs, CEO of OnSide, about how the product is being used for applications in biosecurity. Dr. Higgs explained, there are approximately 300,000 rural properties in New Zealand which are linked by an estimated 100,000,000 annual connections (movements from property to property). The connections lead to the construction of a giant interconnected network, and while this connectedness has improved business efficiency, it has also provided a more effective mechanism for spreading disease.

OnSide has a range of products that help connect people that manage rural properties with their contractors and visitors. For example, maybe you have a company like LIC that has people out in the field collecting milk samples from 100s of dairy farms a week. When these sample collectors start using OnSide, it automatically sends a text message to property managers letting them know when the person arrives and leaves. Suddenly, property managers start seeing the usefulness of the solution and invite other vendors to use OnSide, and the product begins spreading in a viral manner. The data generated provides the opportunity for what happens next.

In our previous section on LIC, we remarked at what a unique situation the country is in. It's a developed market that sits on a relatively small number of islands in the middle of nowhere. Since it's the only country in the world where farmers aren't granted subsidies, everyone is used to innovation playing a key role in improving



Credit: OnSide

operations. Moreover, everyone seems willing to participate in broader initiatives that result in improvements that can only be realized when everyone plays ball. A good example of this would be all the big data that LIC collects from 93.5% of New Zealand's national herd. In the case of OnSide, they're creating a biosecurity solution unlike anything that's been tried before anywhere else.

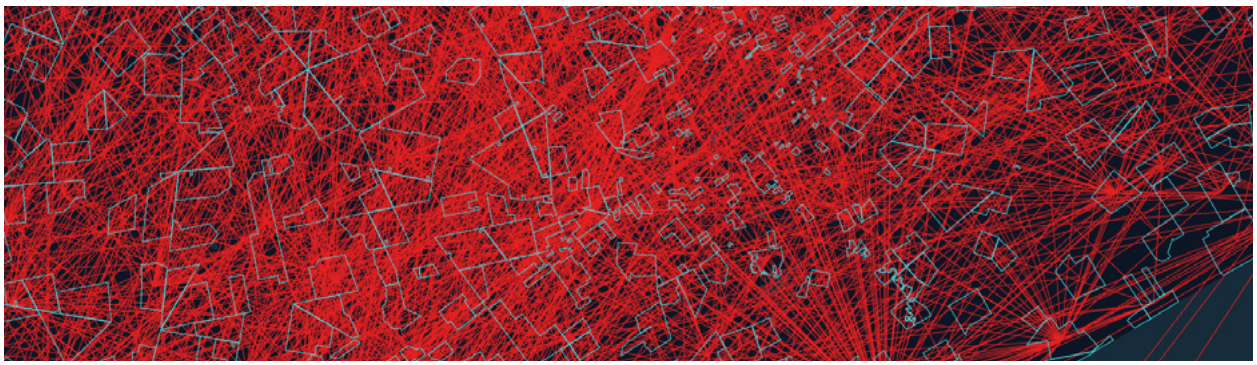
Analyzing How Disease Spreads

In order to understand the spread of communicable diseases, you first need to map the potential pathways in which they can spread through the country into a network. Networks consist of nodes and connections. In the context of the New Zealand farming sector, properties represent 'nodes' and the movements of people, vehicles, animals or plant material represent 'connections' (pathways).

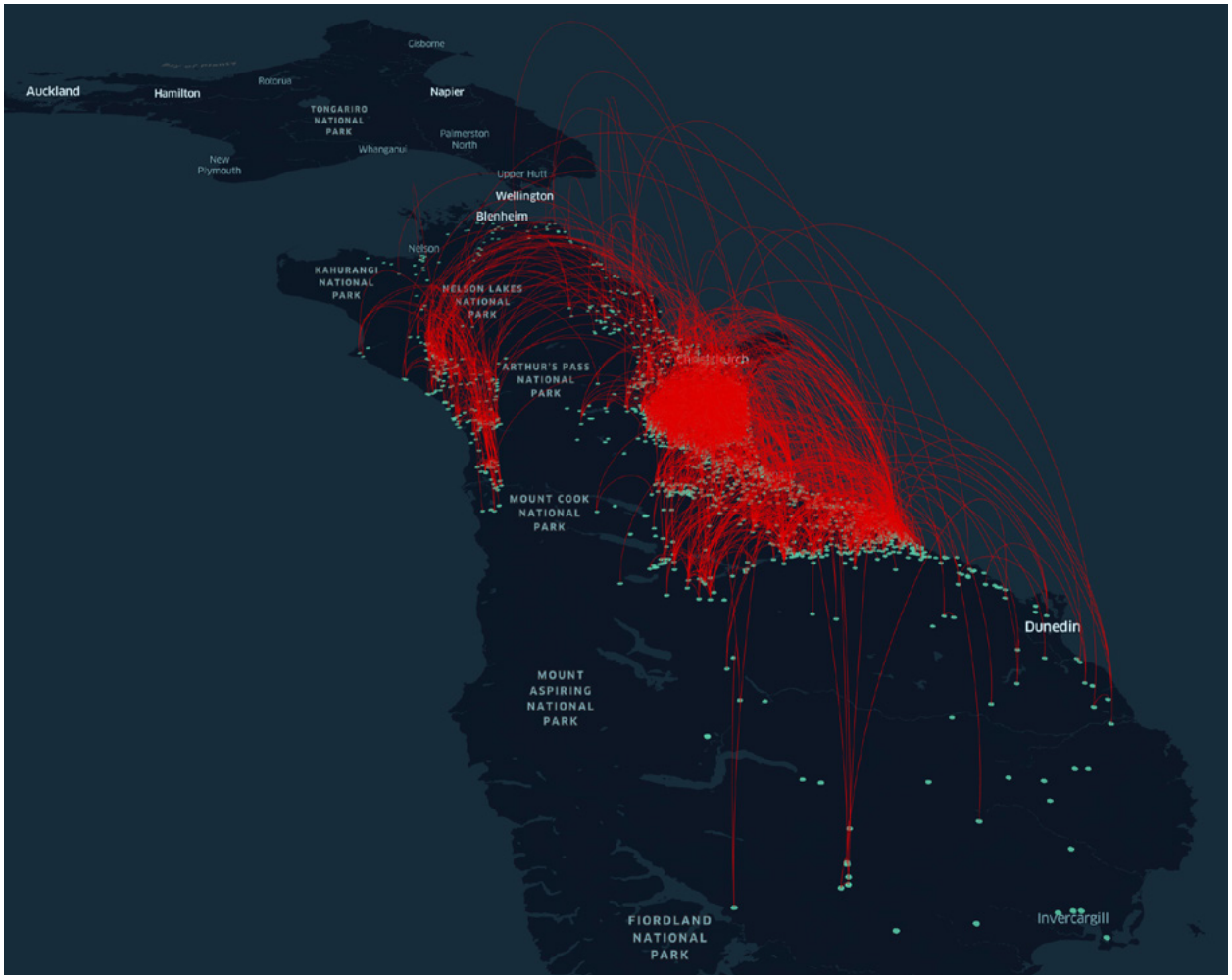
When someone uses the OnSide solution, an automatic prompt is sent when the person crosses a farm boundary – a geofence if you will – to remind them to check-in to the property. The check-in event is captured, along with other information, and used to construct the network of pathways. Any third-party data could also feed into OnSide's network – the cow collars that are being developed by Halter, for example. When you overlay this network on a map of New Zealand you get something that looks like this: His team then uses a modelling approach based on a family of network analysis models known as influence maximisation algorithms. The algorithms can be used to: 1) predict the infection risk of any given property; and 2) to identify properties that are highly "influential" in the way they are connected within the network. The most influential properties would have the largest impact on the spread of the disease if they were to become infected. These two features of the model can be exploited to direct disease testing and response activity in a lightning quick way in the case of an outbreak to protect the entire sector. The key features of OnSide's system include:

- **Optimal monitoring** - Identify properties to constantly monitor for potential incursions
- **Optimal response** - React to the detection of disease, directing resources to optimize containment
- **Infection prediction** - Predict properties most likely to be infected during an outbreak
- **Source detection** - Trace back to where an incursion most likely began

Dr. Higgs used the example of tuberculosis. Every year, 3,000,000 animals are tested for TB which costs the country millions of dollars. Inspectors



Credit: OnSide



Credit: OnSide

go around to farms testing for this disease. It's like searching for a needle in a haystack. Using some very cool data visualization software, Dr. Higgs showed us the spread of TB risk among farms in the South Island of New Zealand in real-time.

The software was used to identify the 10 most influential farms which, if are tested and found to be negative, half the TB risk in the entire Island would be removed. Typical numbers in other real-world applications have shown ~1-2% of properties monitored reduces the spread of disease by 80-90%. Imagine having 90% more resources that can then be focused on eradication as opposed to simply managing to a certain tolerance level. It's only a matter of time before livestock farmers are required to track movements as part of a broader industry push towards transparency and traceability.

The Bigger Picture

While OnSide addresses the biosecurity problem at a tactical level, some of the world's largest food producers are addressing the problem at a much higher level using technologies like blockchain. Some of the world's biggest food producers like Bunge, Cargill, Glencore Agriculture, and Archer Daniels Midland (ADM) recently formed a consortium called **Covantis** which is attempting

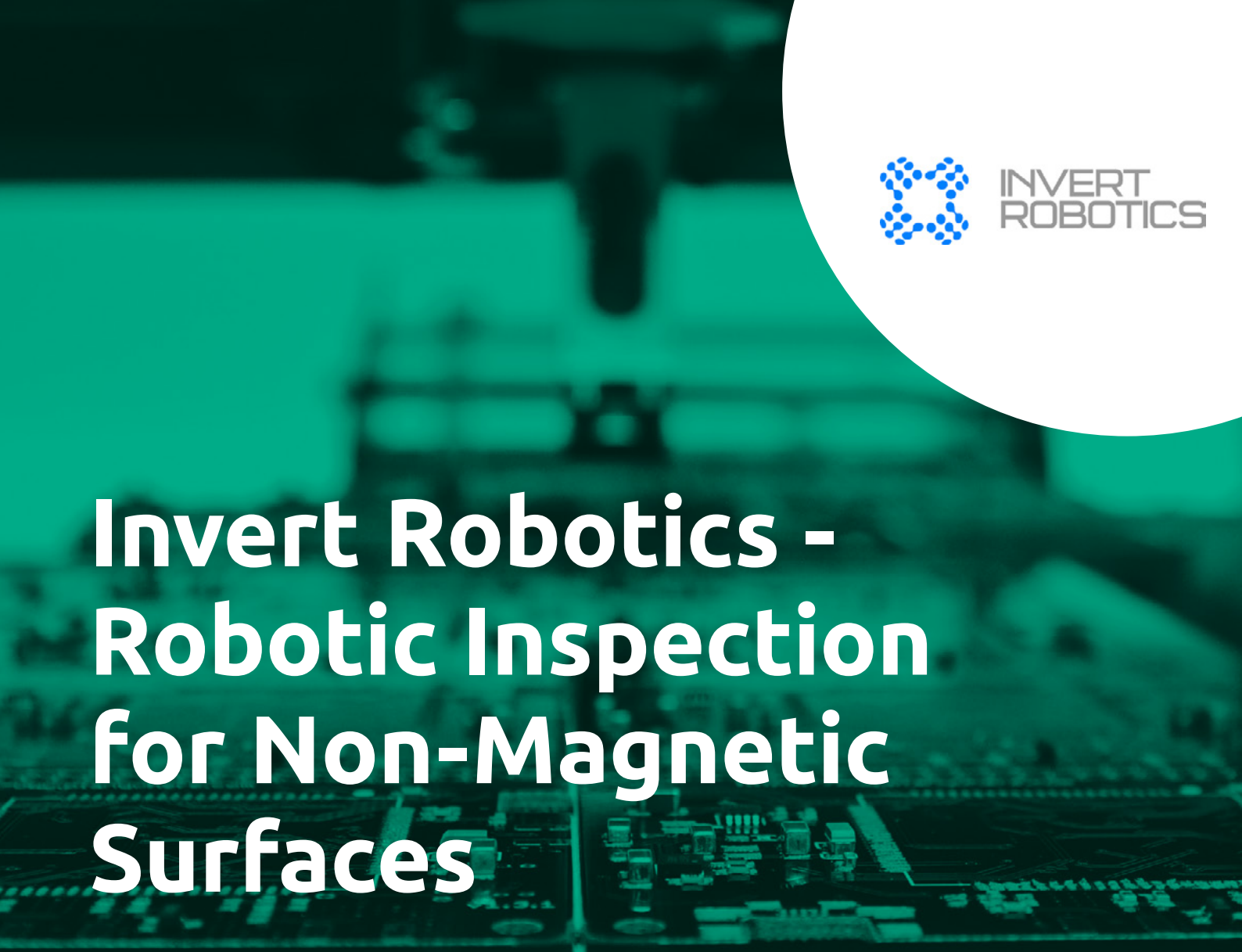
to "modernize global trade operations" using **blockchain technology**. These initiatives are all about transparency and traceability. Every step of the food procurement process will now be tracked and recorded. And it's not just about biosecurity. Think about how much more efficient the food supply chain can become if everything is being tracked at a granular level.

An initiative like Covantis will let some of the world's biggest food businesses strong arm producers into using their solution. At some point, traceability will be implemented at a tactical level to show the movement of people, livestock, and agricultural products for end-to-end traceability. That's where solutions like OnSide can easily be integrated into the broader platforms without having to reinvent the wheel.

Conclusion

As the global population continues to grow, food security is a real problem. In emerging markets, up to 30% of food is wasted somewhere in the supply chain. In developed markets, that number may be far less, but it could still stand to be improved. Having to cull your entire lot of chickens or pigs because of some new influenza strain is a form of food waste. Having livestock that are drench-resistant and produce 14% less meat as a result is another form of food waste. These are problems that OnSide can help solve. Given they happen to be located in one of the most innovative countries in the world when it comes to agtech bodes well for the future of this very interesting biosecurity startup.

