



Transcript: Day 1 – September 9, 2020

PANEL 2: MONEY, RISK, SHAME, AND REPUTATION: INCENTING RESPONSIBLE BEHAVIOR IN SPACE

- **MODERATOR: Ian Christensen**, Director of Private Sector Programs, Secure World Foundation¹
 - **Chris Boshuizen**, Operating Partner, Data Collective Venture Capital
 - **James Boyd**, Senior Fellow and Thomas Klutznick Chair in Environmental Policy, Resources for the Future
 - **Nishant Choksi**, Managing Director, Ares Advisors
 - **Francesca Letizia**, Space Debris Engineer, European Space Agency Space Debris Office
-

IAN: Welcome to our panel session on the topic of Money, Risk, Shame and Reputation: Incenting Responsible Behavior in Space. Space domain--space domain has become increasingly complex. We have more satellites, space applications and technologies, space users, and space operators relying upon having a stable orbital environment than we have ever had before. And that trend continues to increase the complexity of the operating debate--domain will only become more, more complex in the coming years.

New activities and new actors brings with it the potential for increased benefit. But it also brings challenges to space sustainability that cannot and perhaps should not be addressed through regulation alone. We must find business and community rationale to develop responsible and implement responsible behavior in space.

There's been much discussion about using positive and negative incentives to encourage responsible behavior in space, but few practical proposals. This panel aims to explore how the best developed some practical approaches. We want to discuss themes such as in managing an increasingly complex orbital environment. What role is there for voluntary commitment and best practices? How do we track and monitor performance towards those commitments? And what role does the insurance and investment communities have to play incenting or encouraging responsible private sector space activities?

Can we draw lessons or experience from other sectors, encouraging the private sector to act in sustainable and responsible ways in space? So over the next 15 minutes, we're planning to dive into these topics. We have a panel of experts I think is very well placed to look at these topics from multiple angles: technical, business and economics. You can find their full bios on the summit web page, but I do want to briefly introduce each of them:

Francesca Letizia is a space debris engineer at the European Space Agency Space Debris Office, where she leads assessments of general compliance, space debris mitigation guidance by operators, and the

development of metrics to con--to assess the contribution of missions to the overall space debris environment. Francesca is also a member of a multi-organization team developing space sustainability rating. So, Francesca, I guess that means in terms of scope for our panel you're covering reputation today.

Chris Boshuizen is an operating partner at D. C. V. C. Or Data Collective, a San Francisco-based venture capital firm, where he leads that firms' investment in space and other deep tech companies. The space portfolio at DCVC includes US firms such as Rocket Labs, Capella Space, and Planet. Chris was also a co-founder of Planet, where he was the firm's chief technology officer. Chris, looks like you're the money angle today on our conversation.

Nishant Choksi is the managing director of Ares Advisors. Hey has over 17 years of experience in space and insurance brokerage industries, where he specializes in risk management in large portfolio placements and claims. Nishant, clearly you're covering the risk angle in our discussion today. Jim Boyd is a senior fellow and holds the Thomas Klutznick Chair in Environmental Policy, Resources for the Future. Also the director of social science and policy at the National Socio-Environmental Synthesis Center.

An economist by training, Jim's research emphasizes collaborations between ecologists and economists in order to guide decisions that affect natural resources. So, Jim, I guess that leaves you with the shame angle. Sorry about that. So with that, we'll get right into the discussion here. I'm excited for it.

Just a brief word on format: we'll start off with some moderator led discussion, but we're gonna leave plenty of time for audience question and interaction. So please do submit your questions via the Zoom Q&A feature. Again, that's where we'll be looking as the moderator to, um to see the question. So please, do you use that feature. And so with that, let me switch over to our first question. And that is for Francesca.

In your work with the Space Debris Office at ESA, Francesca, you are involved in the research, tracking and evaluating potential risks in the space environment. In your viewpoint, what are the--what are the most pressing challenges operators must address, and how can initiatives like the space sustainability rating encourage that for those operators to do so?

FRANCESCA: Hello, and thank you for having me here today. So to reply to your question. So what we are witnessing in, in these recent years is a dramatic increase in the launch traffic. So just to give some numbers: while maybe 20 years ago we were launching around 100 satellites per year, now, already this year, we have launched more than 600 satellites.

And if we try to see what this means in terms of the impact on the environment in the long term, we find that the current level of activity, combined with the current level of adoption of mitigation guidelines is not sustainable, in the sense that if we continue like now, we would observe an exponential growth in the number of debris objects. So the main challenge to be addressed is exactly how to improve the compliance rate for what concerned the disposal of satellites and at the end of their missions and the minimization of breakups in orbit.

And so for this point, there are several actions that operators can take to minimize the risk of breakups. For example, from ensuring that the spacecraft is properly passivated at the end of the mission, or testing new platform for lower altitudes and instead for what concerns the, the end of life disposal, we also see that there is a large margin for improvement. So if you look at the current statistics we see that in LEO only around 20% of the satellites that should perform a disposal maneuver to actually try to do so. And so the improving in this, in this aspect is really essential to ensure sustainable operation in space.

And now, if you want to be a bit positive, we can look at the GEO region where actually the level of compliance is much higher and consistently above 80% in, in these last years. And so one can ask why there is this difference, with respect to LEO. And one reason may be that in GEO, operators clearly see the economic and the operational advantage of keeping this region free from inactive spacecraft. And so, in order to make this link more visible for, for any operator, we have been working on initiatives such as the space sustainability rating that you mentioned before. So on one end--one of the elements of the rating is what we call the environmental impact assessment of a mission.

So in essence, basically, we perform this assessment by estimating, which is the probability for a spacecraft to break up in orbit, for example, because of collision or because of an explosion. And then we look at which is the potential effect of this fragmentation on other active satellites. So we do this basically to contribute to create this link between current behaviors and future operation and we have seen that this could be part of the reason why we observed better compliance values in GEO. And an additional aspect this says, also that we believe that this kind of assessment of the mission provide an additional granularity with respect to just checking if an orbit-- or sorry, mission is compliant or not.

