

Tech Reimagined – S03E33 – INSURING THE SPACE ECONOMY: OPPORTUNITIES & CHALLENGES

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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 steaming to 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 an interesting personality from the tech or business world as our guest. And speaking of interesting personalities, we're really excited to introduce you today to David Wade, a space underwriter for the Atrium Space Insurance Consortium or ASIC. Hi David, how are you today?

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

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Bradley Howard: Well, before we jump straight into it, can you introduce yourself to our audience and let us know a bit more about your background?

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David Wade: Yeah, sure. So as you said, my name's David Wade. I'm the space underwriter with the Atrium Space Insurance Consortium. So the Atrium Space Insurance Consult Team or ASIC is a consortium of nine Lloyd's syndicates, who've delegated their underwriting for space risks to Atrium for us to underwrite on their behalf. So we have a \$45 million line that we can write on any satellite, any launch, or any in orbit satellite.

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Bradley Howard: We're looking forward to hearing more about this. So the subject of today's episode is the space insurance market and the changes in innovation that it's seen over the decades. So just a bit of positioning here. According to nature.com 2022 was a record year for space launches with SpaceX leading the way, by some way as a private company. So in light of this, can you share with us what are the key areas of growth and opportunity in this space economy and how insurance companies are positioning themselves to capitalize on these trends?

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David Wade: Yeah, absolutely. So the biggest growth areas are still with regard to satellite communications. Satellite communications has always been the most prominent use of satellites. Something like 50% of all of the satellites that are in orbit are used for communication purposes. And last year was no different. Last year the majority of satellite launches were for satellite communications. What has changed over the last few years is the way that we're providing those communications. Traditionally, satellites were used for broadcast communications more than anything, so satellite TV, but what we've seen recently is that satellite broadcast is declining. People want on-demand services now

rather than sitting down to watch linear TV at the time that it's broadcast. And what we are moving towards is those on-demand services. So the satellites are keeping pace moving from broadcast towards broadband or data services.

So what we've seen over the last few years is a lot more of those broadband or data type satellites being launched, still communication satellites, but providing data services rather than broadcast services. And in particular, constellations. So constellations of satellites are large numbers of satellites operating from a low Earth orbit, maybe only five to 1,000 kilometers up. The problem with satellites operating from that orbit is that they move with respect to the user on the ground. So if you are wanting a continuous service, you have to have multiple satellites to provide that continuous service as those satellites move around the earth. In the case of SpaceX and the Starlink service, they've now launched over 3,000 satellites to provide that continuous service using Starlink. And that's accounted for by far the majority of the launches in the last year.

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Bradley Howard: And each SpaceX launch is launching a few of the Starlink satellites, yeah?

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David Wade: That's right. So when they launch the Starlink satellites, they typically launch between about 40 and 60 satellites per launch, and then those satellites separate from the rocket and they take a few months to be then put into the correct position in orbit. But now we're up to, I don't know, 50, 60 launches of Starlink satellites, up to 60 satellites at a time. So a tremendous project, huge growth potential. Those satellites will be used, as I said, for data services. One of the drawbacks of using the traditional satellites that were in geostationary orbit, so geostationary orbit is satellites that are sitting 36,000 kilometers above the equator. One of the problems with using those satellites for data services is the time delay as the signal goes out to the satellite and back again. So by bringing those satellites much closer to earth allows those satellites to be integrated into the 5G networks and things like smart cities, driverless cars, and those kinds of services going forward. So that's where all of the interest and all of the growth areas are right now.

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Bradley Howard: And how does that affect the insurance industry then? Or how does the insurance industry work with space companies?

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David Wade: I mean, we're typically ensuring the launch of satellites and the in orbit phase of those satellites' lives. Now, traditionally, we've ensured satellites for the whole duration of their life. We've ensured them for the launch phase, and then one year at a time for the entire, usually a 15 year lifetime for a geostationary satellite. And that's been the space insurance market's bread and butter for the last 30 years. We've ensured those broadcast satellites, those geostationary satellites for their entire lifetime. What we're seeing with the constellations is that the operators are less interested in insurance. They're launching hundreds to thousands of satellites, and each satellite it's built on a production line. It's quite cheap to manufacture. So a lot of the constellation operators like Starlink, they're thinking about launching spare satellites rather than relying on insurance as a risk transfer mechanism. So what we've seen with the constellations is some are not buying insurance at all, and some are only buying insurance for the accumulation when those satellites are being launched.

