

## **Tech Reimagined – S03E37 – A CLEANER RACE TOWARDS THE STARS**

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Announcer: Tech Reimagined, redefining the relationship between people and technology. Brought to you by Endava. This is Tech Reimagined.

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Bradley Howard: Hello, and welcome back to Tech Reimagined. I'm Bradley Howard. I'm glad to welcome you to the latest episode of our show. We're now full steam into season three, in which we explore how technology is influencing the fabric of our society, how we live, the way we work, and how we do business. Every Thursday, we're lucky enough to have the chance to sit for half an hour or so, and learn from some of our interesting personalities that we invite on to the show from the technology and business industry. And speaking of interesting personalities, we're glad to be able to introduce you today to David Wade. He's the space underwriter for the Atrium Space Insurance Consortium, ASIC. Hello David. How are you today?

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David Wade: Yeah, very well, thanks Bradley. Thank you.

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Bradley Howard: Welcome to the show. Would you like to give a bit of a background into where you've come from, what you do now?

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David Wade: Yeah, sure, sure. So always been fascinated in space since I was a small boy. Always wanted to get involved in space. Studied aerospace engineering, satellite engineering at college. Worked in the satellite industry, taught satellite engineering for a few years. And for the past 23 years, I've been working in space insurance, originally for a company called Marham. But in 2007, I set up the Atrium Space Insurance Consortium, which is a consortium of nine Lloyd Syndicates who have delegated their underwriting of space risks to me to underwrite on their behalf. So I typically ensure the launch and in-orbit phases of a satellite life for those nine Lloyd syndicates.

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Bradley Howard: Well, welcome to the show. Today's subject is going to be about the sustainable future of the space economy, so that we can have a cleaner race towards the stars, I suppose. So from an insurance perspective, what are the main challenges associated with sustainable space exploration? And how can it be addressed?

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David Wade: The biggest challenge right now is debris and the number of objects, particularly in low Earth orbit. So the majority of satellites that we are ensuring are in geo-stationary orbit, 36,000 kilometers above the Earth. And at that distance, all of those objects go around the Earth at the same speed as the Earth's rotating. So they tend to travel in the same direction, at the same speed. The story in low Earth orbit is very different. Low Earth orbit up to 2000 kilometers above the Earth's surface, and we've got thousands of objects in low Earth orbit. The number of satellites that have been launched has doubled in the last 24 months. We've now got 6,000 active satellites, 30,000 pieces

of debris all floating around, the majority of them in this low Earth orbit. And at low earth orbit, satellites are going around the earth every 90 minutes, traveling at seven kilometers a second.

And all of those orbits, they're orbiting in orbital shells. So think of the layers of an onion. They're orbiting at a particular altitude, but a lot of satellites are crossing over near the poles, in particular, crossing orbits. And so we see a lot of conjunctions where satellites come very close to each other, where satellites have to maneuver out the way of each other. They have to avoid pieces of debris coming their way and that type of thing. And that's a major issue for the industry. For many years, space was just seen as big. You could leave your satellite at the end of its life and not worry about it. But with the number of satellites now being launched, SpaceX has launched over 3000 Starlink satellites now. With a number of satellites like that being launched, we really, really do have to worry about the low Earth orbit environment now.

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Bradley Howard: Are there any regulations in place that ensure companies can literally clean up after themselves?

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David Wade: The regulations that govern space are from the United Nations treaties that were written in the 1960s and 70s, but they were more about the registration and who is responsible. So the liability treaty does at least hold who is responsible, but if two satellites collide in orbit, you have to prove who was at fault. Those UN treaties then come down through local licenses, licenses that the launching state would provide to the satellite operator. And some of those licenses start to impose, not so much regulations, but certainly guidelines. It's more gentleman's agreement at the moment. There is a document called the Interagency Debris Mitigation Guidelines. And this was NASA, the European Space Agency, the UK Space Agency, Russian Space Agency, Japanese Space Agency, all coming up with some recommendations as to what a good satellite operator should do to look after the space environment. And the recommendations that they came up with were things like, at the end of a satellite's life, it should be de-orbited within 25 years.

It should be left in a position so that within 25 years, it naturally decays, that orbit naturally decays, and the satellite burns up in the atmosphere. At the end of the satellite's life, you should passivate it so that if there was any pressure vessels, say a fuel tank or a battery that had a fluid inside that would boil over a period of time. You should leave the valves open so that that fluid, that gas, escapes from the tank. We have seen situations where fuel left in fuel tanks has boiled over a period of time, built up the pressure inside the tank, and then it's exploded and caused a shower of debris. So there were those guidelines that were written, but they are just guidelines. There's no threat, there's no fine, there's no punishment if you don't work to those guidelines. The only threat really is that you might not get a license from the local operator next time around.

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Bradley Howard: It's just astonishing doing some research for today's episode that we recognize some of the litter that we've put into the oceans and land on Earth. And the same is going on 200 kilometers above our heads as well from scientists that we would expect a slightly better behavior from, I suppose, that we can handle that. So are there any technologies that are being developed to clean up after the space debris?