And this could be useful, for example, especially for new camera operators to understand how different choices in the mission architecture may have a different impact on the on the environment. And on top of this, if you look at operating in space as a shared resource, then this approach also encourage more transparency in showing how different actors are consuming these shared resources. And then, as you mentioned in the introduction, what we're trying to do with the space sustainability rating is also to try to put emphasis on good behavior. So this means that we are not trying to create a new set of guidelines, but rather to recognize operators that comply to them. Or, go even beyond by adopting measures that try to reduce, which is the disruption that they can cause to neighboring missions in the short term or more in general to, to the environment.

So in summary, the way we think that the space sustainability rating can encourage operator is by making more explicit this link between current behaviors and sustainable operations by offering more transparency and also offering a framework for positive recognition.

IAN: All right, well, thank you for that. And I think there's a couple of things that we can return to that are important, just that idea of transparency and how that may help us think about being, being responsible and then that you have a positive encouragement is something I think we will definitely return to.

So, Chris, the next question is for you. So Letizia's just described--or Francesca, excuse me--described, uh, an effort to better kind of quantify and become more transparent about space sustainability challenges and our performance towards them. In your role as an investor and as a venture capitalist, to what degree do these space sustainability challenges even matter in making investment decisions? And what does--and how does that relate to the role or any role that the investment you might have in encouraging responsible space behavior?

CHRIS: Yeah, that's a great question. I think my answer is different because of my NASA and Planet experience. So we, you know, at Planet we--before we started Planet, we were working actively on new approaches to debris management and to conjunction analysis. And the people that we work with at NASA ultimately joined Planet. So Planet had that in its culture and so I've taken that to DCVC. I'm not sure, though, that's universally true for the investment community at large, though. And the reason for that is that they just don't have that shared experience and they don't know about it.

And so I think, one of my main recommendations for new companies and Francesca, I think what one of my observations is, the difference between LEO and GEO is that the GEO community have lived and breathed that for 40 years, and a lot of the new entrance in the LEO market and new operators, sometimes space companies started by people with absolutely no space background, which on one hand is absolutely amazing and, on the other hand, completely terrifying. And so sort of bridging that gap, where we want to encourage new people to enter our industry and bring new ideas to us, but also kind of catch up on the history and the important dimensions of this business that they need to understand.

And so I use my role at Data Collective to evangelize, a lot of orbital debris and collision and space traffic management, and situational awareness concepts and I promulgate that from my role, and I encourage my fellow VCs to do the same. But I think we do have an education gap, both in the investment community and, and the startup community.

IAN: So education and information sharing as a starting point before we can even begin to think about incentives around behavior. So lets--

CHRIS: Yeah, you gotta know the problem exists to be able to know you want to solve it.

IAN: Excellent. Let's, let's hold that point and come back to it shortly. So ah, Nishant over to you now for the insurance side of this. So it's often in our community suggested that the space insurance sector can enact policies and pricings to reward or encourage private actors to act responsibly. How would you react to that? Can we have a safe driver discount for space operations?

NISHANT: Yeah, thanks--thanks Ian. And, um, yeah, I think you know, to answer that question more directly. We've already heard from Francesca and Chris, and they've introduced elements of things that I consider on a daily basis from insurance perspective, and that is what is the risk? Can we understand it? And how can we price it? And how can we price it to a sustainable level to maintain a space insurance industry that can support these broader changes in the space industry at large?

So I guess, to give you a bit of background: The purpose of the space insurance industry is to enable space businesses to help them

protect their balance sheets against space related risk. But this needs to be done in a pricing level that's sustainable for the industry. We try to price at risk at a point where we believe it's commensurate with the risk being sought, and those risk profiles these days are absolutely changing as Francesca noted earlier. We--so here, we can offer actual real solutions, but they have to be at a good price, have to be at a fair price.

But clearly these are exciting times for the space industry and for us as space insurers. To respond to your question directly, absolutely, we can offer a safe driver discount, and I would say to a large extent this is actually already incorporated into our pricing models. However, we do see challenges for the new space operators. The challenge is how space activities, are defined and today, we do not see that they actually are. We have our own view of what safe means from a technical perspective, from an insurance policy perspective. But the expansion of the industry is creating these new risk profiles to evaluate, and it's natural that the growth creates uncertainty and this leads to a potential increase in the risk.

There's, actually two pieces, that I would kind of highlight from an insurance perspective. For liability insurance, those are risks that impact third parties, so everyone's concerned really about the collision risk, space situational awareness. We find that nations that require these have different requirements. At times, it may be the case where it's not very feasible or practical even to measure what we consider to be the maximum probable loss, which is how rating and insurability is determined from a liability standpoint. It's a difficult calculation for not only nations but also those actors that are required to ensure against those liability risks. So it is, it is a bit difficult. Then, from my perspective, I need insight into aspects such as operational plans for collision avoidance, deorbit plans, other contingencies that would help de-risk the liability and to what extent different space operators can actually do this varies greatly. And I think Chris actually mentioned that as well earlier.

The other aspect is the asset coverage, which is that insurance against actual physical loss of your own--first, of your own space asset. We can also look at not just physical, but also loss of revenues. But that's purely at the discretion of the space actor, and at times it could be a requirement of their investors. So to give you a bit of perspective, the established operators were familiar with space insurance and its benefits do see a safe driver discount because we have transparency in technical aspects such as flight heritage, technical depth and breadth of their teams.

We have statistical evidence to support quality of reliability statistics that support overall missions. We would expect to see the same level of information and transparency on the new space operators, but that's really not always the case. And in closing, I really want to highlight the fact that the space insurance industry has already in the last 3 to 5 years been able to demonstrate its ability to create new insurance solutions to cover some of these new risk aspects.

It's the adaptation and awareness of those benefits to--of space insurance, that continue to, I would say, elude the broader spectrum of buyers and operators in the new space sector. And it's the ability to insure against the risk of loss that benefits not just the operator buying insurance, but the customers, regulators, the investors and the broader space community. So I really feel that that is the real value creation of space insurance, to reach the sustainability of this in the industry.

IAN: Thank you for that, Nishant. A couple of things there that I was trying to, trying to jot down here so we could come back to you. There is a clear thematic link between you-- you're talking about awareness of the role of the insurance industry place and its, and its products and an ability to develop those things to the--what Chris was saying about, just, awareness within his sector about some of the challenges that we face. So clearly there's a theme already developing around, on what we can do to educate and broaden, broaden awareness.