Some of the people who might be likely to use OnSide's solutions would be the truck drivers who transport tankers of milk across New Zealand's roads. Those stainless-steel tankers also present a food biosecurity risk. That's because cracks and fissures can store harmful bacteria if not identified and repaired. This used to be a dull, dirty, and dangerous job for humans, but that's all changing now.



Invert Robotics - Robotic Inspection for Non-Magnetic Surfaces

Any truly disruptive technology will always have some controversy surrounding it that provokes people's emotions. **Gene editing at the germline**, **DNA testing for IQ**, and **brain to computer interfaces**, are all heavily debated topics by people with various motivations. For artificial intelligence, the controversial topic du jour is to yell "bias" whenever the algorithm provides a result you disagree with. Prior to that, everyone's feathers were being ruffled by the loss of jobs that AI and robotics will potentially bring about, a topic **we've touched on before**.

If we had to get everyone to agree on which jobs we might replace with AI and robotics, a good rule of thumb would be anything that's "dirty, dangerous, and dull." Operating **mining equipment** might fall into that category. So would things like logging or **commercial meatpacking**. But there's one other qualifier we might add to the "three d's." It's any job where a mistake by a human could result in many deaths – or even worse, many lawsuits. For such jobs, it makes sense to employ robots that don't make mistakes. If the robotic solution can actually do the job better than the human, you're creating operational risk by not adopting it. Investors love these types of businesses because the product sells itself. One such company is robotics inspection startup Invert Robotics.

Invert Robotics

Founded in 2011, New Zealand startup Invert Robotics has raised around **$15 million** in funding from investors that include Yamaha, Finistere Ventures, and the New Zealand Venture Investment Fund. The company was originally spun out of technology developed by the University of Canterbury School of Engineering, and their secret sauce is the "sliding suction cup method" which allows their robots to adhere to non-magnetic surfaces. It's all based on some clever engineering that uses four "passive" suction cups to constantly make sure the 5 kilo *(11 lb)* robotic crawler sticks to a surface *(one suction cup alone can support the robot)*:

Getting a Start in Dairy

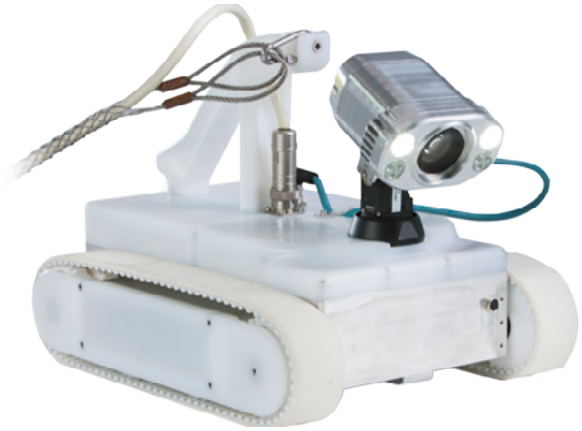
You'll find a number of companies out there offering inspection robots for magnetic surfaces, like the beleaguered General Electric with their "Inspection Robotics" business that caters to industries like oil & gas, or Gecko Robotics, a startup **we've looked at before**. What you won't find are companies offering robotics inspection services for non-magnetic surfaces, aside from Invert Robotics. The need for such a solution is driven by industries where non-magnetic surfaces are more prevalent, like food & beverage and pharmaceuticals.

It's like sliding a suction cup along a wet surface – Credit: Invert Robotics

In order to better understand the potentially limitless use cases for this robot, we sat down to talk with Managing Director Neil Fletcher and Director of Technology James Robertson to learn about how they first got started off in the dairy industry and where that journey has taken them.

Stainless steel is used a lot in industries where harsh chemicals – like caustic soda – are used to clean surfaces due to its ability to withstand corrosion. That's why you'll see lots of stainless steel used in commercial kitchens or places where you need to maintain very hygienic surfaces.

Try using harsh cleaning chemicals day in and day out on carbon steel and they'll eat through the metal in weeks. That's why stainless steel is commonly used for things like industrial-sized storage and processing tanks. If we're talking dairy, cracks in stainless steel tanks or pipelines can harbor bacteria which can then make people sick. Dairy products often move from the cow to the store in 24 hours, and some bacteria require 24 hours to manifest themselves. This results in recalls which can be extremely damaging to a brand. That's where the robots come into the picture.



One of the robots from Invert Robotics – Credit: Invert Robotics

Imagine if you will, hanging from a rope inside a dark container which smells of old milk while scanning the walls for cracks. Dirty, dull and dangerous are words you might use to describe the yearly task of visually inspecting industrial equipment used by the dairy industry. They say upwards of 90% of the time needed for inspections is spent on preparation, while the remaining time is spent on actually inspecting things. Workers are often falling off scaffolds, or slipping while abseiling, and these injuries are forcing the dairy industry to actively look at a different way to perform inspections. Enter Invert Robotics.

Not only can Invert Robotics do the job much faster – hours vs. days – but they can also do it for the same price and at a level of quality that's beyond what humans are capable of. *(Using 30X optical zoom, the robots can identify defects as small as 65 microns, or 2/1000 of an inch.)* In just seven years' time, Invert Robotics has already captured about 80% of the market share for dairy inspections in New Zealand, and 4-5% globally based on their latest estimates. Nine out of ten of the world's largest dairy companies are now using Invert Robotics in some capacity.

Visual inspections in the dairy industry are the bare minimum required to achieve regulatory compliance, and Mr. Robertson described this as "an ambulance waiting at the bottom of a cliff." The ability to scan more often and more accurately is one perk of using robots, but there are also other tools that can be used for even more detailed inspections. Industries involving oil, gas, and chemicals, already use such advanced methods because when things go wrong in these spaces, it involves massive explosions on the six o'clock news. That's where Invert Robotics decided to play next.

Inspection as a Service

Inspecting equipment for cracks and fatigue is something that typically takes place at yearly intervals. Invert Robotics has built hubs in six different countries from where they deploy technicians, along with their trusty robots, to clients' sites where they perform inspections. They don't make recommendations, but simply tell the clients what they found, leaving them to decide what needs fixing. If you'd rather the problems were fixed immediately while your equipment is down for inspection, they can do that too.

This "robotic inspection as a service" offering is also finding traction in other industries that use non-magnetic surfaces – like oil & gas.

Chevron recently announced their lofty goal of "no human entry in confined space by 2020," which may be completely unrealistic, but that's where they're heading. The petrochemical industry likes to use stainless steel because it's more durable, and that's the direction the industry is moving towards. In the 1960s and 1970s, carbon-steel storage tanks were used, and the method of evading corrosion was painting the insides *(imagine how fun that job would be)*. Today, pricing models have changed completely, and in many cases, it makes sense to outright replace old carbon-steel infrastructure with shiny new stainless steel infrastructure. It makes even more sense now that Invert Robotics can provide a way to inspect these non-magnetic surfaces. Given how regulated these industries are, more advanced inspection methods are often employed. Invert Robotics can handle this since each robot is able to carry a payload of up to 5 kilos *(11 lbs)*, meaning ultrasonic inspection methods can be employed alongside visual ones. Eventually, they'll even look to employ **predictive analytics** to anticipate failures.