So if you're launching 50 on a single rocket, you buy some insurance for that launch phase only. But once the satellite separates from the rocket, then the insurance ceases.

And at that point you rely on having those spare satellites in orbit to continue with the service, if any go wrong. So it hasn't necessarily been a great move for the space insurance market as the industry is developing, but that's something that we're having to deal with. We're looking at different types of cover to try and take that forward, to try and show that insurance still has a role to play, even with this latest generation of communication satellites.

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Bradley Howard: For the constellation satellites, heaven forbid they were to ever fall back down to earth. But they're within the atmosphere, aren't they? So would they break up?

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David Wade: Yeah, they're above the atmosphere. They're typically at 500 to 1,000 kilometers, but even at that height, you still get very tenuous reaches of the atmosphere. So you still get a drag force acting on the satellite. So over a period of time when those satellites stop working, they will gradually come back down, re-enter the atmosphere and burn up at a height of maybe 600 kilometers. That might take 20 years or more to happen. So that satellite will continue to float around up there for 20 years or so, posing a threat until it reenters the atmosphere.

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Bradley Howard: Out of all the launches and the vessels or aircraft that we put into space, what percentage are covered by insurance?

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David Wade: Very few. So at the moment, there's over 6,000 active satellites in orbit, but only 300 are insured. So very few satellites, 5% that are currently insured. The majority of those are the large geostationary communication satellites, the ones providing data services and broadcast from geostationary orbit. Those satellites might be valued at up to, well, \$400 million or more, so insurance for those single assets is almost essential. The ones in low Earth orbit, the constellation satellites providing communications from low Earth orbit, they're generally not insured. The other satellites that are insured are imaging satellites, so we see a lot of the satellites taking images. You would've seen on the news, for example, those images coming out of Ukraine, seeing the Russian troops build up on the border of Ukraine. You will have seen that a lot of those images had Maxar as a tagline on the image.

Maxar is a company that operates those imaging satellites. They're called the WorldView satellites. Can take images of down to about a quarter of a meter resolution from 600 kilometer orbits. So they operate from low Earth orbit. And we've been insuring recently, we've been insuring some of the capsules that take the cargo and crew to the Space Station. So we're getting involved in some of those activities around the Space Station carrying cargo resupply missions up to the Space Station.

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Bradley Howard: So when SpaceX does a launch, I'm just trying to think about how the sales process would work. So when SpaceX does a launch or starts speaking to another space company about carrying cargo, do they say, "Would you like insurance with that?" And if they do want insurance, then they contact you?

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David Wade: Usually it comes via the satellite operator that will be putting the satellite on top of the launch vehicle. I mean, what we are insuring really is the satellite rather than

the launch vehicle itself. So usually the satellite operator will contact a space insurance broker, and then the broker will come to the space insurance underwriters to underwrite those risks. It's a very small market, 30, 35 underwriters worldwide that cover space insurance and five brokers. So it's a very small market. It tends to be the non players. So yeah, a satellite operator, there's probably only... I mean, there's a lot more startups now, but there's probably still only 100 satellite operators in the world, certainly who are at that point of buying insurance who are launching satellites and buying insurance. So it's an incredibly small market. Yeah, what we're covering is the satellite so it's the satellite operator that triggers that process and starts the purchase of the insurance.

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Bradley Howard: How do you use data in order to work out your pricing? I mean, is there enough of a data pool? I know there's lots of satellites, but there haven't been that many launches to build up trends.