So, Jim, I want I want to come to you now. Now you are--you're coming to us from outside of the space domain, but you've done a lot of work in environmental economics and natural resources management, looking at what I might call analogous challenges in different sectors to what we're looking at in our community. So as you listen to the challenges that we've discussed so far on this panel and perhaps in the previous one, is there anything that you're thinking about from the experience with natural resources management, environmental economics that might be immediately coming to mind as relevant here?

JIM: Yes, several things. And I actually, if I had to pick one thing to focus on, it would be to build on Nishant's comments related to insurance. So there's an important analogy in the environmental policy arena to this space insurance issue. And that is, that insurance plays a hugely important role in deterrence of damages and reduction of risk in the environmental area. Whenever you put an oil tanker out to sea, whenever you build a gas station, whenever you build a landfill, you actually are required by US law to have insurance coverage much like you're required to have insurance coverage as an automobile driver. And that requirement to have insurance plays this incredible behavioral role, in my view. And that is, we tend to think of environmental regulation as: do this, do that. But these insurance requirements harness the power of the market, harness the incentives created by different types of pricing, like Nishant's concerned about. And so that's a clear analogy.

The one, the one thing I want to add to what Nishant said, is the importance in my view of mandatory insurance. If you leave it as a voluntary thing, it can work to a certain extent. But I'd like to put out there for discussion the idea called financial responsibility requirements or mandatory insurance requirements. Which actually helps stimulate the insurance market and level the playing field for all the actors concerned. So that's one analogy that's very clear.

Shifting gears a little bit, the problem of orbital congestion also has analogues in the environmental arena. Um, we worry a lot about automobile congestion and develop policies for dealing with that. So, uh, intuitively, you know we impose tolls on cars to in effect, um a) raise revenue but also b) people to change their driving behavior in a way that produces congestion. Another alternative is kind of the HOV lane analogy, and not quite sure how this would work in this space context, but basically what you're doing there is you're allocating slots based on particular behaviors.

You know, how many people you have in the car, in the space context. I'd be interested in your thoughts on, you know, allocating space to platforms that have particular technological characteristics and things like that. That's another analogy we could explore. And then environmental economists actually did a lot of early work on spectrum allocation because environmental economists worry about public goods

and the commons. And so there's a lot of lessons to be learned from my world, I think, in terms of any of those spectrum allocation questions. Again, how you allocate, uh, scarce spectrum either via auction or by giving spectrum as a property right, and then allowing people to trade that property right to get to the highest value uses. So these are all, all analogies that I think are worth exploring.

But the direct answer to your question--I think the insurance angle is the most appealing, and from my work on environmental issues, arguably the most important thing to explore more deeply.

IAN: All right, thank you for that. I think there is a lot there that we could pick up for on discussion. And that's great, cause we're now coming to the portion of the panel that is meant to be that discussion. So I'm beginning to see some audience questions come in. Please, ah, audience members, please do submit those questions through the Q&A and upvote the ones you'd really want us to ask. But I want to pick up on something, Jim, you were just talking about right there. And that was the potential to have a requirement for insurance. So there are a few--and I say few very deliberately--a few jurisdictions in space world that require on orbit insurance.

It is not particularly common. We typically have launch insurance, and that's to protect the business adjustment. But we do not typically require on orbit, on orbit insurance. There's a currently--current rulemaking action moving through the FCC in the US, which has the space debris mitigation requirement role in the US space regulatory system, that is, ah, requesting comment on requiring and putting into place indemnification requirements so that private operators would indemnify the US government against liability concerns around, around debris operations.

So curious from, I think, Nishant and Chris in particular, how you would react to some of the suggestions Jim just made around requiring insurance, given the context that we have in our industry and some of the emerging businesses that we're looking at?

CHRIS: Yeah, Nishant, do you want to go first?

NISHANT: Sure, I think--thanks, Chris. Yeah, you know, when it comes to-- I would say the early days of some of these new risk profiles emerging, we see, we understand that there are risks related to collisions and liabilities, and space operators want to protect their own assets. So there's, there's different classes of risk that we need to consider. What the right product is and how that fits into it.

As Jim, was mentioning earlier, is it gonna be mandatory or required? Clearly, from my perspective, you know, insurance, no matter what kind of vertical you're playing in is a cyclical kind of business. You have claims that lead to rate movements, introduces more capacity into the market. That capacity drive--comes in, creates more competition and all of a sudden you see rates dropping. And then we kind of go through that cycle yet again.

You know, when we're at the early days of these types of risk, you know there is a tendency for some insurance to take a view that certain risk should be excluded simply because we don't fully understand or have an appreciation for. There's other risk that we do understand that we can price those.

But those might come at premiums that might not be adequate or feasible for space operators to buy that level of insurance, it might be too expensive. So finding that commonality is possible. Now, if you take the route that it needs to be required, you're gonna attract a lot of business. You're gonna attract a lot of capacity because they see a development of a market. And these are for-profit companies, right? So looking to generate, expand revenue—if we see a market expanding, that's opportunity for insurers to enter. Until we see—start seeing a level of claims activity, or lack thereof, that's really going to determine where that pricing goes and what insurers are going to or not going to be able to buy, levels of insurance.

CHRIS: James actually brought up a great analogy, which is that of the automobile. On our roads, we solved these problems a very long time ago. And, you know, most countries have mandatory third party insurance. You know, so in space, if you, to your own business case, feel like you don't need to ensure your own asset for the loss, that's okay, that's acceptable.

But I think it's not acceptable that, you know, you could potentially cause harm to someone else. And ultimately, right now, you mentioned Nishant, the liability transfers to the state under the treaty. So you basically exposing—as we have, as we encourage more people to start space startups and other types of enterprises in orbi, we're increasing the liability for our government.

We don't want to lose our right to do that, so we really need to help them out. So I think that's a fair ask from governments to mandate that companies have third party liability insurance. Um, another point about the car example is the situation we have in LEO right now is, you could be driving your car, and if it breaks down, you get out and you leave it there. And you leave it there forever on the highway.

And so space debris, you can think of as a highway where just the broken down cars keep accumulating and at some point you can't drive anymore. And so, I think we need to go further than just having legal and fiscal tools to solve this problem. I think we also need to make sure that people can afford to pay for the debris removal. And that's an additional layer of insurance that I think people should have, um, where if their asset failed, they're on the hook.