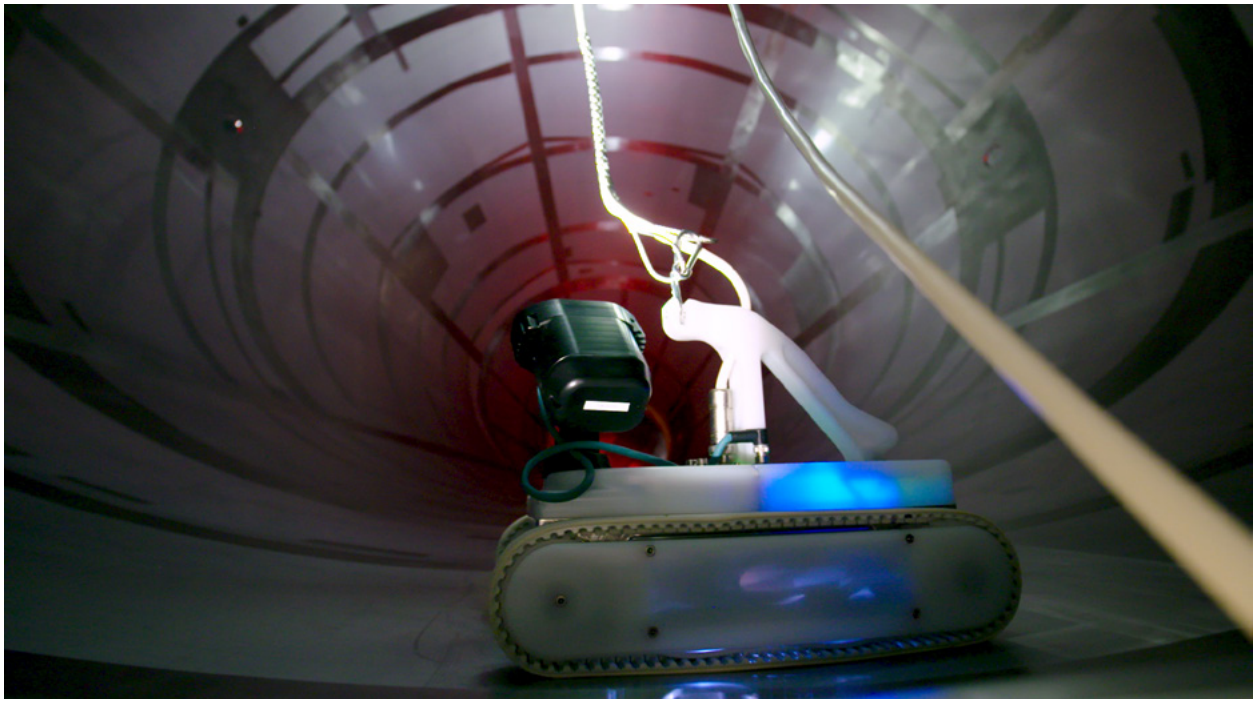
Looking to the Future

The use cases for Invert Robotics' technology are vast. Mr. Fletcher talked about how he once watched an airplane inspector tethered from the ceiling of an aircraft hangar, methodically inspecting 10,000 points on the surface of a plane. Spray bottle in hand, the man would first spritz some liquid onto a small spot, and then wave his magic wand over it looking for cracks – on his hands and knees. Every hour, it's back down to the ground because worker health and safety comes first. After three days of this, the worker moves onto the next plane. *(Those office workers who complain to Gwyneth in HR because someone stared at them for longer than five seconds don't know what real discomfort is like.)*

Now, several airlines are looking to use robots from Invert Robotics to perform airplane inspections. Pretty much any inspection job that's dangerous and uncomfortable could be performed by these robots. Just think of how many wind turbine blades there are to clean now that **wind power is cheaper than coal**. These are just some of the many applications Invert Robotics is eyeing up with their robot that can easily crawl any non-magnetic surface including glass, carbon-fiber, and plastic. Over time, the robot will also become smarter because soon it will be using artificial intelligence.

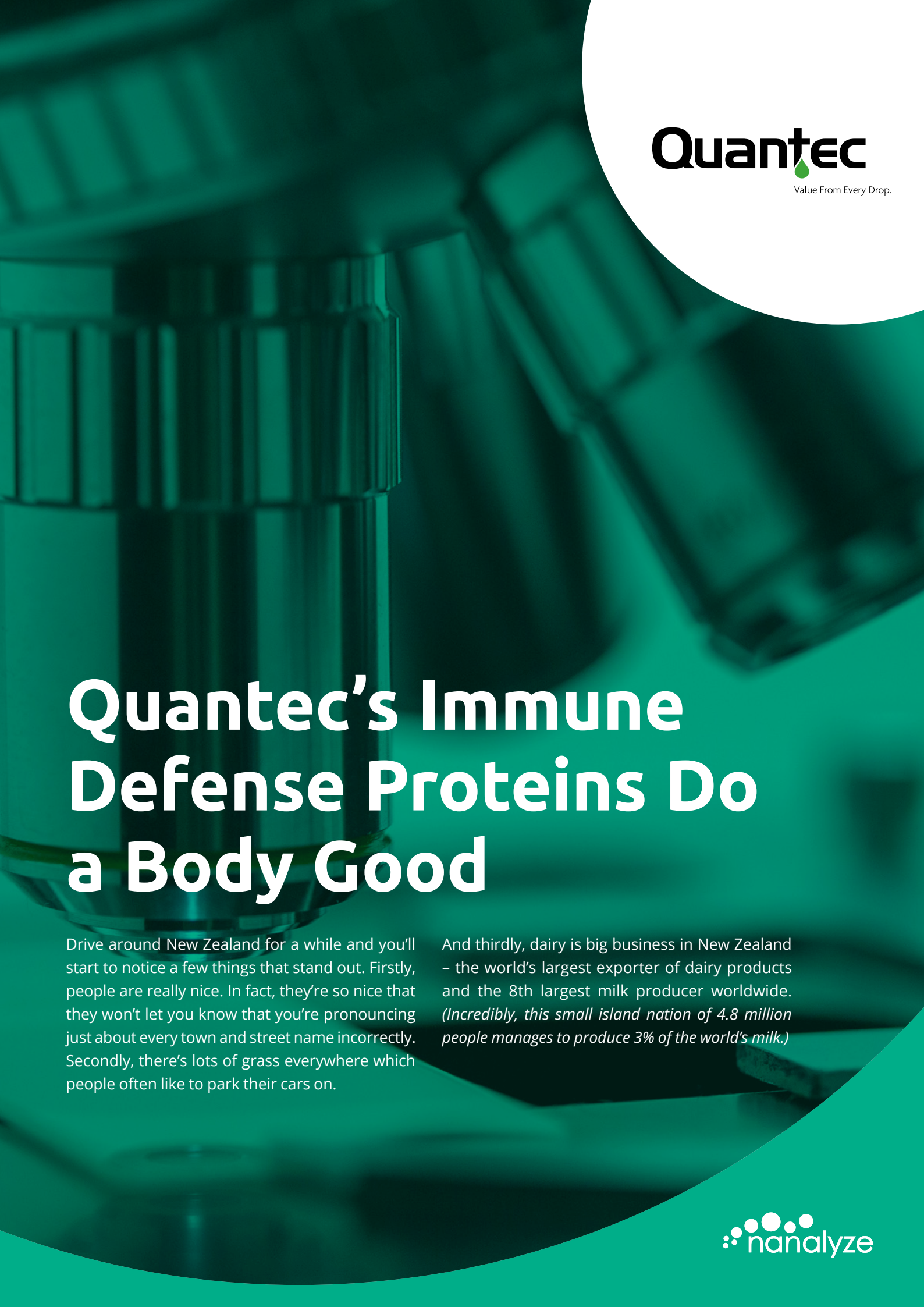
Mr. Robertson has had his hands full lately as his team looks into how technology like machine learning and specialized cameras can be used to increase the effectiveness of the robots in finding defects.