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David Wade: There's only been maybe 12,000 satellites launched since Sputnik 1 back in 1957, and the number of satellites is growing rapidly at the moment. So the number of satellites in orbit has doubled in the last 24 months. So we're seeing really recent developments at the moment. You're right. I mean, using data can be quite difficult. Certainly with only 300 insured satellites from maybe 10 different manufacturers across numerous different countries, not all of which are insured consistently, so we have our favorite countries and manufacturers to insure, as do other people. So getting hold of data can be quite tricky, and I think that's one of the reasons why in the space insurance market, most of the satellite underwriters, most of the space underwriters have an engineering background themselves. So a lot of the space underwriters studied aerospace engineering or worked in the space industry before coming into insurance.

And if you didn't do that, you probably employ an engineer who did as a consultant or as part of your team. So really, we're not using statistics very much on the space insurance side. We're really having to go down to grassroots level and look at the risk from the ground up. We're still relying very much on technical briefings, going to visit the satellite manufacturing facilities, going to visit the launch sites and the rocket manufacturing facilities, and really seeing that technology. And more than anything, it's understanding what's changing from the last satellite. So take somebody like Airbus, they have a product line called the Eurostar E3000 that's currently transforming into the next generation called the Eurostar Neo. And really what we're looking at there is how that technology is changing. A lot of the technology is the same as what's flown before. Parts obsolescence is an issue, so we're looking at, well, what new parts are being introduced? What testing is being done?

As they're improving the performance of that component, what testing is being done to show that it will continue to operate as expected? What testing are they doing to make sure it survives the space environment? So we're looking at that kind of data rather than data analytics or any big data set. What's always interesting for us, and one of our worst case scenarios is if we were to have a generic defect. Aa lot of components on satellites are only available from one or two manufacturers worldwide, so you end up with US manufacturers, European manufacturers, Japanese manufacturers all using the same components from the same suppliers. And if we had a generic defect in one of those components that wasn't captured for a few years, let's say it was some sort of deterioration which only got spotted a few years after the satellites had been launched, we might have a significant number of satellites in orbit that could be exposed to that defect. And that's one of our worst case scenarios. Within Lloyd's, we have a realistic disaster

scenario to look at that particular instance to try and capture what our worst case losses could be.

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Bradley Howard: I've got so many questions from that answer. So what did you study before you became an underwriter?

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David Wade: My first degree was in aerospace engineering, and then I did a master's degree in astronautics and space engineering at Cranfield University. I was always interested in the space side, but undergrad there was very little at the time that was available that solely focused on space. So I had to do aerospace engineering, do as many modules as I could related to space, but then to specialize in space I needed that master's degree.

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Bradley Howard: And then you talked about needing to do some investigation because there just isn't a lot of data. So for launches, do you get involved with SpaceX or any other launch provider to understand what safeguards they have around their technology that you are insuring a satellite that's part of their payload?

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David Wade: Yes, that's right. So any new launch service provider that comes along, take SpaceX as an example, they know that they have to convince the insurance market. Insurance has an enabling function. Without the insurance those companies are not going to get the investment that they need to build the satellite. So SpaceX knows that they need to convince the insurers that their launch vehicle is safe. So prior to the Falcon 9, the SpaceX rocket, prior to that launching, we were invited to the SpaceX factory, we were having briefings from SpaceX on a regular basis to keep us informed about the development of the launch vehicle. Factory visits to allow us to see the testing facilities that were being put in place, the manufacturing process that they were going through, the quality procedures that they were operating under. They went to a lot of efforts to prove to us that they had the right people, the right knowledge, they were building a reliable and good rocket.

That process probably started, I would guess, three, four years ahead of the first launch of the Falcon 9. And typically you have a couple of launches which are not insured right at the start just to prove that all the technology works and that it's all come together. So typically we see a couple of test flights before the insurance community has to start insuring the first flight. So yeah, we're working with all the satellite manufacturers, all of the launch service providers sometime in advance of the first launch just to know the technology. So by the time we see it, we're comfortable with it.

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Bradley Howard: Do you see SpaceX, because as a standard member of the public it seems such a revolutionary type of company from how it goes about, so it's marketing to the average person, et cetera. Do you think there'll be other companies that start following in its footsteps and having reusable rockets with such a great consumer marketing?

