

Dr. Simon Weeks: And ended up leading their global aerospace warranty program for something like four years. And during that time, actually in the UK, we set the foundations for what became the ATI, and that in combination with the government of the day committee, we had a large amount of funding into aerospace research over an extended period of time left to start the ATI and I was offered the opportunity to join it and I really wanted to put something back into aerospace in the UK.

Kat: Absolutely. Can you talk a little bit about what some of ATI's really big technology initiatives are at right now? What are some of the big goals that we're really driving for in the next couple of decades?

Dr. Simon Weeks: Sure. Just a little bit about the ATI...

Kat: Technical difficulties.

Dr. Simon Weeks: Technical glitch.

Kat: There we go.

Dr. Simon Weeks: A few details on the ATI. We've been going since 2014. We're basically, our role in the UK is run the UK's national aerospace technology strategy and the technology program that goes alongside that. We are working on a budget at the moment of about £4 billion for over a number of years. So we're investing about 300 million a year jointly of government industry money.

Dr. Simon Weeks: Big priorities there are really the future generations of propulsion, so really appropriate to come here to this conference, and that's for me a great part of our investment. And then, making sure we're investing in the latest technologies for composite wind technology.

Dr. Simon Weeks: So the UK, Airbus build, assemble all of their wings; quite a huge operation doing that. And then bringing through the next generations of systems technologies and there's a huge focus now on electrification, typically propulsion. I think all of us would have seen the growing pressure and awareness of the need to accelerate the work to reduce the environmental impact of aviation.

Kat: Definitely. Can you talk a little bit about electrification of aircraft a little more? We've had a number of panels here so far at the forum that are kind of focused on that, but really focusing it more on "These are the advancements we need to make in gas turbines in order to drive toward electric aircraft." Can you talk about that a little bit?

Dr. Simon Weeks: Yeah, certainly.

Dr. Simon Weeks: Another beautiful future aircraft. And I think it's going to depend very much of what size aircraft you're looking at.

Dr. Simon Weeks: There's a huge hike at the moment in the world today, something like about 200 companies now globally. Many of them startups looking at electric powered aircraft.

Dr. Simon Weeks: Big focus on battery power. The problem with batteries is you can't store very much energy compared with kerosene. Kerosene is a very efficient way of storing energy. I've been using gas turbine power in combination with electrical power, so using the gas turbine to generate electrical power, and using that electrical power to drive electric propulsors, may give you a lot more flexibility to make more aerodynamically efficient aircraft. It may well be that you can use these hybrid systems to make larger aircraft more aerodynamically efficient. So that would be a great thing in the future. That's a little way away. We'll just show you one of the projects we've got going in the UK. This thing here, over on the left hand side, that's called the E-Fan X. And that's a joint program between Airbus and Rolls Royce, in the UK, also in Germany. At the moment we're modifying the aircraft, which is an old V8 system [inaudible 00:04:21]. Inside the fuselage, it's got a huge generator system, batteries, power converters and those all feed into the green engine under the wing and that being electrically powered. So we're trying to demonstrate, I think for the first time, a very large hybrid propulsion system and that could well be one of the things to come in the future.

Kat: Yeah. So in the recent years, ATI has either invested or backed a lot of concepts like E-Fan X and other aircraft. So can you talk a little bit about some of the criteria or factors that goes into ATI deciding to back a particular project?

Dr. Simon Weeks: Yeah. Well firstly it's got to fit our technology strategy. So working with UK industry, we've put together a national technology strategy for the UK. A bit like NASA's got a technology strategy for aerospace as well, and you know, we do talk internationally to people. So we know NASA quite well and work with them to gather their thoughts on where the world of aerospace should be going. So we set that out in our strategy, which anyone's free to download from our website. So we check that those technologies fit with that strategy. Did we think that the program that's been proposed is ambitious enough, it's challenging enough and it's bringing through new technologies? And then down the line, we'll actually deliver some economic benefit in the UK, which is one of the reasons our government have put a large amount of money in because of the economic importance of aerospace industry in the country.

Kat: Absolutely. So as you mentioned, some very ambitious projects here.

Dr. Simon Weeks: That's right.

Kat: And of course when you're, when you're aiming high, it's a series of ladder rings you have to climb in order to get to the top.

Dr. Simon Weeks: Yeah.

Kat: So with projects like E-Fan X and more broadly some other electric aircraft, what do you really see as being some of the key challenges and also some of the key advancements we need to make in the next couple of decades to really bring this about?

