

## **Tech Reimagined – S03E35 – NAVIGATING THE RISKS OF NEW TECHNOLOGIES IN SPACE INSURANCE**

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Speaker 1: 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 and 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 are lucky enough to have the chance to sit for half an hour or so and learn from interesting personalities from the technology and business industry. 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 or ASIC. Hi David, and thanks for accepting our invitation. How are you today?

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David Wade: Yeah, I'm very well, thanks, Bradley. Yeah, really good to speak to you.

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Bradley Howard: Can you explain a little bit about your background please?

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David Wade: Yeah, so my background, like a lot of Space Underwriters, my background is in engineering, satellite engineering in particular. I studied aerospace engineering, I did a master's in astronautics and space engineering. I studied at the International Space University and then worked for a couple of years in the space industry, taught satellite engineering for six years at Kingston University, and then for the last 23 years now have been in insurance, underwriting space risks.

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Bradley Howard: Well, let's get cracky on some of those risks. Today's topic is going to be about new technologies in the space insurance. So what type of technology related risks do you normally insure against?

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David Wade: So the usual type of risk that we would insure against is mechanical breakdown or mechanical failure, mechanical wear out. Imagine say the bearings in a motor not having sufficient lubrication, that would be covered by an insurance policy if those bearings stopped working and you could not use that motor any longer. Or an electrical short circuit, say a component in a printed circuit board has a short circuit and knocks out part of your satellite, that would be covered. But we also cover things like micrometeorite strikes, cyber incidences, we basically cover anything that happens to the satellite space, weather events, major outpourings of particles from the sun that charge up to the satellite, just about anything that you could think of is going to be covered.

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Bradley Howard: And how do you begin to determine the premium for a space insurance policy?

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David Wade: We now have lots of data, in the early days it was kind of stick your finger in the air and guess what the correct rate was, but yeah, satellite insurance has been around for a long time now, the market really grew in the 1980s, so we have an awful lot of history, which has allowed us to develop our models. Different underwriters take different approaches. For us, we use a Bayesian analysis, where we look at the historical record. So for a particular launch vehicle or a particular satellite, how many in the past have failed? How many have had problems? Historical record is all very well and interesting, but when something goes wrong, you learn lessons, you have a very steep learning curve in the space world. If a launch vehicle fails, you learn a lot of lessons that are applied going forward.

So for a new launch vehicle, it's very typical that we would see two of the first 10 fail, but after the 10th flight, you then usually get a very long string of successes because those lessons that are learned from those first two early failures go into the improving the reliability going forward. So with the Bayesian analysis, we look at the historical record, how many out of those launches that have already occurred have failed? But then we also try to use a crystal ball approach, you look at how many launches will take place before you see your next failure? Trying to recognize those lessons learned, so you use a series of merit factors. Examples, maybe quality control, the manufacturer's experience, those kinds of things. You use a series of merit factors to try and come up with a figure of how many launches you think will take place before you see the next failure. And then you combine those two into a single figure that gives you your technical rate going forward.

The technical rate is only one aspect of it, of course, we have to make margin on top of that. So then it's a matter of negotiation with the broker and what the market competition will allow to see how large you can make that margin.

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Bradley Howard: At what stage of the process are you then asked for a quote? Is it the original thought about doing a launch for something? Or is it quite last minute?

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David Wade: Yeah, all of those and more I think. I can think of one example where we were approached four days before the launch, and that's to provide insurance for a launch that was taking place four days later over a weekend, so that was a bit of a challenge, but that's unusual. Usually I would say typically 18 months ahead of the launch taking place, we are approached, so it's quite a long process. For a new satellite, we'd typically be invited to a presentation by the satellite manufacturer or the satellite operator. They would go through all of the details, and this is, as I say, typically 18 months ahead of launch, maybe even longer. We will then have a period when we can raise questions, get those answers, review those answers, ask further questions if necessary. And in parallel to that, the broker will be working with the client on the wording, all of our wordings will be bespoke. So the broker will be working with the satellite operator to look at those lost definitions.