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David Wade: Yeah, absolutely. Absolutely. They've shown the way, they've shown how different things can be. I mean, the space industry was kind of stuck in its ways. Rockets

have to be thrown away, they're not reusable, and SpaceX has shown that it can be done differently and shown that it can be done differently and cost effectively. I mean, 10 years ago the idea of reusing a rocket was crazy. We were worried about reusing a rocket.

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Bradley Howard: Let alone getting the first one to land on a floating platform in the middle of the sea.

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David Wade: Absolutely. And they've shown what's possible. I mean, just about every launch that we insure now on for SpaceX is a reused rocket. I actually get more nervous now when it's a rocket flying for the first time from SpaceX rather than one that's been reused. We've insured one launch that was using the first stage of the rocket for the 14th time, and I think since then SpaceX has actually launched the first stage of a rocket for the 15th time, and that was absolutely unheard of. All of the other launch service providers are trying to catch up, Mitsubishi or MHI in Japan are building the H3 that should have launched last week, but they've had a delay at the last second. The rocket engine actually ignited and then something happened so they had to terminate the ignition so that's delayed further. The European rocket Ariane, they're developing the Ariane 6 but again, delays, numerous delays. That should have been flying by now. It's probably going to fly very late this year for the first time so we will see a gap between the last Ariane 5 and the first launch of the Ariane 6.

ULA another US operator, launch service provider. They're transitioning from the Atlas V to the Vulcan launch vehicle, but again faced delays. And Jeff Bezos with Blue Origin, his launch vehicle New Glenn is also facing delays at the moment. So there's nobody in the same camp as SpaceX at the moment. They've launched the Falcon 9 about 200 times now, and all of the other launch service providers are still trying to catch up with the Falcon 9. SpaceX is getting ready to launch Starship their next generation launch vehicle, whilst the rest of the market is still trying to catch up to what SpaceX has been doing for the last 10 years. So what they've achieved is absolutely incredible, and they've certainly set the goal posts. There are other companies looking at reusability.

So there's a company called Rocket Lab, operates a small launch vehicle called Electron and that is already trying to test out some reusability ideas. They've brought a couple of stages back down, have not managed to successfully recover a stage yet, but they're on the way. They're trying to do it. They're going to capture that stage as it falls under a parachute. They're going to capture that stage by a helicopter and return it to the landing site using a mid-air capture by a helicopter to capture the first stage rather than landing it on a barge. It's quite a small launch vehicle, so it's significantly smaller than something like the Falcon 9. New Glenn, the Blue Origin launch vehicle that intends to reuse the first stage so yeah, that is definitely the way going forward, but it's just taken a long time for the others to catch up with what SpaceX has already achieved.

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Bradley Howard: So when you visit the factories and check what they're doing, I just can't visualize how you are checking the manufacturing processes. Is it simply a case, and I don't mean that in any bad term, is it simply a case of checking they're building it according to specification that you've previously signed off on, or are you looking for new materials or any other techniques that's going on?

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David Wade: We're not the experts by any means. We have the knowledge, we have some experience, but we're not the experts. So really, I mean, visiting a factory is the icing on the cake to see what they say they're doing being put into practice. We could probably get everything that we need from a technical briefing, but what we are looking for is to quiz them on have they thought about this aspect? Have they considered, oh, I don't know, what are their margins? What quality control procedures are they using? If they're using this new piece of technology, what testing have they done to show that it's going to work correctly? Are we satisfied with that testing that's being done? Are they using standard design methodologies? Are they using standard margins that we would expect to see? Those kinds of things are what we are quizzing.

So if you've got an electric motor for example, you would expected to have the torque at least twice what you need. If a satellite manufacturer said, "Well, we're using a lower level." We would want to know why and what testing have they done to prove that that was acceptable? And those kinds of things. The satellite manufacturers and the satellite operators, the launch service providers, they're the experts so we are heavily relied on them, but we just want to see it's all being put into practice and have our chance at quizzing them to make sure that we're comfortable with the risk.

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Bradley Howard: Are there any international laws or regulations which apply to space vehicles as well?