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David Wade: Yeah, absolutely. I mean, it is an issue that is now being taken very seriously. I think with the launch of 3000 Starlink satellites, 3000 Kuiper satellites from Amazon coming along in the next few years, and all of the other launches that are taking place, this is certainly an area that's been looked at very strongly now. So yeah, one of those solutions is technology to reduce the amount of debris. And there's a few companies working in that area. There's a joint British Japanese company called Astroscale. They've had one mission to date called ELSA-d, which was a demonstration to remove a piece of debris, active debris removal. They have some further missions that are planned where they are going to try and remove one of the upper stages of a Japanese rocket from orbit. As well as maybe some of the old OneWeb satellites when they fail.

There's a Swiss company called Clean Space, which is trying to do a... Clear Space, sorry, which is trying to do a very similar project. They're working on a satellite due to launch in a couple of years time, which will go and capture a piece of debris and remove it from orbit.

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Bradley Howard: So in my mind, I'm thinking like James Bond Moonraker, where there's this (inaudible) comes out with claws, grabs it, and then what does it do? Send it to the sun or to our own atmosphere?

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David Wade: Yeah, back into the atmosphere of the Earth. Yeah. So, yeah, I mean, Astroscale uses a magnetic capture plate. The drawback of that is that you need to put a magnetic plate on the satellite to be captured prior to launch. So if you're going after a particular, say, a OneWeb satellite that's malfunctioned, that OneWeb satellite would have to have the magnetic capture plate installed on it prior to launch. That it's ready to accept the Astroscale satellite when it fails. But the Swiss idea, the Clear Space Swiss company, they've got a spacecraft with four tentacles. Just like an octopus that will go up behind a satellite of any shape and then sort of close in and capture it within its claws, within its tentacles. And then yes, will then fire a rocket motor to drive the captured satellite back down towards the atmosphere.

It's hoped in time that some of these satellites will be able to capture a piece of debris, send them on the way back in towards the atmosphere, but then release the debris and back up and go and capture another piece of debris and do the process again. And maybe remove a few pieces of debris with a single active debris removal satellite. The other thing that's being done to reduce debris is, a couple of satellites called Mission Extension Vehicles, which have gone out to geo-stationary orbits of 36,000 kilometers above the Earth and docked on to the back of an aging communication satellite. So a communication satellite that was running out of fuel, about to be retired but was still providing a good service, was simply come to an end of its life because it was running out of fuel. So these two Mission Extension Vehicles have gone out and docked on the back of those satellites and have taken over the propulsion of those satellites and allowed those satellites to continue their service for another five years.

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Bradley Howard: Wow. And what about on Earth then? Is anyone looking at sustainable fuels or renewable energy? I guess we're quite far away from electric motors for launching rockets, but is anyone looking at the sustainability side that, of the actual launches?

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David Wade: There's certainly talk about green propellants. I think, yeah, you're right. We're a long way from any alternative technology. There has been talk about space elevators, but we just don't have the materials with sufficient structural integrity at this stage that we could build a space elevator. So for a long time to come, we will be reliant on rocket engines. But what we're looking at is propellants that are less carbon intensive or have less carbon. And a lot of rocket propellants are liquid oxygen, liquid hydrogen. So they're relatively clean already, producing water vapor. Some are moving away from kerosene towards methane, or liquid natural gas. Not great from a greenhouse point of view. I mean, methane's not one of the best greenhouse gases. But I think keeping it all in context, satellite launches a very small number. I mean, we're talking, I think last year, 186 launches.

Each launch probably carries a similar propellant load to a large aircraft, maybe a bit more. But the use of launches pales into insignificance against other sectors or other industries such as aviation and marine, even automotive. Because we're only talking sort of a couple of hundred launches a year at most.

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Bradley Howard: And in terms of materials, I would imagine that SpaceX with its reusable rockets is good for the environment.

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David Wade: Yeah, it is a kerosene... I mean, it's liquid oxygen kerosene, so it does produce carbon as part of that process. Being reusable means that you have to retain some propellant for coming back down and landing. So it's a little bit less efficient than some of the other launch vehicles, in terms of having to carry that additional propellant load. But the fact that you're reusing that rocket over and over again, certainly yes, must have some beneficial effect for the environment overall. Absolutely.

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Bradley Howard: So when you talk to the manufacturers, because you get really involved in the core design of satellites and other space vehicles, is sustainability ever discussed?

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David Wade: Yes. Yes, absolutely. I mean, ESG is so important for practically every sector right now. And I think every company is wanting to show its credentials in terms of ESG. I mean certainly the insurance sector is, and most of the space companies are. So yes, sustainability does get discussed. Within the UK, there's a very big push on sustainability for space activities now. The Science Minister, George Freeman at a conference last year announced a very big program that the UK wants to really put sustainability of space at the forefront of its licensing activities. So the UK, France and the US are really leading those initiatives right now. And as part of that licensing process, they will probably require much more evidence to show what you are going to do at the end of the satellite's life and how you're going to control it. One of the things that we're working on, Lloyd's has been deeply involved in, is an initiative that was started by the Earth and Space Sustainability Initiative or projects started by them. Looking at how we can make space more sustainable.

