

THE CIRCULAR ECONOMY

Start-Ups Pioneering The Circular Economy

Taking innovative ideas
from pitch to product

growthgarage.mcam.com



Growth Garage

FOREWORD



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Through our Growth Garage challenges, we at MCAM are offering our expertise, material infrastructure and resources to innovative start-ups and scale-ups to support their development of creative solutions that enable the circular economy.

Sustainability is a team effort, and only through collaboration can we solve the business, environmental and social challenges the world is facing today. We are committed to fostering innovation and exploring new technologies, applications, and business models to drive our vision, one where the circular economy shapes the future of business.

At MCAM, we help the challenge winners deliver innovative solutions that fit our core values of environmental and social sustainability, human health, and comfort. We call this sustainable well-being of people, society and our planet Earth KAITEKI. I am grateful for the growing interest in the challenges, and amazed by the truly innovative submissions we receive.

INTRODUCTION

Growth Garage is the business accelerator from Mitsubishi Chemical Advanced Materials. Its aim is to support innovative companies and help them tackle some of the biggest engineering challenges in the world today.

At the beginning of 2021, Mitsubishi Chemical Advanced Materials (MCAM)'s Growth Garage launched its first challenge, offering an exciting opportunity for engineering entrepreneurs and innovators to get their ideas from pitch to product.

Winners receive MCAM's full support and expertise – and access to its unique materials and manufacturing technologies – to help develop their projects from initial prototype to final product in three months.

So far, there's been two outright champions. Canada's Delson Aeronautics won the inaugural challenge, and Crover, a grain storage solutions company, won the second. A third company,

Circularise, was involved in the Kaiteki Challenge run by Greentown Labs, the pioneering US climate-tech incubator, in partnership with Mitsubishi Chemical Holdings Corporation.

All three of these innovative young companies have had similar journeys; starting with ideas conceived at university and developing them into burgeoning start-ups. Circularise, already counts Porsche and numerous market-leading plastics companies as customers.

Here, we share their experiences, following their journeys of turning their ideas into realities, exploring the challenges they faced and identifying their plans to develop and grow.

Delson Aeronautics

BACKGROUND

Delson Aeronautics envisioned a future where aircraft soar so silently they seem designed by nature, rather than humans. The company was founded by Michael Deloyer and developed with engineers Eitan Rotbart and Ammar Jessa.

AIM

Delson's vision for a better future was to create low noise propellor blades that can be recycled, specifically for unmanned aerial vehicles (UAVs), or drones.

WHAT DOES IT DO?

Delson's patent-pending drone blade design results in an average 10 dB noise reduction, making them 50% quieter than an equivalently sized conventional propeller blade.

SOLUTION

The Delson team developed its UAV blades over the last three years, creating thousands of iterations using additive manufacturing.

The blades were made possible using MCAM's high-strength lightweight carbon-fibre based composite, KyronMAX®.

As a result, drone operators can get far closer to their subject without causing a disturbance.

The blades are strong enough to allow drones to operate at their full power.

BENEFITS

The blades' high tensile strength allows centrifugal loading beyond 3,000N in flight.

The drone blades can operate in harsher and more unpredictable environments from -30°C (-22°F) to 50°C (120°F) and in high and low humidity environments – from deserts to rain forests.

The blades' high flexural strength and stiffness allow loading over 24.5 g/cm² (50 lb/ft²). At the same time, the blades' low material density and weight increases flight efficiency, responsiveness and stability.

The strength of the blades ensures over 1,000 operational hours.



“So many of these challenges are just software-based. MCAM gets that making hardware is very challenging and often very expensive. That’s what makes this competition unique and sets it apart.”

We talked with Delson Aeronautics founder *Michael Deloyer* about his incredible journey from start-up to exit.



Where did the journey start? Did this begin as part of your studies?

I studied industrial design at university in Canada and specifically focused on transportation. However, aircraft propulsion was always on my mind, to the extent that I even debated going back to school to study aerospace engineering. However, I knew what I wanted to focus on so, in the end, I decided to teach myself.

In 2017 I started developing my ideas for propulsion units that were high performance, high thrust and high efficiency, but low noise. It began as an independent research project; I did many design iterations; testing and prototyping. Through my discovery process, I got connected with my two partners in the project. It eventually took us three years to develop a propulsion system that came close to fulfilling our requirements.