And then we'll come out to the market and usually test those lost definitions with a handful of underwriters in the first instance and start the placement process, but all of that is typically completed, well, certainly 12 months to 18 months ahead of the launch. Typically, at the time that we're doing it, it is maybe 12 months ahead of launch, but we see so many delays that by the time it happens, it's 18 to 24 months between writing the policy and the launch actually taking place. In orbit risks, it's all compressed. In orbit

risks, we get a health report, so we're renewing a satellite that's in orbit, we're renewing it one year at a time for the 15 year lifetime of the satellite, typically 15 year lifetime of the satellite. And for those, we'll get a health report maybe a month before the policy expires. We'll review that health, have a chance to raise any questions, get those questions answered. And then, yeah, the whole process is compressed into about a month or so before the renewal takes place.

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Bradley Howard: With so few underwriters around the world and so few brokers, I'm assuming there isn't much churn within the industry. I wouldn't have thought a satellite is covered for 10 years by one underwriter and then it moves. Well, does it?

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David Wade: It does tend to move, the space market goes through cycles like every other sector of insurance. And particularly in 2022, we've seen a cycle where there was quite a lot of launches, but people were a little bit hungry for income because some people who used to write the Russian risks were no longer able to, some people did not go down the big launch placements that were placed. So losing that income from the Russian risks, for example, they were hungry for income, so then they started chasing every in orbit placement that was coming up to try and make sure that they replaced that lost income.

So you see that competition drives down prices, sometimes those prices go below the point at which you're comfortable. So there's a little bit of churn, but I would say most of the big operators they stick with their preferred markets, but as satellite values decrease, certainly as the lifetime goes on, a brand new satellite I launched might be 250, 400 million dollars, and then most of the market would have to be on that risk, but towards the end of the life, a satellite that's maybe getting down to 50 million dollars to a hundred million dollars, there's still sufficient capacity in the market to drive competition by the time you get down to 50 to a hundred million dollars, and that's seen rates reduce over the course of the last year for sure.

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Bradley Howard: Wow. Does the satellite owners have a no claims proof that you have for motor?

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David Wade: In some instances, yes, we do. Yeah, the insurance is exactly the same as every other classes of the insurance really, it's just the values that are involved are somewhat higher. In some cases we use a no claims bonus, those are usually instances where we have a slight difference of opinion on what the rate should be. Maybe an early flight of a launch vehicle or a particular satellite technology that we're not entirely comfortable with, comfortably enough to quote it, but can't quite get to the price that the client is looking for, so that final negotiation sometimes comes down to a no claims bonus. Okay, well, pay our price upfront, and if it goes clean, we'll refund the difference to you to get down to your price. That usually is then followed with a request from the broker to make it an additional premium. And they pay the lower premium upfront and pay the extra if they have a claim, but that's all part of the negotiations that go on, absolutely.

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Bradley Howard: Wow. And back to new technologies, with a few new man flights coming soon, there's landing on the moon again, and then hopefully Mars as well. How do you

even begin to price those? Because you can't use your Bayesian principles for that because the last man on the moon was so long ago, the technology, I assume, is completely out of date.

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David Wade: Yeah, absolutely. I'm not sure yet we'll be getting involved with the manned landings or the human landings on the moon. Certainly, we're looking at some of the technology that will be delivering payloads to the moon, so instruments to the moon ahead of those human flights. So there's a new program that NASA has called CLPS, Commercial Lunar Payload Service, where they're going to use commercial providers to deliver payloads to the surface of the moon, and some of those commercial providers will certainly be looking for insurance. And yeah, you're right, completely new concept. If we can, we would like to see demonstration flights before insurance gets involved. That's not always going to be possible, some of those early missions will require insurance.

And what happens in those situations is we look at the similarities to other satellites. So a lot of the technology that's being used will be similar to the satellites that are already in use. For example, it will probably not be a brand new rocket engine, that rocket engine has probably been used sometimes on satellites previously. It will probably not be new guidance systems, the guidance system will probably have been used on previous satellites. So we'll be digging through each individual system of the satellite to see where that technology's been used before and looking at how it differs from what has been done before, and that will start to form the basis of some rating. That said, it will still... that first mission landing on the moon will still be a brand new activity. And in most of those instances, if we are prepared to write it, we would write a much smaller line than usual.