For all of, all of the recovery cost to restore free access to that public commons. And, you know, I think this is, a new idea, but a number of companies and startups are pushing this, and I think it's probably one of the biggest tools that we need to put in place, which is, you just can't leave you broken down car on the freeway anymore.

NISHANT: Can I jump in here on Chris' point? Yeah, there's also an analogy to exactly what you were saying there in the environmental field that relates to mining activities, the end of the life of landfills, things like that where, um, there are bonding requirements, uh, that ensure that money is available for any repair or accidents that occur after the lifetime of the landfill or the mine. And the insurance industry plays a role in that bonding activity as well. So I'm really glad you made that point.

IAN: All right. Thanks, all this stuff is very interesting. I want to ask one more question as a moderator, and then I'm going to start going to the audience question and answer. But Chris, you said it's acceptable behavior to leave your car on the highway and walk away from it. All right, so the question

I want to ask, and I think I'm gonna ask Francesca to start, and then the other panelists to weigh in here-- how can we talk about incentivizing or encouraging responsible behavior if we don't know what responsible behavior is?

Do we have a baseline in our community for identifying what a responsible space actor--be that a commercial actor or government actor--what that looks like? So Francesca, can you talk about that from the standpoint of the space sustainability rating? And then I'd be curious to hear the other panelists' reaction.

FRANCESCA: Yes. So I think that on one end, we, we have actually already the tools to define such baseline. And somehow you can think that this baseline has already been defined, even maybe not articulated in a single document or, or guidelines.

So, if we think that the problem of space debris, we can see that there are two dimensions to the problem. The long term and the short term. So for the long term there is a continuous ongoing effort in international bodies such as the Inter-Agency Space Debris Committee to model the debris environment, its sensitivity to different parameters as, for example, the compliance or mitigation measures.

And this can help in identifying which actions are expected to have the largest positive impact and so define these minimum level of responsible behavior in space. And for the short term one, instead, we can look mainly at, for example, the collision avoidance process and how operators can minimize the burden on other operators, but also in the space of other systems in in general. And so we look at action, such as communicated maneuverability of the satellite and screen and maneuvers. All these elements that were mentioned also in the previous panel. And here we see the cooperation among operators can really be positive in shaping these best practices and contributing again to define which is the minimum level of responsible behavior.

And, for what concerns me, the space sustainability rating, specifically as you asked, these are all elements that actually are part of the, of the rating. So the rating will be composed by different modules. And some of the modules exactly are, for example, on what operators are doing in terms of data sharing or the, their collision avoidance operation et cetera. And it's also always important to keep in mind that the step that should always be done when we look at this best practice is also to understand, um, how we can then feedback these also into this long term simulation of the environment to understand really, what are also the long term implications.

But I think that the tools are there, and it's possible to define this baseline.

IAN: Thank you for that. Any of the other panelists have a perspective on either what Francesca has said, or on the question of whether we even know what a baseline of responsible behavior is?

CHRIS: Well, I think it's changing, right? I mean, back when we had really just one or two CubeSats and then more or less basics and every other launch vehicle was launching a GeoSat. I think things were

fairly stable. Now that we've got a large number of small to larger satellites to LEO and MEO and increasing numbers of them, the situation's changing, and I think we've learned a lot.

I mean, I think even some of the things we talked about today were not even considered at similar conferences five or 10 years ago. We talked about SSA, space traffic—space situational awareness was a topic, but not really about the responses to derelict satellites and collisions and so on. I think this is a new dimension that, frankly, we as a community are just discovering, um and so you know, that, that needs to become mainstream, but I don't think it is yet.

IAN: All right. Thanks. Let's start turning to our audience now. We have a number of questions submitted through the chat. So I'm trying to start weaving those into the conversation here, um, and let's start with this one. We've been talking a lot in this panel about commercial activity, new actors and new commercial business models and new uses of space.

We also recognize that historically, a lot of the activity in space has been government and some of the—a large portion of the debris objects that we're concerned about are legacy objects from government activities, right. So the question has been posed is, how do we incent governments to act responsibly? Is the incentive structure that we think about there a different set of mechanisms than we might think about for the commercial industry? And so, Jim, maybe I put you on the spot, if there's any lessons from your domain there? And then, to others that want to take that on.

JIM: Sure, just briefly—the government, the federal government in particular, often does, in the environmental context, take a lead in order to stimulate and demonstrate good behavior. So you'll have energy efficiency requirements for federal facilities... for example, recycling initiatives. So you do see some of that. Now, the politics of that, though, I mean, basically, it's an interesting question: why does the federal government do that?

It's really about congressional politics. There's gotta be a nudge, um, from the Hill, in fact, to, um—and it can be a fairly direct way of getting some experimentation and leadership from the federal agencies happening. But I assume that the real driver there is— first of all, the agency's belief that it's the right thing to do, sort of a cultural belief, and then some political and—political inducement and budgetary authority to actually be doing that. So to me, what that means is, if the private sector sees a role for the government to be proactive in a way it isn't right now, that is kind of a congressional and a political calculus. That'd be my guess.

IAN: Chris and Nishant, can you maybe pick up on that? How can the private sector be more effective to advocate for government action on some of its legacy objects?

NISHANT: Chris, on you, this one.

CHRIS: Okay. There's not a lot we can do about them yet, right? I mean, we can't go and get them and move them really? So that's hopefully coming in the next decade. But we're not there yet, so all we can really do is track them. And, I think just being more forthcoming with their catalog and the accuracy of their catalog would be a big step so that people can predict their collisions and do their avoidance maneuvers with better, better information.

That's probably the biggest step. And then, obviously having a commitment from this day forward to, you know, from stop tossing second stages into orbit and things like that, which is something we all need to do, but, you know it's--One of the sad things about this problem is that, once the damage is done, it's done and, at least in terms of our state of art right now, it's irreversible. So until that changes, that we kind of start dealing with the problems that we've got. So I think at least sharing information is a good start.

IAN: Back to the transparency and information thing that we started at the beginning of this, right? Francesca, we have a couple of questions here that relate to sustainability rating itself....So the question has to do with what the rating is measuring, talk about space sustainability rating and talks about operator behavior. And so we're measuring and trying to define how to compare how operators are behaving in terms of responsibility. Should we also not be considering design of satellites as part of this? We don't want to design satellites to fail, is that also not part of responsible behavior?