The old way of looking for defects – Credit: Invert Robotics



Credit: Invert Robotics

The idea is that the robot operator becomes a "human-in-the-loop" who can validate what the robot is proactively finding. It's similar to how **surgeons are using augmented reality** to assist in surgeries. That's the shorter-term vision which the company is very close to deploying. The longer-term vision is a shift to a predictive analytics model where the customer is provided with a potential defect and a confidence interval. The humans won't be going anywhere, as their expertise will be needed to interpret boundary cases so that the system continuously improves. Invert Robotics is experiencing rapid growth with revenue targets in the low nine figures, and most of their business comes from word of mouth. Clients come to them now asking for their services, which means the biggest problem they're facing is making sure they have enough robots and humans in the field to perform all the jobs they're being asked to do. It's a good problem to have for this ambitious New Zealand startup that's now making a big splash on the global stage – just like our next startup.



Quantec

Value From Every Drop.

Quantec's Immune Defense Proteins Do a Body Good

Drive around New Zealand for a while and you'll start to notice a few things that stand out. Firstly, people are really nice. In fact, they're so nice that they won't let you know that you're pronouncing just about every town and street name incorrectly. Secondly, there's lots of grass everywhere which people often like to park their cars on.

And thirdly, dairy is big business in New Zealand – the world's largest exporter of dairy products and the 8th largest milk producer worldwide. *(Incredibly, this small island nation of 4.8 million people manages to produce 3% of the world's milk.)*

nanalyze

We naively envisioned cows churning out milk into cartons which made their way onto grocery store shelves, but that's a very small part of what milk is used for. Here's a breakdown of what products come out of New Zealand's national herd of more than 4.8 million dairy cows that represented 39% of export revenues in fiscal 2019:

Year to 30 June	2015	2016	2017	2018	2019
Whole milk powder	5,385	4,609	5,271	5,818	6,680
Butter, AMF, and cream	2,219	2,378	2,794	3,812	3,617
Skim milk & butter milk powder	1,762	1,347	1,385	1,228	1,323
Casein & protein products	2,129	1,834	1,735	1,601	1,574
Cheese	1,557	1,720	1,830	1,905	1,967
Infant formula	415	685	778	1,240	1,641
Other dairy products*	582	716	845	1,050	1,318
Total	**14,050**	**13,289**	**14,638**	**16,655**	**18,120**
% Change	-21.0%	-5.4%	+10.1%	+13.8%	+8.8%

Source: Stats NZ and MPI.
* Other dairy products include: liquid milk and cream, ultra-high temperature milk, yoghurt, and ice cream.

Credit: Quantec

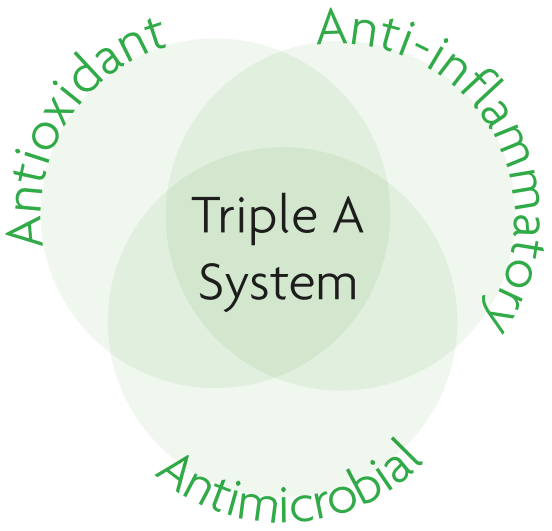
When you're so into milk you decide to do a PhD thesis on it, New Zealand is a prime place to relocate. That's what American Rod Claycomb did back in 1999 when he came to New Zealand and became the founding CEO of SensorTec, which developed and commercialized sensor technologies for the measurement of biological components in milk. After leaving his first venture, he went on to co-found a second company around milk – Quantec.

Immune Defense Proteins (IDP)

Founded in 2008, Hamilton, New Zealand startup Quantec has taken in more than **$2 million** in investor funding to develop IDP, a patented formulation based on milk bioactive proteins that's extracted from pure natural milk. *(It takes about 2.64 gallons of milk to get 0.03 ounces of IDP – or 10 liters to get one gram.)* First discovered in 2005 by Dr. Claycomb's co-founder, Dr. Judy Bragger, and patented the same year, IDP contains more than 58 different proteins and is produced by the cow as a defensive shield against infection and inflammation, protecting both the mother and the calf. Fast forward to today and they're a well-established, growing, and profitable organization, all based on its IDP technology, with traction in different markets. With a tenured CEO on board, the team is focusing heavily on R&D through to commercialization and a growing sales team.

Dr. Claycomb described to us just how they extract IDP from milk using fractionation, something that he's a bit of an expert having led the team that developed the world's first on-farm milk fractionation robot. It's now a process protected by global patents, and IDP is being targeted towards three geographically and functionally diverse applications, each with some serious

IDP®
Immune Defense Proteins



Credit: Quantec

potential behind it. The one we want to focus on first is perhaps the most interesting because it involves selling nutritional products to the 350 million Chinese consumers who buy them today. The direction is clear in Quantec's marketing collateral which has all been localized for the Chinese nutrition market.

The Chinese Nutrition Market

Spend some time living among the Chinese and you'll quickly start to notice that you're not in Kansas anymore. If there are ghosts in your house, expect to lose about 30% of the property's value. And don't think you can sweep that ghost

Credit: Big Stock Photo

under the bamboo mat. You are legally obligated to tell buyers if your house has ghosts *(usually this involves some death that occurred on or near the property)*. Signing up for health insurance at your place of employment is also handled differently. The first big choice to make is whether you want Western Medicine or Chinese Medicine.

If you don't know anything about Chinese medicine, just walk into one of the many Chinese pharmacies around and see how complex the practice is for yourself. With more than 13,000 medicinal ingredients, Traditional Chinese Medicine *(TCM)* has been used for the past 3,500 years by the Chinese who are now the most commonly found humans on the planet. *(One in five people on this planet is Chinese, a statistic that throws a monkey wrench in whatever D&I strategy Gwyneth from HR has been wasting her time on lately.)* TCM isn't backed by any science, yet it seems to work remarkably well, and everyone uses it.

These are just a few examples of a fascinating alternative belief system that the Chinese have held for centuries, and one that considers lactoferrin to be a super-ingredient.

Lactoferrin is a protein with antibacterial properties that's found in milk. It's also one of the proteins found in the ingredient IDP.