Dr. Simon Weeks: I think that electrification is all around, clearly, power density, and it's the power density of how you would store or generate that power. So batteries will be actually key to smaller aircraft and the power density needs to at least double from where we are today. The batteries. Electrical machinery. So motors, generators need to hit much lighter, more power dense than they are today. And all of the electronic units you need to manage that power, again, need to have smaller power that's there today. So I think the answer, power density is a key issue and the systems integration around what could be actually quite complex vehicles. So integrating those electrical propulsion systems with possibly with autonomous flight systems as well in the future. Particularly for small, small air taxis.

Kat: And then as far as in all market demand. As we all know in the aerospace industry, the economic viability of all of these products is sometimes really what determines their success. Do you think that the market for hybrid electric or total electric aircraft, do you think that's going to be able to keep up with the amount of time and money the industry is investing in it to get to that?

Dr. Simon Weeks: I think there will be a market there, and one of the things that's driving it is increasing congestion around our societies. We reckon in the UK -- I think the cost of just traffic jams in the UK is at least 9 billion pounds a year. So well over \$10 billion a year, and that's just the tip of the iceberg; commute times are going up and up and up. So does the air offer you a realistic way to block some of that?

Dr. Simon Weeks: Actually, if you can allow autonomous flights, or say electrified aircraft, in air space, you could deliver a whole range of other different services from those. So survey machines, transport of parcels, the construction industry is start looking at using drones for the construction of buildings. So there's a whole world that starts to get unlocked. Electrification is part of it, and autonomy. The ability to allow huge numbers, actually, of small air vehicles to operate in the same air space could well transform the ability to get things from A to B and offer services in the air. So I think it's a really exciting potential future. I think there's a market.

Kat: Definitely. Another advancement we could be looking at in the next couple of years is supersonic flight. There's several companies that are building out

concepts for supersonic airliners; some are even aiming to go hypersonic. The question is, what do you see as the market there? And then of course there are several challenges from involving the international standard. We currently can't do supersonic flights over land, and then there's also the problem with the emissions.

Dr. Simon Weeks: I think that problem won't go away. I think the environmental impact would be a key issue. I think that the moment is being debated in ICAO, which is the international civil airline organization. Supersonic aircraft will use several times as much energy. Going fast takes energy, and if you were to go hypersonic, you're sitting on top of a huge flying fuel tank. So will there be a commercial market and passengers for supersonic? I think maybe for the very rich. Few can afford it because it's going to always be expensive, but I don't see a mass market for it. If we're all trying to fly supersonically that will not be great for the environment either. So I think the market will be there but it'll be small probably for very high-end small business jets. There are, as you know, one or two projects underway of course as an aerospace enthusiast, it's very exciting, but we do need to think about the environment.

Kat: Absolutely. And as you mentioned, the international standard that ICAO is working on, that's another really big issue right now. And particularly in Europe, it seems that the public has a more negative perception of supersonic flight than perhaps the Americans because of course the Concorde, and we all know that wasn't very good for the environment, as cool of a machine as it was. So do you think that, is that really going to be another key challenge to overcome for supersonic airliners? And do you think that if we don't overcome that, you think that can really limit the market?

Dr. Simon Weeks: Yeah. I think, what we see over in Europe is a real upswell of public opinion on the environment and, aerospace is an easy target. You can see lots of aircraft flying around and so I think it's going to be a powerful factor in what sort of stuff we could do in the future.

Dr. Simon Weeks: Already in some countries, if you look in Sweden where this young woman, who very soon will become prominent globally now. It's always leading this challenge environmental challenge. The demand for civil flights has dropped by something like 15% since the campaign has started a few months back. So it's having real impact, people are making decisions on whether they fly.

Kat: Definitely. And then why don't we go back to one of your earlier slides, because I know we were talking a little bit about, I think it was the second one when we were talking about the air transport vision for the UK. That one. So one of the slides here, you're mentioning it's going to take a lot more than just vehicles. We're taking on some of these tact challenges of lowering emissions. It takes a system. Can you talk a little bit about that and how we can go about implementing that system?

Dr. Simon Weeks: Sure.