What challenges were you trying to solve for prospective customers?

I initially thought of a few use-cases. The obvious one was for wildlife conservation research. There's already been lots of interest in using drones to study animal behaviour but it wasn't always practical due to the noise, especially if you need to get close to the subject. The military was another potential market, as stealth is also an essential factor for them. And finally, there's an emerging market for drone delivery.

How vital was sustainability and the circular economy to the project?

It was a focus for us. The whole premise is to reduce noise and be more like nature; most natural systems aren't deafening. But equally we didn't want to create more waste. Blades are typically thrown away after a couple of years due to wear and tear. In addition, traditional blades are generally made from injection-moulded polymers that have been hard to recycle.

What challenges were you facing before you entered the competition?

We had all the typical start-up issues – ensuring we had enough money, developing and manufacturing samples, getting customers. More fundamentally, was this something that people needed?

What were the key drivers for entering the challenge?

The fact that MCAM would help us develop the blades and manufacture them was something we'd not seen before from this sort of competition. It was also key that they didn't want to take our intellectual property. So it helped keep things simple. It means we weren't tied into working with specific companies unless they were the right partners.



How are you working with MCAM?

So many of these challenges are just software-based. MCAM gets that making hardware is very challenging and often very expensive. That's what makes this competition unique and sets it apart.

How are you going about finding customers? What sort of companies are interested in using your blades?

We've made a lot of connections from winning the challenge. Our YouTube video got 20,000 or 25,000 likes in two or three days. On the back of that, we were flooded with emails from people who wanted to know more. So now we've won, we can give the blades to potential clients to test and prove what we've been talking about.

What does success look like for you and the business after completing the challenge?

Just before we were announced as winners of the challenge, I took a full-time post with Horizon. They're building the first practical hybrid electrical vertical take-off and landing aircraft (EVTOL), so I've swapped designing drone blades to designing aircraft. Delson will either license the blades to a manufacturer or sell the IP and patents for the design outright. The whole experience has been a brilliant stepping-stone and enabled Delson to go from a burgeoning start-up to an exit in record time.

Crover

BACKGROUND

Crover is on a mission to help maintain optimum storage conditions and reduce losses for grain storage operators. Its unique robotic solution improves and automates monitoring and management activities. The idea was developed by Crover founder Dr Lorenzo Conti as part of his research into granular physics.

AIM

The Crover team's vision is to radically improve the efficiency of the GOP (grains, oilseeds, and protein crops) supply chain and the associated bulk storage, and to reduce grain losses due to spoilage.

WHAT DOES IT DO?

The robotic device maps the conditions inside grain bulks to identify suboptimal storage conditions, and mixes the grain in-situ, which helps maintain its quality.

SOLUTION

The core technology behind the Crover robot comes from years of research in granular physics and rheology (the study of how granular materials "flow"). Crover's method of movement in granular materials is made possible by a new, ground-breaking physical discovery and patented (UK) technology. Like aeroplane wings in the air or a boat's propeller in water, it allows an object to move through solid grains.

It works in any environment made of bulk solids and powders, such as sand dunes, heaps of grain, mineral bulks, chemical powders, and potentially even loose Martian terrain.