After nearly a decade of figuring out the optimal way to conduct business with the Chinese, Quantec managed to achieve success. Just this year, they inked a 20-year contract with Chinese mother-baby Holon, which sells its products to about 20,000 stores. Quantec products can be found in about 8,000 of them today. Much of what needs to be done now is to educate the Chinese on the value of IDP which means speaking to them in conferences and workshops in person. In a market like China, personal sales pitches are extremely effective.

Figuring out total addressable market for this segment is tough, but **a report by Roland Berger** talks about the historical growth of China's nutrition market – 13% compound annual growth from 2005 to 2015 – and the future growth potential. The same report says you need three things to succeed in the Chinese nutrition market:

- Enhance product influence and brand power
- Develop insights into sales channels
- Seek international collaboration

Those three things are exactly what Quantec has managed to do. The Silver Fern brand sells very well in China, and they make up more than 30% of New Zealand's dairy exports. Now, Quantec can easily sell other nutritional products to the Chinese. They can also sell other variations of their own product, like skincare cream with IDP that helps acne.

Skincare Products for Acne

Again, our story involves both serendipity and hustle. When Quantec completed their clinical studies showing that IDP could be used to effectively address acne, they developed their own skincare product line under the brand name "**Epiology**" and opted out of selling into bureaucratic environments like 'Murica, instead settling on Mexico as their first market. Turns out the demand for skincare products in the Mexican market happens to be much stronger than many other geographies, and the rules and regulations allow for acne skincare products to be marketed without as many regulatory hoops to jump through.

Epiology skincare products – Source: Quantec

Using IDP as an active ingredient in skincare products means high margin and low risk since someone else deals with distribution and sales. While Mexico is their biggest market, they're actively expanding into Latin America now. *(For our American readers, Latin America consists of all countries south of the border that don't speak American.)* There's also a huge demand for skincare products in Latin American countries, and now they're looking to duplicate the success they've had in Mexico. If Quantec manages to make it down to Brazil, the world's fourth-largest producer of dairy products, maybe they can also look to market their third product category.

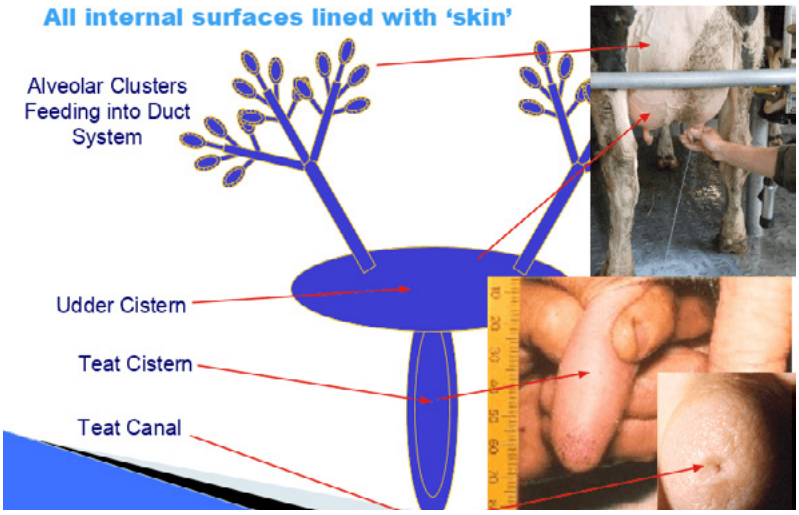
Curing Mastitis

The last application is equally exciting, and hits close to home for New Zealand's dairy farmers. During our time in New Zealand, we quickly learned about mastitis, the bane of any dairy farmer who wants to maximize production for their herd. Simply put, mastitis is an infection of the cow's udder that happens when it returns to the field and lives on grass between milkings. Below is a diagram showing the anatomy involved.

Applying a spray to a cow's teats has been the foundation of mastitis control systems for the past 40 years, and it's about time for some innovation in this space. Since mastitis is probably the single biggest concern for most dairy farmers, a great deal of work goes into testing the milk output to quickly catch and rectify cases. It's a business of its own, and Dr. Claycomb seems to think that using the cows' own IDP, he may be able to dramatically reduce mastitis. That would help increase diary production and ultimately result in mankind being safe from extinction. It's a win-win.

Meeting with startups that are flying under the radar is like scratching off a lottery ticket. Sometimes you are blown away by what's actually going on behind the scenes. Quantec is a great example of a company that's too busy executing to care much about publicity. They're not overly interested funding, which hints at some high-margin cash flows fueling growth that are typical of a commercially viable, well-run company. At some point, it might make sense for the company to carve itself up into verticals, and perhaps pursue other applications as well. For now, Dr. Claycomb isn't overly worried about all that. Quantec's focused on scaling the business to sell a whole lot more product. Wondering whether or not your business can scale production quickly enough is a good problem to have.

While we've mainly talked about cows so far, no article on livestock in New Zealand would be complete without some mention on sheep.



Credit: Quantec

LANACO

Lanaco – Creating the World's Most Valuable Wool

If you had to guess which country in the world produced the most sheep, you might be tempted to say New Zealand. You may be surprised to hear that the country with the most sheep is now China with 175 million. New Zealand with around 27 million doesn't even make it into the top five. That's largely because New Zealand's dairy industry has taken over now, accounting for more than 30% of the country's exports. For the remaining sheep farmers in New Zealand, and there are still plenty of them, it's a sinking industry that's suffering from commoditization. One man helping to turn this around is award-winning sheep breeder Andrew Ramsden. What Washington State has managed to do with their Cosmic Crisp apple, Mr. Ramsden hopes to do for New Zealand's sheep industry with his Astino DFC sheep breed.

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Plant-based protein of the best kind – Credit: Te Mana Lamb

Breeding Superior Sheep

Breeding sheep for optimal traits is something that Mr. Ramsden has been working on for decades. One of his prior success stories is **Te Mana Lamb**, treasured by the world's top chefs for it's incredible flavor profile which results from a different type of fat, an intramuscular fat, higher in Omega-3 with marbling on a micro-scale.

It's what Kobe Beef did for beef eaters, and it doesn't behave like regular lamb during preparation and cooking, meaning it not only tastes better, but it looks better on the plate. Creating and selling a premium product from sheep is what the New Zealand sheep industry needs to come back from the doldrums. The process of developing a new type of value-added lamb requires a breeding objective – find the breeds where there are strengths and select those traits to carry forward.

Now, Mr. Ramsden is using this same method to create the world's most valuable functional wool fibre which is now being sold under the brand name "Astino."

Lanaco and Astino Wool

People are now aware of wool's amazing properties thanks to Merino wool, a material that's exploded in popularity in recent years because of its functional performance, especially for travelers. Fall into a river wearing cotton and you might die from exposure, but wool provides insulating properties, even when wet. The fibers manage moisture, such as water or sweat, while remaining dry on the fiber surface to increase comfort. Wool is also fire resistant, odor-resistant, bacteriostatic

and biodegradable. The popularity of wool, even the Merino wool, hasn't done much for New Zealand sheep farmers though. That's because it's become just another commodity where the cheapest producers – like China – are able to undercut everyone else on price. That's why Mr. Ramsden focused his expertise on developing a breed of sheep with superior wool that is protected by intellectual property. His flagship sheep breed, Astino, has high quality wool fibers that are of a high consistency and designed to deliver superb air filtration performance.