FRANCESCA: First, I want to say that what we have been doing in these two years of the, in the development of the space sustainability rating, we see it as a first step. So we are not aiming at solving all the problems in this first iteration. So for sure, there are aspects that, um at the moment we're not considering.

But then maybe with the evolution that we have been mentioning already, there will need to be included later on in the development of the rating. But this aspect of the design, we are already--some are taken into account because one of the elements that we consider is, for example, the application of standards, um, in the design of the, of the mission. For example, if you apply the ISO standard and you will get a better rating. So somehow in a, let's say an indirect way, these aspects are taken into consideration. The problem specifically with the design choices, which is one of the aspects actually that we, that we considered in the really initial phase of the, of the design of the rating, is that it's an aspect that is difficult for an agency to verify. So you will have to go through the documentation of the satellite and do this assessment, which may be not so straightforward. And also may rely on information that could be deemed to be, they say not controversial, but may be covered by intellectual property rights. So what we considered for the rating is, as I said--and I'm talking about this first iteration--is to try to remove this kind of barriers, for example, for sharing of data that could be problematic for commercial operators.

And this is one of the reason why the design is considered, but through the application of standards, and not through really an analysis of the specific design that the operators is adopting.

IAN: All right, thank you for that. Let's--and apologies again, gonna jump around in subjects a little bit here--but let's return now to the discussion of information sharing, awareness, and education that we had at the beginning of this. And so, Chris, I think this is gonna be for you to start, but I'm certainly welcome for any other panelists to come in on this. The question that we have in the chat is about how do we educate future space entrepreneurs about space sustainability challenges and does that--do we want to look for the university system, do we want to build specific programs around space sustainability? But it is also a bigger question to this, is then: how do we also educate the investor

community that you spoke about? About some of these challenges and what are the challenges to doing that?

CHRIS: My real concern is people from outside the industry who get excited about space. So you know the example in my world might be somebody who just sold a software startup, and then, you know, decides it's finally time to return to their love of space. And so they go to Palo Alto VCs and raise a bunch of money. And neither of those two groups of people know anything about space. They just get excited by it and have a ton of money.

That's my biggest concern. So those ones are hard to reach because they don't know what they don't know. For the rest of us that are in the space, including space VCs who have been coming to space conferences for years, but--and know the issues and people who have degrees in aerospace engineering or been to the International Space University or regularly attending the IAC, those people know of the existence of this problem, and I see that their behavior is very different.

So I think we've done a pretty good job in our own community of educating the people that we know. And we share that information. And every way you go in this industry, from your undergraduate university, through the ISU and professional life, you hear about it and it is baked in. And I think we've done a very good job of that. The question is, how do we get these other people to, say, go to ISU before they start a space company or come to this workshop as part of their learning process to building their business plan? And that's the part that I haven't solved yet.

I'd love to hear ideas about how to sort of broaden that net--to sort of capture those people and bring them into the community we have here, you know, where we have people like Francesca doing excellent work that is available to them. Secure World as well, right? How do we--how do we embrace them and welcome them in and tell them what they need to know?

FRANCESCA: If I can add something on this. An idea that we were considering for the sustainability rating, but also for our work internally in ESA, is, for example, to provide a web-based platform where operators can, let's say, submit the main characteristics of their mission and understand how this rating or this environmental impact assessment, that I mentioned before, will change if you change some parameters in the architecture of the mission. Because exactly as you, as you said, Chris, before-- we also think that it's very important to bridge this education gap, to make more clear how different choices can really have an impact, which is the effect on the environment on the long term. So this is how, from a purely technical point of view, we are considering to address this aspect.

IAN: All right, thank you both. Clearly, I think we can define that we need to do better there, in terms of reaching out some of these new audiences that are driving activity in our segment, but the specific challenges of how we do that are something I'm challenged with in my own work in Secure World. So it's a sure challenge for all of us. Alright. Gonna go back to a couple of technical questions here. Um, so we have--we have a question that looks at I think something that's somewhat related to what Jim raised about, um, certain orbital zones, or, you know, the HOV concept, right? How, if we can apply that to space operations. I think this question it's to any panelist who wants to take it-- we have seen some proposals and some new startups and new businesses to look at trying to utilize a region of space

known as Very Low Earth Orbit. So, you know, probably below 250 kilometers, something that would decay naturally very quickly. The question is, do we think this is an interesting way to balance space safety with new areas of activity and new innovation?

CHRIS: Do you mind if I take that?

IAN: I think so. Go for it.

CHRIS: Yeah, Yeah. No, I think I think that's a really interesting idea. So, um, one of the sort of big advantages that CubeSats in the early days had was, um, the small, small surface area and low orbit. They kind of naturally clean up. And, you know, we--the Earth is bombarded by several tons of meteorite material every day. So, you know, few satellites that could get completely vaporized is a fairly insignificant contribution. There's no real pollution that I believe is measurable from a satellite re-entering the atmosphere. And so it's a pretty cool idea, and so if we can solve that at least those satellites are out of the way.

And when your car breaks down, in this case, it cleans itself up. And that's really true of any orbit below 500 kilometers, is that you have enough drag that you just help clean up. The real issue is people going higher than that and getting more excited. So I encourage anyone to go as low as possible for your mission profile. And if you, you know, can use your last single command before your satellite dies or your last drop of fuel to push the orbit down, you should do that because these very low orbit are amazing sort of, you know, self clean up in taking care of the debris.

So I strongly encourage people to look at ideas down there. And, of course, you know, if you're half the distance away from the earth, you know, if you have a camera, you've got double the resolution. So it's better for your business plan too. So I think there's some exciting business plans just around the corner there.

IAN: So that may be an emerging norm we can continue to converse around, is if you can use a low orbit as much as you can possibly use, let's, let's look for that.

CHRIS: Exactly.

IAN: Okay, anybody else on that one? All right. One for Francesca here. Kind of lightning fashion. Does the space sustainability rating consider environmental impact to anything on Earth, essentially, or is it just looking at the orbital domain?