BENEFITS

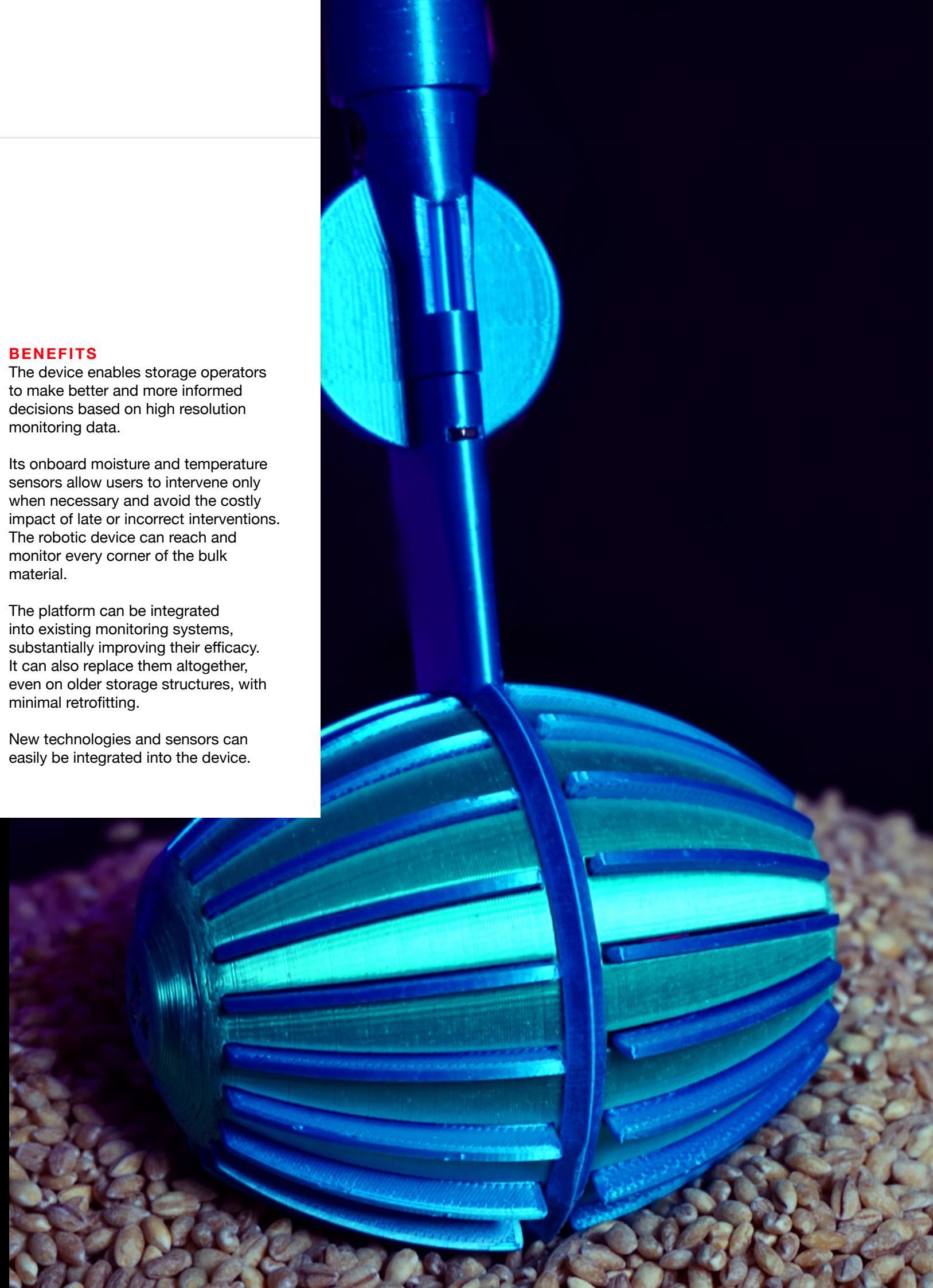
The device enables storage operators to make better and more informed decisions based on high resolution monitoring data.

Its onboard moisture and temperature sensors allow users to intervene only when necessary and avoid the costly impact of late or incorrect interventions. The robotic device can reach and monitor every corner of the bulk material.

The platform can be integrated into existing monitoring systems, substantially improving their efficacy. It can also replace them altogether, even on older storage structures, with minimal retrofitting.

New technologies and sensors can easily be integrated into the device.

"We needed a device that we could test rather than a crude prototype. We were working to tight budgets, so winning the competition would give us the money and help needed to develop the product."



Lorenzo Conti, founder and Managing Director of Crover, explains the genesis of the technology, and the decision to apply it to grain storage.



Where did the idea for Crover come from?

The idea came from my PhD studies at The University of Edinburgh. I was getting towards the end of my project and had a hunch, so I ran some simulations and started doing some experiments in my flat using a box of sand. These experiments not only showed what I hoped might happen, but exceeded my expectations in showing aspects of a physical effect that we like to call the 'Crover Effect'. In simple terms, if you take a symmetrical object like a sphere or a cylindrical body submerged in granular media, rotation is enough to make it move. Due to the success of my experiments, I ended up changing my entire PhD thesis.