Farmers that raise Astino sheep can expect to sell the wool at a 150% premium for the micron grown. The breed has been optimized for other characteristics well. For example, they live longer and have a lambing rate of 1.5 lambs per year, a number that's much better than other breed alternatives from similar country. Wool produced by these sheep is being purchased by a startup called Lanaco, which is going to market with a range of premium air filtration products. And there's a huge opportunity in front of them.

Air Is the New Water

If water is the new oil, then air is the new water. The World Health Organization states that "nine out of ten people breathe polluted air every day," with air pollution being considered "**the greatest environmental risk to health**" given over 90% of people on this planet breathe air that's not of an acceptable quality. According to the American Lung Association, you inhale about 2,000 gallons of air per day. That's enough to fill a swimming pool, and your lungs have a difficult enough time processing it all without the added complexity of pollutants. The need to filter pollutants out of the air has any number of use cases, from wearing a face mask when you're biking around the streets of Beijing to filtering air while mankind makes the trip to Mars in order to find the next planet we can occupy when the one we're living on goes pear-shaped. It's the NewSpace use case that brought Lanaco onto the global stage when none other than NASA came sniffing around asking about their premium wool filters which may help humans colonize other planets.

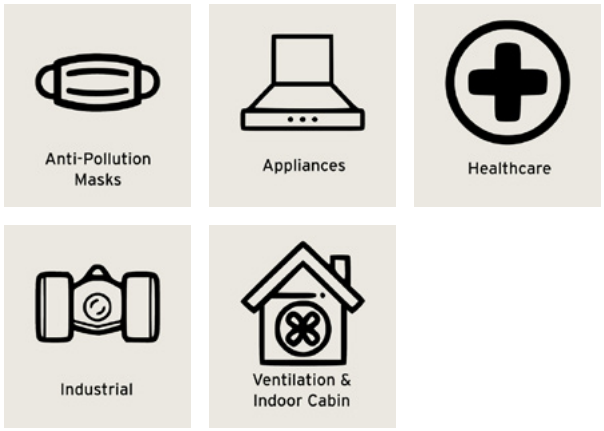
Air Filtration Use Cases

We largely cover space travel in the context of small satellites and space tourism, but there are much bigger ambitions on the horizon. And we're not just talking about Mr. Musk. NASA is building a human spacecraft for deep-space missions called Orion. On its first mission, Artemis 1, Orion will venture thousands of miles beyond the Moon over the course of about three weeks. Flights with astronauts will start in early 2020s, and that's why NASA came knocking on Lanaco's door.

Credit: NASA

A technology scout came sniffing around Lanaco because their wool filters can do things that synthetic filters can't. We already know about some of wool's amazing properties for clothing, and similar properties exist for filtration. For example, wool filters are exclusively capable of **filtering out formaldehyde** from the air. They're also uniquely capable of filtering out

impurities in a spacecraft if there's an on-board fire – like molten plastics. If the technology is good enough to find its way onto NASA's spaceships, then it's certainly suitable for any other number of industrial applications of which there are many.



Filter Applications – Credit: Lanaco

In particular, health applications are where people's lives can be improved or even saved. Over 4 million deaths a year can be attributed to air pollution says **an article by The Scientist** which goes on to talk about how "the health effects of air pollution go beyond birth weight and preterm birth and may stay with the affected individuals their whole lives." One example of a premium product that can directly impact people's exposure to air pollution is the face mask.

Premium Wool Face Masks

Spend some time in Asia and you'll notice lots of people walking around wearing face masks. If you go to the doctor with the flu, you'll leave the office with a face mask. The primary use case in these collective societies isn't to keep the wearer from getting sick, it's to prevent others from catching the wearer's illness.

Credit: MEO

Disposable face masks can be found just about everywhere, and it makes sense that something so intimate should be created as a premium product that combines fashion with functionality. Designer Karen Walker fashioned a face mask cover that comes with interchangeable filters.

HELIX Filter Media provides superior electrostatic performance, capturing over 99.85% of PM0.1 particles and filtering out more than 99.99% of airborne bacteria. Since it's created of wool, it's the world's most breathable filter media that's pleasant to inhale through thanks to an infusion of New Zealand Manuka oil extract. Anti-bacterial qualities help to reduce the risk of being infected by colds and flu. It can also retain toxins such as formaldehyde. As for the price point, you can pick one up along with three filters for around $60.

Credit: Behance.net

Upwards of 30% of New Zealand's exports are to China alone, a country that's obsessed with health and already wears face masks as a social norm. The Chinese are particularly attuned to the health of infants and children, and a bit of education combined with their affinity towards **the Silver Fern brand** could make Lanaco air filters a product every Chinese person keeps in their house – in other words, one in five people on this planet. But the Chinese market is just part of the story. The fact that NASA finds this technology useful for NewSpace applications means there's as much money to be made in other high-value applications. Our next startup also has some grand aspirations around the burgeoning field of longevity.

synthase biotech
extending life...

Synthase Biotech - Increasing Longevity by Decreasing Oxidization

Somewhere in a coffee shop in America, some green-haired millennial is typing away feverishly on their brand new Macbook Air, broadcasting to their Twitter followers about how evil capitalism is. As they pour a dab of pasture-grazed New Zealand cow's milk into their freshly roasted cup of Guatemalan organic free-trade coffee, they lament their woes to the world. Why can't society give me more? Why can't I enjoy success without hard work? On the other side of the globe, some hard workers in New Zealand are pulling off some pretty major feats to put that delicious milk on the table. It all starts at LIC, a New Zealand cooperative whose core business is dairy genetics. *(They're responsible for inseminating 80% of New Zealand's national dairy herd.)* Next to LIC's headquarters in Hamilton sit the prized bulls who've sired tens of thousands of calves.

When the time comes, the bull is loaded into a custom tractor-trailer and taken to a building that's been there for decades. *(The bull is transported this way so it doesn't stub its toe while walking over and consequently produce less sperm.)* The bull is led up to an attractive cow who stands waiting while a human handler watches and waits. Once the bull convinces the cow that he's not just another player interested in a one-night stand, he mounts her, and this is where all the fun begins.

The human handler then needs to "manipulate" the bull with a device that collects the prized semen – or a "jump" as it's called in dairy lexicon. Once collected, some of the semen is frozen and shipped to various parts of the world. It's where life starts, and it's a fitting place for a longevity company to start as well.

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Collecting a "jump" – Source: Livestock Improvement Corporation (LIC)

An Accidental Discovery

Founded in 2015, Hamilton, New Zealand startup Synthase Biotech has taken in **$3.36 million** in funding and contributions to develop a platform technology that seems to have limitless promise. The technology behind the company came about as somewhat of an accident while researchers were looking for an alternative to latex when the Japanese were constraining supply. In an Arizona desert exists a shrub that contains latex, as well as an enzyme that prevents the latex from oxidizing. *(Oxidization is how a substance reacts to oxygen, and in some instances it's not good – like rust.)* It's this plant enzyme that may, eventually, be used to increase **longevity in humans**.