So typically I'm writing 20 million dollars on an individual satellite. If there's an activity that I'm prepared to cover, probably at a significantly higher rate, I would reduce my exposure significantly on those early flights. Most people would take the same position and that drives down the competition, forces the price up, but on those early flights, we certainly don't want to be overly exposed to new technology. It's certainly, it's a criticism that's often leveled to insurers that we're not prepared to insure the early flights, but I think where we see the need, where we see how important something is, it is an aspect that insurers are prepared to get behind. I can think of an example a couple of years ago where a spacecraft called ELSA-d, which was to capture a piece of debris and remove it from orbit to demonstrate what's called active debris removal.

That was a commercial venture, came to the insurance market, insurers recognized the importance of what that company was trying to achieve, and despite it being the first attempt at active debris removal, there was enough insurers who were prepared to write a small line to get that insurance policy covered and get it in place for the client to allow them to go ahead and do that mission. So insurers will step up to the plate, but it takes quite a while. We need to get to know the client, we need to get to know the technology. We want to come along on that journey with the satellite operator, we don't want to be approached a month before launch. We want to be working with them for, I think in that case, three to five years beforehand, to really understand what they were trying to achieve, how they were developing their technology, how they were getting through those milestones, and really proving that that technology was going to work.

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Bradley Howard: So I'm not asking for anything confidential on this public podcast, but are you and the other underwriters in the space industry already looking at some of the really new technologies that are being used or designed for Mars?

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David Wade: Not yet, Mars is a little bit too far into the future for commercial operation, well, for insurance sector at the moment. And most of the Mars activity will start off with government missions, those will be European Space Agency, NASA, those kind of activities to begin with, so very unlikely to be insured at that stage. We have in the past seen the market has been approached to insure a spacecraft going to Mars in the past, that was probably a little bit too difficult for the market to accept at that time, it was a particularly new vehicle going to Mars, but then we have to look at what we can cover. So in that particular instance, if I recall, we offered coverage for the launch flight of the launch vehicle. So we covered the satellite until the point that it separated from the rocket.

So had the rocket not delivered the satellite to the correct trajectory, it would've been a valid claim. Had the rocket blown up during that launch phase, it would've been a valid claim, but once the satellite's separated from the rocket, then yeah, then they were on their own. So yeah, we have considered those kinds of things in the past, but with limited cover, let's say.

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Bradley Howard: Are there any space related activities that are not usually covered under policies? Asteroids, war, solar flares, how about aliens? Do you ever think about aliens in any of your policies?

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David Wade: No, we don't have aliens (inaudible) -

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Bradley Howard: That's a sweeping statement (inaudible) .

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David Wade: Yeah. Yeah, we don't have specific exclusion for aliens. We do cover most things, your mechanical wear out, electrical breakdown, space weather, if you get a big event from the sun, that can lead to one part of the spacecraft charging at a different rate to the other part or to another part of the spacecraft. So you might get an arc form between the two and get localized heating, which damages the satellite. So we do cover those kinds of things. Our typical exclusions are things like war, insurrection, strike and riots that might affect the ground station where the satellite is being controlled from, so those would be the typical type of exclusions. We do have an exclusion for anti-satellite weapons, which is probably quite a unique one in terms of insurance. We do, I think also sort of quite a standard exclusion in most insurance policies would be willful or intentional acts of the named insured, taking some action against the object that is insured.

But we do have one exception from that, which is the range safety officer. If the rocket starts to go off course, there is somebody sitting with their finger on a button that can detonate the rocket, so we do have an exception for that one person who can detonate the rocket if it starts to wander off course. Cyber was silent, we've had to introduce some language for cyber coverage in the past few years, it was something that was silent. So now cyber attacks are excluded, but cyber incidents, non-malicious incidents are continued to be covered. No aliens, I'm afraid.

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Bradley Howard: Right. Okay, there you go, there's an opportunity for a new line there. So has artificial intelligence started impacting space vehicles yet? Thinking (inaudible) guidance or anything like that?