At this stage, I didn't think about turning this into a business; however, someone at the University suggested I talk to the start-up and spin-out advisory team. After speaking to an advisor for

about three months, it became clear that the logical thing to do was set up a business to develop the idea. It was an "okay, I've got to do this" moment. If I didn't do it, no one else would. However, after 12 months of working on it, I realised I needed help, especially as I was a theoretical engineer and had no experience building things, especially robots.

Why chose grains as a focus for the device?

The idea came from my work on granular materials, which includes grains. The original idea was to build a CROVER to explore and take samples on Mars or other planets. Although this application is different, the technology is essentially the same.

Initially, I came up with a long list of applications where the technology could be used. Most industrial applications I'd seen were in handling solids or powders for the chemical industry. The university helped me access professional advice to analyse the different commercial applications I'd identified, and the grain storage CROVER came out as the strongest. I didn't have a background in farming, other than that my grandfather used to sell tractors in the north of Italy. I initially talked to farmers but quickly realised that the primary target audience were grain merchants, cooperatives and port operators who own centralised storage facilities. This is because they store more grain, and for extended periods, giving them a compelling business reason to invest in our solution.

So, what sort of challenges were those grain merchants facing that you thought you might be able to help with?

The biggest challenge is the deterioration in grain quality while in storage. We had all sorts

of stories from people who thought everything was fine, then suddenly everything was spoiled and they had to throw it away. There's a big gap where grain storage operators are identifying problems too late. We wanted to develop a solution that ensured what went into silos and sheds was the same quality when it came out. One of the other challenges is around health and safety. The standard way to monitor the grain is manually, either with probes which are used to take samples and direct measurements at various points, which can be dangerous, or with static probes, which have limited reach and don't always reflect the actual condition of the whole grain bulk. And in some silos, you can't do these sorts of tests at all.

Was sustainability something you were thinking about when developing the CROVER device?

I had our initial list of potential applications for the device. However, I was also thinking about its social and environmental impact. When I thought about how it might impact grain storage, it knocked all the other ideas out of the park, especially as grain is so fundamental to our diet worldwide. So, from a sustainability perspective, it felt like the right choice.

What challenges were you facing before you won the competition?

We'd got to the stage where we were trying to determine who had the manufacturing expertise we needed for the uniquely designed parts of the device. We were trying to figure out who we could work with to get the support we needed.

What was the driver for entering the MCAM challenge?

We were trying to finalise the choice of materials

and manufacturing process, so it was perfect timing. We needed a device that we could test rather than a crude prototype. We were working to tight budgets, so winning the competition would give us the money and help needed to develop the product. There is a lot of support for biotech and fintech in Scotland, but not so much for hardware.

How is MCAM helping you develop CROVER?

We are still at the early stages, but MCAM will be testing different materials for us. Although the device will be 3D printed at the start, they are also looking at how to produce it using injection moulding. To test it in grain silos, we also need to ensure it's compliant with UK guidelines and the required certification, which comes with tight design requirements. MCAM bring a lot of expertise to the project that we simply don't have.

How has the business developed?

The most challenging thing at the start was trying to do everything on my own; building a team of people has shown how important it is to work with others. We are now 24 people, including interns.

What does success look like for you now the business has won the challenge?

For now, it's about completing the pilots, then getting the first commercial unit out there and signing a deal. Next, MCAM will help us scale up production cost-effectively for the different stages of growth. Then they'll provide us with the materials, manufacturing, supply chain expertise and initial production runs of the device. So unlike other accelerators and competitions, MCAM is offering something entirely different.



Circularise

BACKGROUND

Circularise facilitates a shift to a circular economy by digitally tagging and tracing materials across complex supply chains. It helps suppliers make information about materials easily accessible to customers and regulators, without risking confidentiality or sharing sensitive or proprietary information. It also enables sustainable practices on an unprecedented level. The company was founded by Mesbah Sabur and Jordi De Vos in 2016.

AIM

Circularise strives to improve transparency and traceability across complex supply chains, enabling a shift towards a circular economy.

WHAT DOES IT DO?

Circularise uses blockchain technology to deliver end-to-end supply chain traceability. It allows brands, suppliers and manufacturers to choose sustainable, reusable and recyclable materials and provide information about products and their supply chains transparently, without risking privacy.