Dr. Simon Weeks: Obviously when aircraft fly they generate emissions. But depending on how you fly them, that can make a lot of difference. There's almost, at least 10% to come, if we could fly every airline and it's most efficient course to go from A to B. That's possible in technology is there. I think to do that now, it's as much, funny enough, it's more about the speed of the politics around aviation that [inaudible 00:13:57]. If you looked in European environment there are many, many separate air control authorities and they will need to decide to adopt effectively the same system and actually, you don't as many air traffic control centers, as there currently are. So there's much of a political issue in Europe, I think it's where the US could move a lot faster because it's a single air transport authority across the whole country, and it's a very big country. So I think it's an opportunity there for US to probably lead the way.

Kat: That's exciting. And speaking of the political situation, of course one thing that's kind of hanging over the UK and has been, for the last couple of years now is, are we coming up on Brexit finally? Is this the moment? Are we going to push it off again? I'm really curious to get your thoughts on what this can mean for the UK aerospace industry, given that a lot of it is exports, and some companies like Airbus certainly seem very scared that there might be a possibility of a no-deal that would effectively make it much more difficult for them to do business.

Dr. Simon Weeks: There was a lot of concern. Who knows whether Brexit will actually happen on October 31st we'll wait and see. That didn't happen the last time, so we'll see. I think if you look, the aerospace companies that I'm aware of in the UK have been very proactive actually, putting a lot of measures into place to ensure that the supply chain and logistics keep flowing. I think that's the biggest concern because I think there were various already agreements in place that limits customs duty and all those sorts of things. Charges for going across borders. The key thing is, will Brexit make the whole process of getting from A to B across Europe, or between mainland Europe and the UK much more difficult, and as far as I'm aware, most countries have done something to try and alleviate that. So I think there'll be a few bumps in the road, but I'm pretty confident the industry will rally rank and find a way to get around it.

Kat: That's great. Do you also think there's a possibility that depending on what kind of Brexit deal we have, do you think there is a possibility this could affect some of the initiatives that some European countries are headed towards right now? Particularly regarding lowering emissions?

Dr. Simon Weeks: I think that will stay, and interestingly, Theresa May, before she finished as Prime Minister, committed the UK to zero emitted carbon by 2050, which I think it's the first government internationally to do that, and that's a hugely ambitious target. So we were trying to figure out, could we actually do that aerospace, and if so, how do you do that?

Dr. Simon Weeks: It's not just the air vehicles, it's the transport system it's the fuel that we use as well. So how do we get more low carbon impact fuel into aircraft? And again, the solution, these politicians need to do something to start the market to make

alternative to fuels and affordable with respect to fossil fuels. You know, there's a lot that can be done to do that, but I think that push to low emissions will continue in respect to the Brexit.

Kat: That's very good to hear. All right, we're going to open it up for questions now. So we have our lovely box mic. Carmela has it! Raise your hand if you'd like to be the first to catch this lovely box and ask a question.

Kat: Thank you sir.

Speaker 4: Energy density like [inaudible 00:18:07] hybrid. You touched in your slides on fuel cell technology.

Dr. Simon Weeks: Yeah.

Speaker 4: Are there other, and I know battery technology [inaudible 00:18:20] energy [inaudible 00:18:20]

Dr. Simon Weeks: That's quite interesting. At the end of the day, there's no magic bullets. Whatever engine source you look at that, there are always some issues with it, but we can move toward a more electric-based system.

Dr. Simon Weeks: And you mentioned fuel cells. They look from the surface quite attractive because you can get several times the power density in a fuel cell than you can in batteries. We're seeing now some projects coming forward, demonstrating fuel cell powered aircraft [inaudible 00:00:19:12].

Dr. Simon Weeks: The people pushing forward there, it becomes a real attractive business model, particularly for shorter range several hundred [inaudible 00:19:19] flight, with a fuel cell powered aircraft. And the operation cost would be half or less than conventional say, [inaudible 00:19:34] powered aircraft. I show the ranges.

Speaker 5: I have a related question with energy density as it related to safety. I worked in [inaudible 00:19:48] and what we see is energy density has been stalled out because of safety and longer visits for the last 50 years, and do you see any case where batteries or fuel cells some plateaued, because of safety [inaudible 00:20:10].

Dr. Simon Weeks: I think one of the real challenges with the battery-powered aircraft, the problem would be how much endurance you get. Can you do a commercial use to fly, for only 5 minutes or 10 minutes and have sufficient energy reserved if something goes wrong and you need to land somewhere, or the destination landing pad isn't available, what do you do? So that's always the [inaudible 00:20:46] is the energy reserve, and that's the real problem with battery-powered aircraft.

Speaker 5: I was thinking also, high-energy batteries tend to catch on fire [crosstalk 00:20:57] there is that safety concern also.