FRANCESCA: So, yeah, as I said, in this first iteration, we on purpose decide to focus only on the in-orbit domain. So we would just look at the space debris issue in itself. And we are not considering aspects such as, for example, the impact of reentry or the impact on the atmosphere. So these factors are not present at the moment for this current edition, let's say, of the rating.

IAN: Thank you for that. I've got one for Jim here from Mark Mulholland. Jim, is there an analogy to the Superfund construct? Phase one is to stop polluting space and start being responsible. Many operators understand this. Phase two being more, more complex, how do we clean up the historical mess that's been created by prior operation?

JIM: Yeah, and it should worry you all a little bit. The Superfund story, in a nutshell, is that, uh, in an era prior to regulation--I'm overstating this--but in the era decades prior to regulation, a lot of pollution was created. And so when it came time to say, wait, that's a big problem. We need to solve that problem. There was then, the question of who's gonna pay. And Superfund involved a mechanism that was upsetting to a lot of people, which was basically a reliance on what's called joint and several liability, which it wasn't market share liability, although that could play a role.

Basically, if you had deep pockets, if you were still in business, if you could pay, you were in principle on the hook for anything, the government could get out of you. So it's a cautionary tale. I think there is a definite analogy here. If I were in the industry, it would be a motivation for me to get really in front of this problem. Because if there comes a time where global institutions decide we have got to solve this legacy problem, they're going to start searching for responsible parties, and that can be very expensive, even for the deepest pocket, leading companies.

IAN: All right, so thank you. Challenges of, um, of balancing appropriate government role versus encouraging and allowing industry activity to continue, right, is something that is fundamental. And I think the questions we're looking at is clearly, ah, a discussion that we could pull out of that experience.

All right, so I'm going to pose this one to everyone, that kind of relates to something that we're talking about in this panel, but also the prior panel. And that is the role of standards and standards for behavior and industry, voluntary commitment standards, versus allowing innovation and new activities to continue and to not become overly, overly specific. So, as entities develop standards or norms for responsible behavior in space, do we have any concern about that being a, an activity that becomes anticompetitive or leads towards particular standards, entrepreneurs or innovators dominating things for their own benefit?

So the question is, do standards contribute to innovation or do they help us think about being responsible, or are they a concern around limitations?

JIM: Yes. (laughter) Just quickly. Again. This is a fascinating question. Sorry to keep using all these analogies, but, um, you know this this-- in the auto industry, for example, fuel economy standards. The industry leaders can, in principle, at least use tight fuel economy standards as a barrier to entry to reduce competition. I'm not gonna go so far as to say that's anti-competitive in a legal sense. But there is a close connection and intertwinement between competitive advantage and standard setting definitely.

IAN: Chris and Nishant, maybe for you, is acting responsibly as a new operator, is that a competitive advantage?

CHRIS: I think right now there's still an inclination for people to cheat, and to cut corners. So I think that suggests the answer right now is no. But, you know, I think I have observed that at least people who have grown up in this industry typically behave responsibly. You know, nice that they're not cheating. But I do think we need to change that.

And then on the standards part--yeah, I would be reluctant to say--see, one of the burgeoning upcoming space debris removal companies um, you know, patent their connector and mandate that everybody use that connector and have them have a monopoly on that. Because, frankly, we need the tow trucks, right? We need--we need lots of trucks. We need every country to have a tow truck. And so I think that's one thing where we might want to avoid monopolistic behavior. Now, if you built the thing and you get to fly it, that's great. But you shouldn't stop other people from also launching their tow trucks, and cleaning up mess as well.

IAN: So one of the other things that Secure World's involved in is facilitating an industry group looking at standards and best practices for satellite servicing, known as the Consortium for Execution of Rendezvous and Servicing Operations or CONFERS, and that's a discussion we're having, Chris, in that group, is that we see interfaces and interoperability as an important future enabling factor for this on orbit infrastructure and on orbit servicing development. So how do we facilitate that conversation that allows, you know, individual business models to progress?

But you have that, that commonality of functions. And so that's an ongoing conversation but it's a very interesting and important one. Another thing that you just hit on--so is there a business advantage to being a responsible actor, and he said, no, you see people in the industry are thinking about this, and we talked about people coming in from outside of industry that maybe are not as familiar. It seems this is an element of culture there, right? Of corporate culture, of industry culture, and so, um, you know, sustainability--space sustainability has an operational impact.

But how do we--can we design or encourage firms to think about it from a culture standpoint? What mechanisms can be considered for that? I'd be curious to hear--I don't want to put this all on Chris. But I'd be curious to hear reactions from the other panelists is as well.

CHRIS: Why doesn't someone else go first.

NISHANT: I can address part of that one. You know, typically space operators that are seeking to ensure risks, whether they be in LEO, GEO, wherever they may be in space, you know--my job is to understand what their business plan is from a technical perspective, financial, insurance, et cetera. So there's a big--there's a, there's a large process of asking questions that are very detailed and seeing how those answers are responded to.

Typically when we say, you know, are these actors behaving responsibly? The fact that they're even seeking insurance to me is an indicator that they are being responsible. So, so that's a positive sign in and of itself.

The challenge is for the risk that I don't see, that I don't get to evaluate. And right now, because the industry is moving at such a--broadening at such a fast pace, it's difficult to see who is the good actor and who isn't--that not so good actor. Because I tend not to think that anybody is really a bad actor, because if you're investing money and effort and resources and building the right teams and putting assets into space, you're going to do it, at some point, to some level of responsibility. To me, it's

when I see the risk. Then I look at it, then I can evaluate okay, how responsible are you being versus are you being responsible or not.

IAN: So that that comes back to--I've heard other people, I think primarily in the context of the space sustainability rating, good behavior is the baseline, and what we're trying to do is incentivize behavior beyond, beyond that, right? So um, appreciate that. All right, I can pick up on that, a question that, that I am asking from moderator's prerogative.

In encouraging people to stay on that good behavior baseline--and I want everybody to answer this--what is more effective? Shaming bad behavior or diversions from that baseline or highlighting incentivizing, better behavior?