SOLUTION

Circularise provides a standardised protocol for products and materials that creates an ecosystem of connected supply chains and data that can power the circular economy.

It ensures that no one participant has control over the data in the blockchain, with everyone incentivised to do the right thing for the benefit of the entire network.

BENEFITS

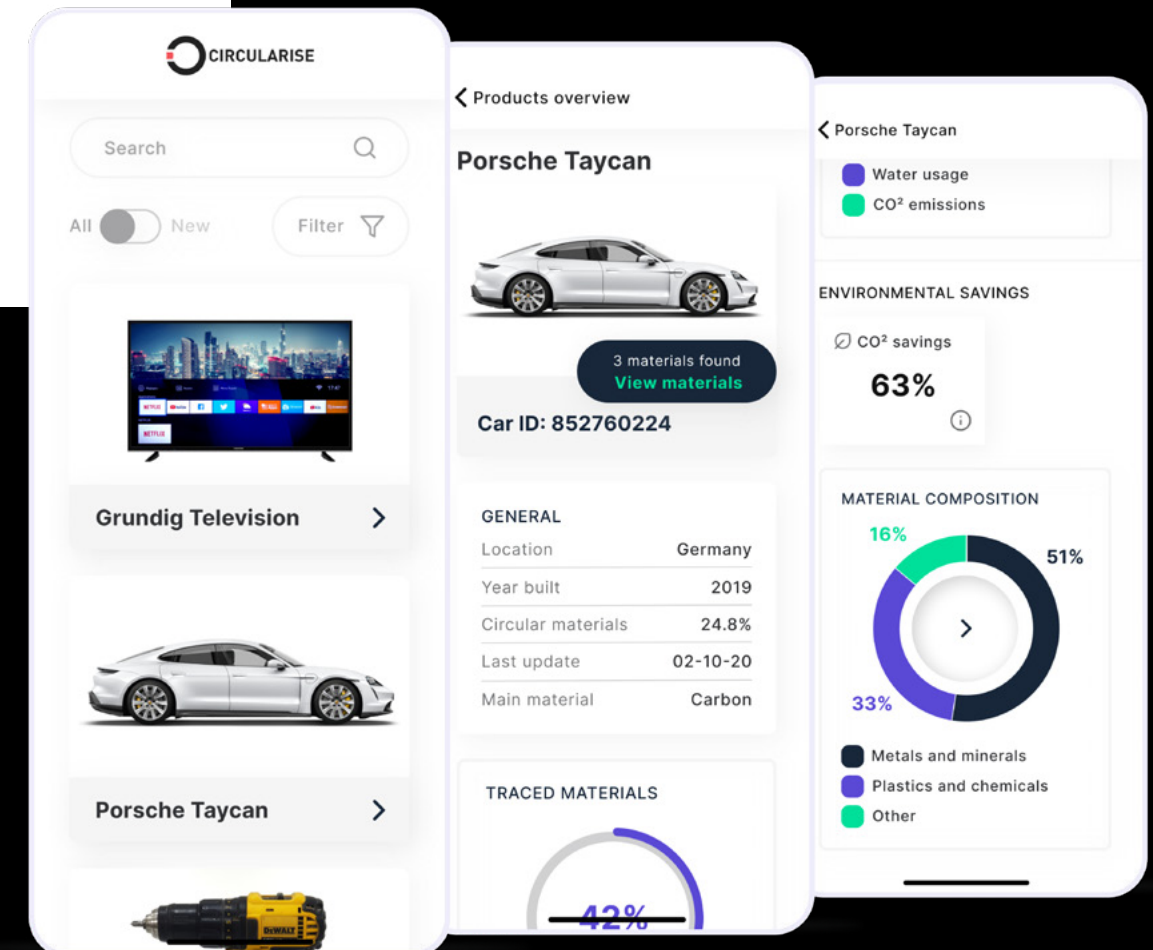
Brand owners and OEMs gain access to reliable and credible sustainability information based on third-party audits and certifications traced via the blockchain.

This means they can track their CO2 footprint and other sustainability metrics to an unprecedented level of detail.

Manufacturers and suppliers can increase the value the offer by tagging materials and making them traceable across the supply chain.

Companies can improve their compliance with circular economy policies and regulations.

