

stars insights: 28 June 2019

**Founder & CEO of Forbes Japan's Start-up of the Year 2019 on
How to Clean Up Earth's Orbit**



*More than 7'500 tons of space debris whirl around in low earth orbit. Although this debris poses significant risks for future space missions and communication satellites, their removal continues to be a challenging task – for technical, financial, and institutional reasons. **Nobu OKADA**, Founder and CEO of Astroscale, explained at the stars Singapore symposium 2019 why cleaning up the orbit is an essential service for aerospace industries and at the same time a promising business opportunity. The interview was conducted by stars alumnus Prof. Dr. Christian VON LUEBKE, Professor for Southeast Asian Studies at HTWG Konstanz, Germany.*

Christian VON LUEBKE: Why is space debris a growing threat for future space projects?
Nobu OKADA: The density of space debris has reached a critical level. Today more than 34'000 pieces of debris over 10 cm in size soar across low earth orbit. Most of them are traveling at high speeds of 7 to 8 km per second. At this speed and density, potential collisions pose a considerable risk for current and future satellite operations. This is a growing problem for global communication, forecasting services, and defence industries. There is a consensus in the space community that we have to remove the debris now. But so far nobody was able to do this.

What motivated you to take on this challenge and to launch Astroscale?
When I was fifteen years old, I participated in a NASA space camp and I had the opportunity to meet Mamoru Mohri, the first Japanese astronaut to join a US space shuttle mission. Mohri-san was a source of great inspiration. He told me that space was awaiting my challenge. But he also explained that there was no blueprint of becoming an astronaut and that I should master something else first before pursuing my astronaut dream. I totally forgot about space for some years. I graduated from the University of Tokyo, where I majored in genetics. After graduation, I worked for the Ministry of Finance in Japan. In the

late 1990s, while Japan's economy was struggling, the Ministry gave me the opportunity to pursue an MBA degree at Purdue University in the United States. Contrary to Japan, there was strong optimism in the US economy. Every weekend some of my MBA colleagues would leave to start up their own companies. After completing my MBA, I worked at McKinsey & Company and also, eventually, launched my own IT companies. One was successful, one failed. And then I turned 39 years and experienced a midlife crisis. What do I want to achieve in my forties? At that time, I recalled the encounter with Mohri-san and his handwritten message: "space is waiting for your challenge". Maybe my dream was in space. I attended a couple of space conferences to get an overview of the hot topics. I was initially imagining moon missions, Mars explorations or the construction of new rockets – but I realized that space debris was a key issue. My plan to launch a space debris removal company was met with scepticism. Experts in the space community warned me that a start-up could not handle the financial and technological risks – unless you're a millionaire, they said. Many people told me that there was no market and that space agencies had long conducted trials with limited success.

What makes space debris removal so difficult? What are the key challenges?

Cleaning up space is difficult for several reasons. It is hard to find technological solutions that are cost-efficient. Debris removal is technologically challenging because target objects travel at high speeds and with complex rotation patterns. This makes it very difficult to approach and to dock with them. So far, none of the existing programmes has accomplished a reliable removal of space debris. They also tend to be very expensive, because they involve heavy constructions that consume large amounts of rocket payload and fuel. Another constraint is the absence of clear governance standards or bodies in space. International regulations are still developing. This institutional uncertainty adds to the challenge of developing technological solutions and viable business models.

How did your start-up cope with these technological and economic challenges? How did Astroscale manage to take off?