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David Wade: Yeah, we haven't really seen it used yet. I think, again, small numbers to date. Lots of data analysis goes on in the background in terms of writing those software algorithms and things, but we haven't seen widespread use of artificial intelligence yet. I know some insurers are starting to look at what benefits can be brought in terms of using artificial intelligence to look at data sets, but it's such a small dataset. Only 300 of the 6,000 active satellites are insured, and they come from a wide range of manufacturers from different countries. Some information is restricted, export restricted, some information is just considered too commercially sensitive to be provided. So data is always an issue, and I always worry about sort of using a limited data set. Are we really getting the information that we need? There are some great data sources out there, there are companies that provide data on satellite anomalies, there's companies that provide data on space debris, monitoring space debris, and giving alerts as to when space debris might be coming your way.

There's companies that are trying to offer services looking at debris and trying to offer services that might be useful to insurers, how many objects are in a particular orbit? For example. (inaudible) you can use that as part of your rating assessment. I wouldn't say it's come into the rating significantly yet, by far the biggest factors that we have to deal with, the mechanical wear out and electrical failure, much more than debris or space weather events at this stage.

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Bradley Howard: None of the vehicle manufacturers are looking at AI for autonomous vehicles, is that such a thing for the navigation?

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David Wade: Certainly, there's some of the satellite operators are looking at autonomous collision avoidance. So the constellations, these large constellations of satellites like Starlink, where you are launching three thousand satellites to a very similar role, but there will be times of conjunction when two satellites are coming together. There'll also be times when debris happens to cross that orbit or another satellite wanders through that orbit. So there are periods where you need to take evasive action, you need to fire a thruster to maneuver your satellite out of the way of a potential piece of debris. And there are companies that are looking at sort of autonomous collision avoidance maneuvers. I think SpaceX has had some success with that to date. There's still a lot of inaccuracies around how close, a lot of inaccuracies about the orbits of a particular piece of debris. Significant amount of inaccuracy in terms of altitude and exact position of that piece of debris.

So operators are still taking a call, they might get a warning to say, this piece of debris is coming their way, but they're still taking a call as to whether or not it's worth maneuvering the satellite because the inaccuracy in that data is so large. I think in terms of using onboard sensors to detect that debris and maneuvering accordingly, I think we're in the very early days of that. Certainly companies are looking at it, not really convinced that anybody's achieved that kind of use just yet.

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Bradley Howard: Why is the debris field so inaccurate?

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David Wade: You're measuring that location of debris using ground-based radars. So you are using a radar signal, various radars dotted around the earth, sensing those objects, because I think just from the distances involved and the time scales involves getting that

radar information, there is a level of inaccuracy there. These objects are moving at quite a speed, they are not continuously tracked. They're picked up by a radar, say in the Southern Hemisphere, and then maybe two or three other hits during the course of a 90 minute orbit. So they're not continuously tracked, they're constantly trying to sort of match the object to the data. So I think there's a lack of accuracy in that process, but also there's an awful lot of objects up there that can't be tracked. We can only really track things that are larger than a tennis ball. So there's about 30,000 pieces that have been tracked, but there's millions of pieces smaller than that, which can't be tracked, which cause an issue.

And every piece in (inaudible), no matter how small it is, is traveling at seven kilometers a second. So even a tiny particle, a dust particle still carries a lot of kinetic energy should it hit something. There are certainly companies looking at improving the accuracy. So a company called LeoLabs is setting up new radars, higher frequency radars that will improve that accuracy, but with the technology that's currently in place, yeah, it's quite large inaccuracies associated with tracking the debris.

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Bradley Howard: Right. Well, thank you David, once again for such an interesting conversation about such an interesting topic. If anyone wants to get ahold of you, David, what's the best way they can do that? Are you on any social media?

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David Wade: I'm on LinkedIn, and yeah, have a look at the Atrium underwriting webpage or the Atrium Space Insurance Consortium webpage, and my email address is on there.

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Bradley Howard: Excellent, thank you. To all of our listeners, if you found this episode insightful, 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 any of the major social platforms. Until next Thursday, I'm Bradley Howard, and this has been Tech Reimagined.