“We also faced the challenge of operating at the forefront of two industries – blockchain and the circular economy.”



We talked to *Mesbah Sabur*, founder of Circularise, about where the journey started.



Everything started in earnest six years ago while I was studying for my master's degree at the Delft University of Technology in the Netherlands. I first discovered the circular economy as part of the industrial product design degree course, where we had a module on sustainable design engineering. I was sold on the idea of the circular economy; it was a concept that made a lot of sense to me, and I was eager to learn more.

In 2016, I eventually decided to do my master's degree. The aim of my thesis project was to work out the issues surrounding the circular economy and then do something about them. One of the biggest challenges was the lack of transparency and the communication infrastructure around

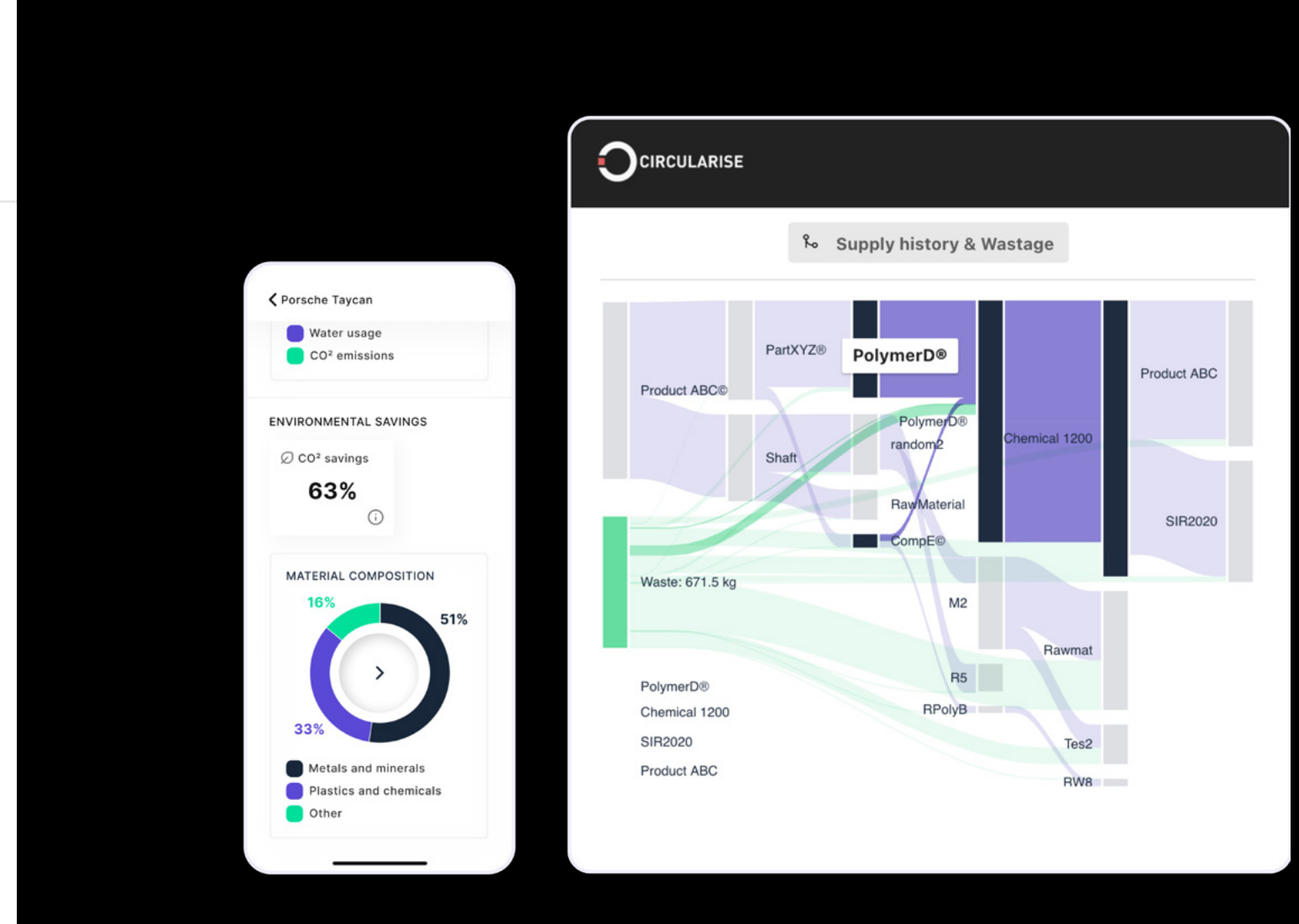
supply chains. The data relating to it are usually scattered everywhere and not shared. This creates all kinds of barriers to circularity and then recycling and reintroducing materials back into the economy. There was certainly no solution back then. But I knew that if the puzzle could be cracked, it would accelerate the circular economy.