Turns out that humans don't react well to prolonged exposure to oxygen over time. While oxygen is what you need to live, it's also what can ultimately take you out in the end. You've probably all heard of "antioxidants" which can prevent oxidative damage to cells and tissues by scavenging unconstrained radicals. It's damage that arises from unconstrained "free" radicals that can eventually be fatal. Synthase Biotech has an enzyme that it calls Aloxsyn® which has "extraordinary specificity and rates of reaction against toxic lipid peroxides." In other words, this enzyme can be used to halt and even repair much of the damage that aspects of oxidization can do to mammalian cells, and the company has developed a way to produce the enzyme using a fermentation process.

We sat down to talk with Dr. Andrew West of Synthase Biotech, which has IP protection around the use of this enzyme, Aloxsyn®, in their first product applications for frozen bull semen and cattle embryos.

Improving Cow Fertility

Given how much work happens in Hamilton around frozen bull semen, it was a likely place to start. If a cow isn't fertile, it's not producing milk. Consequently, you want to maximize cow fertility in order to maximize milk production. Keeping a cow that doesn't produce milk is uneconomic and produces unnecessary greenhouse emissions from its belching, or whatever it is they're supposed to be doing that's wrecking the planet.

Ideally, fresh semen works best for artificial insemination, but there are many use cases where frozen semen is needed. You may need to transport the semen long distances, or you may want to preserve some semen from a prized bull to be used next year. When using frozen semen instead of fresh semen, fertility rates can drop as you might expect. However, when adding some Aloxsyn® to the mix, you can get a better outcome. That's based on a major trial that Synthase Biotech recently conducted.

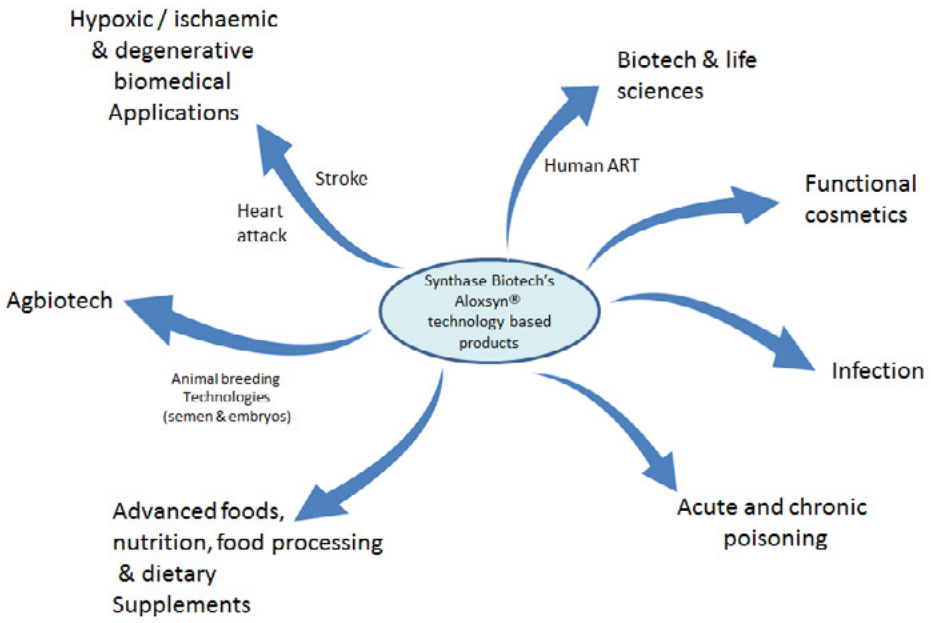
If you're talking cattle, the final customer is always the farmer. That's who Aloxsyn® is helping. But it's just one of many potential applications for this technology.

Additional Applications

Synthase's proprietary bioactive, Aloxsyn®, may have a positive impact anywhere inflammation can be found. Dr. West believes that the number of potential applications for the company's enzyme are very large. One application Synthase is looking at is storage of blood platelets, which will require some trial testing, but which represents a huge potential market. Then, there are more sperm applications.

Once a bull has a jump, that sperm dies almost immediately if it doesn't end up inside the cow where it belongs. Whilst working on frozen sperm, it looks like Aloxsyn® also extends the life of fresh cattle sperm by five days. *(LIC scientists showed us a proprietary solution they're using that increases the life of cattle sperm by three days.)* Why stop at cattle sperm? Fertility of pigs and horses could also be of interest as well, not to mention human fertility.

All of these fertility applications are higher margin, but there are also lower margin applications that can be considered such as increasing the shelf life of food. With around 30% of **food waste** in developed markets attributed to food spoilage, it's another way that we may be able to help feed all



Source: Synthase Biotech

the billions of mouths coming online. *(Seems like a fitting application considering that they're about increasing human fertility.)* In order to address high-volume applications like this, production would need to be scaled and costs would need to be driven down. It all requires investment and partnerships with interested parties who want to collaborate.

No longevity company is without some grand visions of what the future might hold. In some preliminary experiments, a rat's heart was stopped from beating for 30 minutes and then blood applied with the enzyme. The rat heart recovered 100% of its function. A rat with a severe stroke could fully recover if Aloxsyn® was applied within 45 minutes of that stroke. The implication here is an interesting one. Perhaps lipid peroxides in all that backed up blood behind the clot serve to damage the brain when the clot is overcome, and Aloxsyn® cleans up those toxins? It's a promising example of what the future might hold, and if you have about $100,000 to pony up, Dr. West says Synthase Biotech will work to create a mouse that produces its own Aloxsyn®, a mouse that just might live longer. It's a drop in the bucket for the many billionaires out there seeking the fountain of youth. For New Zealand investors, however, that sort of work is pretty risky.

The New Zealand Biotech Scene

The *New Zealand Herald* published **a pretty comprehensive article** on Synthase Biotech last year which contains some relevant information about the state of biotech in New Zealand. It's dismal. Investors don't look favorably on life sciences companies and that could be because the New Zealand stock exchange isn't of a size that would support them. *(The entire New Zealand stock exchange has a market cap of just $142 billion. To put that number in perspective, Johnson & Johnson is over twice that size with a market cap of $363 billion.)* On the other hand, Australia is much more accepting towards biotechs with about 200 listings on the ASX. Synthase is not pursuing an ASX listing, but if the company moves into development of a human drug based on Aloxsyn®, it will need millions of dollars for clinical trials. Significant investments over time will allow Synthase to add a range of human applications to complement its livestock ones. After a few years of selling animal products, their manufacturing operation will have all the kinks sorted out, and that's half the battle before embarking on some human trials.

The more we know about the world, the more we realize how little we know. That's obvious when you consider how some of the world's greatest inventions – penicillin, X-rays, the microwave, LSD – were all discovered by accident. The Peter Thiel types out there who are willing to sink large sums into the burgeoning longevity industry might find the capital requirements for companies like Synthase Biotech to be more economical. According to a talk by Finistere Ventures a few years back, agtech valuations in the United States are half of fintech valuations, while New Zealand agtech valuations are half of that. If the fountain of youth exists in The Land of the Long White Cloud, it's likely to be selling at bargain-basement prices.

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