FRANCESCA: So if I can, if I can start. Um, so somehow operations in space are quite transparent, in the sense that it's not so difficult to spot who's maneuvering and who is not. And in fact, the, say, the bad actors or the most dangerous objects are actually well known. However, this has not been particularly helpful in these last years if we look at the level of compliance to mitigation measures that I mentioned at the beginning. And this is exactly why with the space sustainability rating we're trying to shift this attitude towards instead, trying to highlight good behavior and spot, put in the spotlight the operators that are responsible, because we think that in this way, this can serve also to present positive examples of technological or operational solutions that have been--have proved to be successful in terms of debris mitigation. So that's why we want to go in the direction of yes, promoting the good behavior.

IAN: Anyone else? Shaming or calling out positive behavior?

JIM: Okay. I'd like to take it in a slightly different direction, and not answer your question. I think--one thought I'm having is, who's doing the shaming and the rewarding is an important question. And this relates to the power of, kinda, consumer attitudes and consumer demand, the way people in a supply chain, for example, will reward socially responsible behavior or not. And a question I have for your community--that shame and reward thing tends to work really well when the consumer sees very clearly a connection between what they're buying and what the problem is.

So, you know, conflict free diamonds would be an example there. I'm having a harder time--I don't think that at the consumer level, there's an awareness of that connection to what's happening in orbit. I'll use myself as an example. If, let's assume StarLink is screwing something up up there--am I part of StarLink's supply chain?

I have no idea. And so I'll just throw that out there as an important thing to think about is, who's actually doing the shaming or the rewarding and how strong is that connection gonna be felt.

IAN: Go ahead, Chris.

CHRIS: Yeah, so I mean, there was one notable example last year of someone who did cheat, which was Swarm, and I mention them by name because I believe that having at least one

notable example of something that is considered fairly aberrant in our community is great because it scares the crap out of everybody else. And I think it did scare a lot of people. And my observation in speaking to other people was just that they reinforce the 'I can't believe that, that's really bad.' And that little neuron that flips and gets re-communicated to other people, which is that it's really bad is really important.

So I think there is an element of public shame that is valuable. That said, if you have people that are marginal, where they're like, they just don't know how it works, there's no real value in shaming those people. They just--that's where you really want to just encourage them, hold the hand through the process, explain, invite them in and--I think we already talked about earlier, you know, educate them. I think that's the primary toolkit.

IAN: Keeps coming back to that education awareness piece, right? Yes, that's the critical element of this. Jim, thank you for--I think you just raised a very good point. The space industry is not yet a particularly consumer, individual, consumer-driven market. It's a government driven market. It's a business driven market. But in terms of end use consumers, it's very much several steps removed, right, you may be using maybe watching direct TV or something or using GPS on your phone, right, but your connection to the orbital, the orbital environment and the risks thereof is fairly removed. Right?

So I think that is a--that is a challenge that we do face in terms of who's doing—where the pressure is coming from, very much so. Nishant, anything to add to this? Ready for the next one?

NISHANT: Yeah, I think from an insurance perspective, you know, one of the principles you know, just the law of large numbers, right? It dictates that the losses of the few are paid by the many. So inherently, I think that buyers of insurance are incentivized to behave responsibly--responsibly, to do the right things that they need to do when they face technical challenges or business challenges to de-risk their profile. And if they do that, you know that that benefits them.

And it benefits the next guy buying insurance or the next guy buying insurance. Although when you have an issue, depending on how that issue played out, that's, that pain is actually felt not just by the customer dealing with the claim, but also by the future customers that have similar risk profiles. So I think, you know, calling out the good behavior is the right way to build that reserve of premium that's--ultimately, you know, there will be claims, we all have to expect that. And if everybody behaves responsibly then that pool grows and it is able to cover and create a sustainable insurance community.

IAN: Yeah, thank you. I think it's an indicator in and of itself of success, right is growing that pool and that available purchase. All right, so I got about 10 minutes left here. Gonna go back down to some some detail level questions here before we wrap up.

The first one here from the audience member has to do with a very core trend that we're seeing in our industry, which is the emergence of these very large, often called megaconstellations in low earth

orbits. Jim, you mentioned, StarLink, right, that's one of the key examples. Amazon, OneWeb, some others.

The question is, and it's interestingly phrased, it's phrased as--why cannot or why can't we have some international body like the International Telecommunications Union, govern the allocation of orbital altitudes in a model similar to air traffic control? Is that a model that we should be looking at, or is that something that is probably beyond need or reason at this time?

FRANCESCA: So from the, from the technical perspective, we look at the example of ITU as an inspiration and we ask ourself how this could be reflected in terms of allocation, even if from our perspective, we don't think that an allocation based on altitude, it's maybe the most appropriate one. But for example, with this idea that I mentioned in the beginning, when we look at the impact of a mission, what we do is--what we try, what we can try to do is to understand which is the maximum capacity of the environment, we call it. So, which is the number and the type of missions that are compatible with a stable evolution of the environment over time.

So to avoid that we have a condition where we do have this exponential growth in the number of objects. And our idea, and we are doing some research and some activities on this topic, is exactly how you can start from this concept to then derive an allocation mechanism that can take this into account and be sure that the new missions that are launched are within these boundaries, so that also in the future it would be possible to have sustainable operations.

IAN: Transparency and measurement then an understanding and then think about what regulatory changes or anything needs to be made. That seems to be a reasonable perspective. So, Nishant, I have an insurance specific question, so this one's got to go to you. Cyber security is something that we're seeing more attention to in the space community right now, we just saw in the last few days the Trump Administration came out with an executive order relative to this topic. So the question is, how does the insurance sector look at cyber issues for satellite operations? Do you provide insurance specifically for cyber security risks, or is it too hard to estimate the cost and risk level associated with that?

NISHANT: Thanks, Ian. This actually is one of the growing risk concerns in the space insurance industry today has it recently, actually that the risk is actually excluded for some very specific language that's in the policy wordings today. You know, does it make it hard to estimate the costs? It still does. It is hard to estimate the cost, especially when the security posture of a lot of the companies that we evaluate are different.

We have, I think, a lot of space buyers today that come seeking insurance will now start getting used to seeing questions that are related to cyber as the broader space insurance industry tries to understand what that risk actually is. And because it varies so greatly between operators, it's difficult to establish what that baseline coverage should look like and what that pricing in concert should look like as well. So it is--today it is excluded--not to say that, you know, in the future, if we understand it better that that couldn't be put back in to cover.