Where did the idea of using blockchain come from?

The idea was something I developed with my co-founder Jordi De Vos, who had also studied at Delft. It was mostly a reaction to a conversation we'd had. The first idea we had was 'let's build a software platform that can enable companies to share data'. But one of the first issues you get into is around trust. We also realised that you have to do this at scale, which creates all kinds of problems around privacy and confidentiality. So we needed to look for a solution that would enable more confidence, decentralisation and independence, hence blockchain.

Could you tell me a bit about the journey from coming up with the idea to developing it into the business it is today?

Two things were really important for us back then. First of all, before graduating, Jodi and I were part of an accelerator program called YES!Delft. We started with the idea and, by the end of the programme, we had a business plan. We were learning the most basic stuff around entrepreneurship; how to hire people, develop a business model, write a business plan. It forced us to think about some of the basic building blocks of Circularise. Then, through my mentor back in the university, the business plan we wrote was presented to the Europe Institute for Innovation and Technology, which is part of the European Commission. They decided to fund us, and gave us a €50,000 grant.



What were the biggest challenges you faced once you'd received funding?

There have been quite a few challenges. The biggest has been surviving in a market unprepared for our product and what it can do. At first, the only question most companies had was, what is blockchain? Luckily for us, that narrative has changed considerably. We no longer have to explain it in detail. But back then, people weren't prepared for it.

We also face the challenge of operating at the forefront of two industries – blockchain and the circular economy. Both are concepts that are still very new, with most companies still trying to grasp what they mean for them. We've also had to figure out the right markets to target and find a beachhead we could enter.

How did you go about finding your first customers?

We found one of our first customers by pure luck. Three years ago, we went to CES, the consumer electronics show in Las Vegas, and that's where we met our first client. One of their team passed by our booth and heard us present Circularise. It was a light-bulb moment for him as this was something they had been thinking about. He even

had a slide on his laptop that was almost identical to what we presented. It was a mixture of luck and good timing. We are now working with 15 to 20 companies in the chemicals and plastics sector. We're also working with Porsche on an exciting new project which will allow owners to track some 30,000 parts in their car.

What makes companies buy into your offering?

Our ability to preserve confidentiality. Everybody wants to enable transparency, show more data, and show what's happening across the supply chain. But nobody wants to do that at the cost of reduced privacy or confidentiality. We've found this is incredibly important to our clients in the plastics and chemicals industry, which explains why they are so interested in our offering.

What does the roadmap for Circularise look like moving forward?

This year we'll be transitioning major companies towards a production environment, especially as it's still early doors for most businesses. Our goal is to get all the systems fully automated for our existing customers. Next year will mostly be about integration. In the medium term, it's mostly about seeing how we can develop different integrations and data points.

CONCLUSION



Tim Vorage
Founder and Manager
Growth Garage

Working alongside these passionate teams and seeing them grow, is an inspiring experience for our MCAM colleagues. Supporting these innovative companies is as rewarding as it can get. It generates new ideas, sparks the passion among our engineers, creates an open innovation culture and contributes to accelerating the implementation of the Circular Economy. You could regard Growth Garage as a startup itself and that's also probably why we are able to identify ourselves with the journey and challenges that the participants of the Engineering Challenges go through...and also very much understand what kind of support they are looking for. As a next step, we will further invest in our capability to be an interactive platform for these companies to connect with other innovators and established companies that might be interested in what they have to offer. We are thrilled to continue our journey and can only imagine where it will go.

To find out more about how you can take part in the next MCAM Growth Garage challenge go to growthgarage.mcam.com

“To meet the challenges
of tomorrow we have to
nurture the visionaries
of today.”

Tim Vorage