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David Wade: Yeah, so all space activities are governed by UN treaties, but those UN treaties were written in the 1960s and '70s when it was Russia or the USSR in those days and America launching objects that was state owned and usually are a lot of them for military purposes. So those UN treaties don't really lend themselves very well to the current commercial market. We have to work within those treaties, but it is the launching state, what's defined in the UN treaties is the launching state. So that is the state that procurers or launches the satellite. It is that launching state that ultimately holds responsibility. And those responsibilities are then passed onto the commercial satellite operator through a commercial license. In the case of the UK, you would have somebody like the UK Space Agency or the Civil Aviation Authority would issue that license to say that you are allowed to launch that satellite. And one of the requirements that the UK government passes on is the need for some third party liability insurance. So it comes down from the UN treaties via these local licenses that are issued by the individual nation's regulators, and some of those then might start to impose particular requirements on the commercial operators.

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Bradley Howard: So when you talk about third party liability, that's one vessel hitting someone else's vessel?

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David Wade: Yep.

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Bradley Howard: How often does that happen?

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David Wade: Well, not very often thankfully. It has happened. In 2009 we did have a collision between two satellites in orbit, and that created a shower of debris. I think it was

about 600 pieces of debris that were generated when those two satellites collided. It doesn't happen often thankfully, and under the UN treaties this is protecting objects in orbit as well as objects or other property on the ground. So if a launch vehicle were to fail and that rocket or parts of the satellite or rocket were to fall to the ground and damage property on the ground, then you are liable. The country, the launching state that allowed that launch to take place is liable for any damage that is caused. In orbit you have to prove fault, and that's much more difficult. If you've got two satellites in there, respective orbits intersecting and they collide, how would you prove fault? And we've never seen a successful case brought for a collision in orbit. Thankfully, there's been very few, but that's one of the difficulties with the UN treaty is actually proving fault for a collision in orbit. Well, it'll certainly keep the lawyers happy, but it's a very difficult thing to do.

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Bradley Howard: Wow. One final question. We've been talking about private companies and governments as well. Do you insure both?

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David Wade: Yes, although governments very rarely. Occasionally we'll get to see a project. A lot of countries operate their satellites as if they're through a commercial sector. So we do get to see some imaging satellites, we get to see some meteorological satellites which are part of the government's Met office, let's say or armed forces, but they're operated as a commercial satellite. So we do get to see some of those activities. In other cases, just the way that the contract is written allows us to get involved. Say the mission is to the Space Station, we are covering some of the cargo capsules or some of the capsules that carry cargo to the Space Station. And the way that those contracts have been written, this is with NASA, NASA is now procuring those launch services on a commercial basis. So rather than buying and operating and launching their own launch vehicle, they are going to the commercial sector and saying, "You build this capsule, you launch this rocket, we will pay when you achieve certain milestones."

And that means that that company can then come to the insurance market and purchase insurance for those unearned milestones, one of which is safe delivery of the cargo to the Space Station after launch. So they can come to the insurance market and insure those aspects. So we're not insuring the government directly, but it's a government contract to a commercial operator that we're then insuring.

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Bradley Howard: I said that was the last question, but I've got another one based on your answer. Is the International Space Station insured?

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David Wade: No, it's not. Parts of it or certain modules or certain flights to the Space Station are insured, but the Space Station itself is not. I don't think there's enough capacity to ensure the Space Station. It's a \$100 billion project and multiple international partners, but there are waivers between the different countries so that they don't hold each other liable. When we go forward to the moon, I mean, we're now sort of getting towards the end of the lifespan of the Space Station and NASA's said that they intend to leave lower Earth orbit to the commercial sector. NASA's now interested in going back to the moon, and there'll be a small Space Station that orbits around the moon from which the astronauts will then go from earth to that small Space Station and go down to the lunar surface and back up to the Space Station when they need to. The intention is that some of those components will be insured. So the power and propulsion element, the



habitation module, those contracts will be done on the same basis as the contracts for the cargo missions that we currently do to the Space Station. So there will be an element of insurance required for those lunar missions going forward.

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Bradley Howard: David, that's been so interesting. It's just such a fascinating industry. So 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 and click on the contact button, or you can contact us @endava on any of the major social platforms. Until next Thursday I'm Bradley Howard, and this has been Tech Reimagined.