And insurers have had their input into that process to suggest ways that we think the regulations should change to try to recognize the good citizens. To try to recognize those satellite manufacturers, those satellite operators that are going the extra mile in terms of looking after the environment. So that's not only things like de-orbiting at the end of life and much more quickly than the 25 years that the current guideline has. I mean five years is becoming the new standard. Passivating satellites at the end of the life so that

they don't explode. But also considering the orbit that you're going to use. If you have a satellite that only needs to be in orbit for 12 months to demonstrate a piece of technology, do you really need to go to a 600 kilometer orbit, which might then take 25 years to drift back down and reenter the atmosphere?

Maybe you should be limited to going to 400 kilometer orbit, and then you've got your 12-month mission lifetime. Once you've proven that capability, the satellite should reenter naturally within five years, even if something goes wrong, just from the drag force acting on the satellite. So there's some initiatives like that that insurers have been heavily involved with trying to get these standard approaches. And I think the hope is that, if the UK is seen to take these ESG initiatives seriously, that will attract extra investment to the UK, attract extra operators to the UK. Because the insurance will be available, the investment will be available, and it will make the UK a real center of excellence when it comes to space sustainability.

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Bradley Howard: We have the situation recently where one of the, I think it was a Russian spacecraft, was docked with the International Space Station, and I think that was hit by maybe some space debris which rendered that unusable. Which is as though the concepts of being hundreds of kilometers above the Earth isn't scary enough, the fact that you've got no escape pod is just even more frightening. But are there any other consequences of just more and more space debris and space junk flying around? I mean, is this the first time that it's ever really impacted a human up in space?

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David Wade: Well, I mean certainly the astronauts on the Space Station occasionally have to take cover because a piece of debris is coming their way.

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Bradley Howard: When you say take cover?

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David Wade: Well get into their return capsules just in case. So it does happen occasionally that they're told to go and sit in the capsule just in case the station gets hit. And the station does get maneuvered quite frequently out of the way of debris. So yeah, it's constantly being tracked by the US Air Force, as well as a number of commercial providers these days. And those warnings are issued to try to make sure that everything remains safe. But there are millions of pieces of tiny, tiny pieces of debris that can't be tracked, traveling at seven kilometers a second that do pose a real threat. Yeah, it's a constant worry and it's getting worse. And I think what initially started off with a number of spacecraft, we're now into a whole scenario of debris colliding with debris, creating further showers of particles.

So the particles are getting smaller and smaller. It's like the plastic in the ocean breaking down into the smaller particles. We're in that process now. And I think no matter what steps we take, the situation's going to get worse for the next probably 10, 20 years. We're already in that position where things are going to get worse before they get better, but we have to start somewhere. And with the recent number of satellites being launched, I think we really need to start taking this seriously at this point in time. And I think the UK is doing a good job, trying to lead from the front in that regard.

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Bradley Howard: Final question slightly off the main topic here. If graduates are leaving university this year and thinking, "Ah, this is just so inspirational, David, I'd love to follow



in your footsteps in the industry." Are you finding lots of new people coming in to the industry?

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David Wade: I think the interest that the UK's put into space over the last 12 years or so, in 2010, there was a project called the Space Innovation and Growth Strategy. And it was a government-led project, took people from all over the space industry to put together a 20-year strategy as to how we could grow the space business in the UK. And I think we're starting to see the results of that. We're starting to see lots of startup companies come to the UK, bits of seed funding from UK government to attract those companies. And so there's a lot of opportunities there. Certainly many more than when I was leaving college. And if I've managed to make a career out of it, I think the opportunities today are significantly greater. There are a number of placement schemes, which the UK Space Agency runs a summer placement scheme, so for graduates. So I would certainly encourage people to look up those counter schemes and try to get some great work experience before they even leave university.

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Bradley Howard: I wonder if there's a whole load of parents listening to this podcast right now thinking, "I'm definitely going to sign my child up for those courses." David, thank you so much for sharing some time with us. It was such an interesting conversation, just hearing about space and sustainability. If people want to get in contact with you or they've got any further questions, David, what's the best way of doing so?

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David Wade: Yeah, I'm on LinkedIn, so you can look me up on LinkedIn. Or alternatively look me up through the Atrium underwriting webpage or the Atrium Space Insurance Consortium webpage, and you'll find my email address there. And yeah, look forward to hearing from people. Thanks, Bradley.

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Bradley Howard: Thank you very much. So all of our listeners, if you found this episode insightful, really hope you did, then please spread the love and share it with your network. Or just follow us on any of the major podcast platforms. We're always interested in your feedback, so please either go to [endava.com](https://endava.com) and click on the contact button, or you can contact us at Endava on pretty much all of the major social platforms. Until next Thursday, I'm Bradley Howard, and this has been Tech Reimagined.