Dr. Simon Weeks: Yeah, and people have been looking at that very [inaudible 00:21:05] There's a lot you can do. In the UK there's a big battery technology program, and [inaudible 00:21:12] as well, I think it can be dealt with, but it does add weight and complexity. People are bringing new types of batteries, as well. Solid state within technology, which should be fairly resilient if you've seen. And since we'll, some of the liquids in the lithium batteries.

Dr. Simon Weeks: So if you've been from the runway and you've got pressure built up, the cell ruptures, you get a fire.

Kat: Okay, who would like to be next?

Kat: It's the pressure.

Speaker 6: You mentioned environmental concerns in Europe, airports has a lot of restrictions as well. Do you see noise and annoyance having the same environmental concerns in Europe, and how do you see the smaller aircraft?

Dr. Simon Weeks: Noise is a hugely [inaudible 00:22:38] issue. And it's quite interesting you asked the public what are the flight powers at Heathrow, what are their concerns? And their concerns are, oh well there's more aircraft, they're getting bigger and getting noisier. None of this is, it's a human perception issue. And that perception kind of ratchets up over time. So people's expectation changes. So I think this is a huge challenge for aviation, air taxis. Yeah, they've got to have almost negligible noise impact otherwise there will be a public separate policy issue. But if it interests you, Paris processions, the company makes a small battery pair of trainer aircraft, which is proving quite popular and you could hardly hear that fly. Whereas normally a little GA, you hear the engine, but couldn't hear a thing. So I think electric vehicles will stay quiet, but they won't be noiseless. If you move air, you're going to make some noise. I think that's one of the biggest challenges.

Kat: All right. I believe we have time for one or two more questions. If anyone else would like to ask one, let the gentleman have the opportunity to throw the mic box.

Kat: All right, well I'll step in and ask a question then. So we had Paris air show a few months ago. We're having this forum this week. Can you talk a little bit about some of the projects you've seen over the course of this year, the last couple of months? Some of the big ideas and concepts out there that are really exciting you at the moment.

Dr. Simon Weeks: Yeah. Certainly our biggest area of work is, is future propulsion, and you're gonna hear more, I'm sure from my colleagues because that's a big chunk of our propulsion program in the UK and they're bringing something called ultra high bypass ratio and engine technology. It's probably one of the bigger changes Rolls Royce has done in many decades, it's totally new architecture. Huge

amount of new technology, very challenging technology. So there's a huge amount of exciting stuff there.

Dr. Simon Weeks: Some of the other things you've been doing, the UK is putting together some unique collaborations with people but that don't necessarily naturally come together. So we pulled together about 13 different groups on the program to bring through radical new ways of developing safety-critical software. You have all these people suddenly realizing not surprisingly, there are other companies out there working on software, and they developed a very openly collaborative way of working, and brought through certain phenomenal improvements on how quickly you can develop software. That's hugely important because the cost of software development for aerospace is rocketing. We're building more and more complexity and so the cost is going up and up. Each generation of products we develop. In fact some of the work that we did back in Rolls Royce a while back showed that within the back 20 years, the biggest cost element of developing an engine to be the control system software, which is a bit scary isn't it?

Kat: Definitely.

Dr. Simon Weeks: So maybe we should have more on software here.

Kat: All right, well we'll submit that for the next forum we have, for sure. Well, thank you so much Dr. Weeks for being here with us today and if you folks would like to see him speak again later this week, he is talking at a panel on the advancements in gas turbines and that's going to be 2:00 PM in remind me which ballroom,

Dr. Simon Weeks: It's just just round the corner from here.

Kat: Just around the corner. It's either ballroom 5, or 3 or 4. I'm sorry, I can't remember the exact one, but please check out Dr. Simon Weeks at that panel. Thank you so much again for speaking with me today.

Dr. Simon Weeks: Yeah, you're very welcome, Kat. Then I'll leave you with this slide, a shameless commercial for the ATR conference in November of this year. So I think it would be the major aerospace technology conference in the UK, a lot of the top names from industry. You know, CTOs of rolls Royce, Airbus, [inaudible] will be speaking there, so it'd be a great event.

Kat: Wonderful.

Dr. Simon Weeks: So I hope to see you in Birmingham in November.

Kat: All right. Thank you so much.

Dr. Simon Weeks: Thank you.

Kat: That was great.

Dr. Simon Weeks: Good.

Kat: Yeah.