When we launched Astroscale in 2013, there was no market for space debris removal. But that did not trouble me. It was good news. In the IT industry, the market was filled with hundreds of competitors chasing after a piece of the pie. A non-existent market implies large opportunities. No competitors. It was a blue ocean. I did not know the exact timeline, but I was determined to search for a solution. The issues and challenges were clear – I knew I could do this. For a cost-efficient and innovative solution, we needed to identify the right technology and the right people. Today, Astroscale receives many CVs from all over the world, but at the outset I had no idea how to create a great team. I read many space journal papers and visited space conferences. I would attend talks, approach people, bow, and ask them to join the team. Technologically, we split the problem into different parts and worked on the solution one by one. We started with our own research. We assessed the projects again and again – at a fast pace – that's why we are here now. There is no magic involved – but because we verify and demonstrate our technologies, governments are now also convinced that there is a way to solve this problem. Pieces of space debris are flying at 28'000 km per hour. The first challenge is to approach target objects and establish a rendezvous point at a relative speed of zero. This is very difficult – also because objects are tumbling. Hardly anyone has achieved this before. Our satellites synchronize the motion and "dance" with the object. They apply an adhesive technology, dock with the debris, apply the right amount of thrust, and bring it down to the atmosphere to burn. Our satellites have little in common with normal satellites, so we had to develop the technology from scratch. We succeeded in constructing a removal system that is

smart and cheap. Astroscale's satellites are very small and weigh only 170 kg. This cuts costs and makes our solution more feasible for debris removal.

How did you secure financing for developing your services in space?

To start this company, I first had to reach an agreement with my wife. I then used USD 200'000 of our private savings as starting capital. I then received initial funding from different Japanese angel investors. We succeeded in demonstrating our project and received USD 7.7 million. I did not know these investors beforehand. I drafted a short list, made appointments, and convinced them. These initial investments made us work hard on our projects and facilitated the basic ideas and processes. Based on these gradual developments, I could proceed and apply for additional funding. It is a stepwise process. Every fifteen months we had a fundraiser. We demonstrated something, raised new funds, demonstrated something, raised new funds – things have been developing steadily. Gradually, we are also receiving more government and institutional funding. Recently we have made a lot of progress and raised more than USD 130 million in capital. But eventually our goal is to sustain our operations by convincing satellite operators and other transnational players to pay service fees. Similar to an insurance model, our customers will pay contributions for our efforts to clean up space and reduce collision risks.

Looking ahead, what are Astroscale's upcoming challenges and prospects in the aerospace market?

The current and upcoming challenge is execution. We have to deliver solutions to our customers. In 2020, we will launch an End-of-Life Services by Astroscale demonstration (ELSA-d), a pioneering mission in the space debris removal field. Last year two new competitors in the US and Europe entered the market and have taken a similar technical approach. I interpret this as a success. Our investors are reassured that there is a market and that our business model is working. For future execution of our projects we need to secure good people. Currently we have 76 people in our team – three quarters are engineers. We will expand to 200 people in the future. Apart from the technical competencies, the people at Astroscale are passionate about our mission. The typical space company does everything. But our focus is debris removal. Our team is unified by the purpose of cleaning up space. Prospects in the near future include end-of-life services for newly emerging satellite constellations. Large transnational players – such as SpaceX, OneWeb, or Samsung – are currently building up and launching constellations that entail up to thousands of connected communication and internet satellites. These constellations will require removal and replacement services to keep the networks operational. We envision large business opportunities in this field. Overall, there is a long journey in front of us but we continue to move forward and are determined to find innovative solutions.

Nobu Okada is the Founder and CEO of **Astroscale**. He is a Fellow of the Royal Aeronautical Society and the International Astronautical Federation. Prior to launching Astroscale, he worked for Japan's Ministry of Finance and McKinsey & Company. Nobu has served at the Civil and Industrial Space Subcommittee of the Japanese Government and joined the class of technology pioneers at the World Economic Forum. Since its launching in Singapore in 2013, Astroscale is continuously expanding its operations. Nobu and his team were recognized by Forbes Japan as "Start-up of the Year 2019". Astroscale has raised USD 132 million in capital to date and collaborates with the European Space Agency (ESA) on issues of space debris monitoring and removal.

The views expressed here are solely those of the interviewee and they do not necessarily represent or reflect the views of the stars Foundation.

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