IAN: Okay, thank you. Thank you for that. Let's see, just kind of scanning through the last questions here that we need to talk... Alright, this may be a question that is rather difficult to answer, but we're talking primarily about responsible operations in the context of current environmental challenges, current space sustainability challenges, and current business and technical practices, right.

So we're talking about responding to our current environment. Is there any way in which we can model or think about future practices that we should be thinking about now to mitigate potential future problems? I used to be a market forecast consultant, and our job was to forecast the future, and I could tell you every single study that we delivered was wrong, right? Because you can take the best guess, but you don't know the future. But how do we think about designing now for challenges in the future? Is that something that we consider? If I've ended the panel on a stumper, you can tell me that as well.

CHRIS: Yeah. I mean, I agree with you about us being wrong about our predictions. I, had not expected StarLink to actually launch that many satellites. I didn't really think any of the megaconstellations would really show up. So StarLink at their launch rate is actually on track to possibly launch 10 to 20,000 satellites over the next few years, which is an absolutely astounding number of satellites. And I just don't think we're prepared for that, because none of us thought anyone was really gonna get the money to do it.

So I think we're behind. So even catching up is mostly what we talked about today. And then the future stuff. You know, maybe we need to start modeling worst cases. And we could have, five years ago, actually built the laws and regulations around megaconstellations. But then I've observed there's a reticence to do that because it doesn't seem real. But we should have. Maybe we should take a lesson from that and actually plan around what we imagine to be future cases, even if at the time they seem unlikely.

FRANCESCA: And if I can, I can add on this. These approaches that I mentioned before, when we look at the, I said with this impact assessment, we want to have more granularity with respect to just checking the compliance to mitigation guidelines, it's exactly to go in this direction. We think that with this approach we can be a bit more future proof, because if we just look at for example, at the number of objects that are in orbit or this kind of classical assessment, we may have only a partial representation of the current situation, which does not really translate in how sustainable are operations in the future. So it's, from a technical point of view, we are trying to reformulate the problem so that we can a bit more flexible in analysis of future scenarios.

IAN: Flexibility is always important, right? So we've got, um about four minutes here, it's time for kind of a wrap up, and closing thoughts. I think--what I'm thinking about as the moderator after this, is really going back to the awareness and education aspect of this. I think that has been something that each of the panelists has mentioned at some point in this conversation. And I think that is a key thing that we need to do as a community, is just be sure that we are, um, effectively communicating about where the challenges to sustainability of the orbital environment are and that there are obligations that we have as a community to respond to them.

So the question that I'm delaying to give myself time to formulate here is: what is the core of the business incentive that will cause operators to act responsibly and not require regulation to do that? Um, and I think each of you may have a slightly different perspective on that, but I'd be—I'd be curious to hear your concluding thoughts on what is the core business incentive for responsible operations here?

JIM: Well, one is to forestall future, less flexible, more draconian regulation. And then I'd also point out regulation is many things. And I guess I would encourage the community to think about regulatory foundations that—whether they're supporting the insurance industry, whether they're supporting flexible, market based orbital allocations—even though those are flexible and market driven, they work best when there is a governmental or regulatory foundation to kind of oil the machine, if you will. And so don't just think of regulation as this very heavy handed thing that's telling you all what you have to do. It can also be a foundation for a lot of, I think, the flexibility and efficiency you're going after as a community.

IAN: Okay, Chris, anything to add to that?

CHRIS: Yeah. So I'm a, you know, technologist at heart. And you know, when given an option, I'd always prefer to take a technological solution than a legal or regulatory one. And so one of the things we did at Planet was we designed a low speed radio that has very wide beam that is very easy to use. And one of the advantages of this radio is that, for instance, Planet—when Planet drops 40, 50 satellites out into orbit at once, particularly on a ride share where there might be another 80 satellites, Planet is always able to find all of its satellites within five minutes, ID them, get positive contact with them and then send its—get refined TLEs from our GPS and then send those back into the community so that people can say, well, those 40 we know are Planet, so we know ours is this.

But other actors, I observed, sometimes spend two weeks sort of hunting, for theirs, not sure which object is theirs, not really steering the antenna correctly, so the business incentive for that is that you can, you know, you can find your satellite. You're not stuck with a lost in space situation. You could get your mission up and running sooner, and you can avoid collisions with other people and not lose your assets in that crazy mayhem of the launch.

So that's one example of a technological tool that helps everybody, provides information to other operators so they can ID their satellites and move them out of the way and get control of them. Everybody wins from that. But it's a simple radio. And so there are little things like that that I think should be possibly mandated, maybe regulation can assist in making them adopted, but at the end of the day, we open sourced this radio design because we thought it was valuable for everybody and so people should just use it because it's actually better for your mission. And so all of the other things that we're talking about here today are side effects. But you can actually put your own self interest first and say, gee, I wish I could find my satellite quickly and get positive control and get on with my job, and you can do that and benefit everyone at the same time. So this is not a—it shouldn't be a cost to people to be a good, to be a good actor. In fact, it could be beneficial.

IAN: Nishant, Francesca, any quick closing thoughts?

NISHANT: Sure, as Chris mentioned, I mean, good behavior shouldn't come at a cost. There is a price but, you know, entrepreneur mindset, you know, they're success oriented. The insurance expense line item on, you know, that they're thinking about, may not even be contemplated until after they've raised maybe a couple rounds of funding, until the risk becomes real to them, the risk of loss really becomes real, and then they consider insurance. Not to say that that's too late, by any means. But if they start thinking about it earlier on, coordinating more with the investors, with the insurance community, and getting a feel for what that risk and how it develops and changes over time as the business grows, looks like, that's what we really need to focus on.

FRANCESCA: And on my side, to connect to what James was saying before, so I also think that the regulatory requirements are really important, but for operators it's also an opportunity--the part of being involved in these best practices definition, as they can really contribute to define what is the new norm, and the more that these action are consolidated and more likely that it would be later on captured in new standards and your guidelines. So it's better to be involved in this process than just be subject to it at the end. So that could be also an incentive to do this kind of behavior.

IAN: All right, well, thank you, everyone. I think that was a very interesting chat, we could probably keep going. I think the message that good behavior should not have a business cost, but bad behavior probably does is something that we all can take away from this. And with that, I'm going to turn it over to my colleague Krystal for some logistical remarks and on to the next element of our agenda. So once again, thank you everyone on the panel.