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PRESENTS

The Corporate Innovation Podcast

Episode 21: The impact of quantum technologies

Guest: Thierry Botter, Head of Airbus Bluesky and Deputy Head of Central R&T at Airbus, previously a Strategic Advisor to the European Commission on Quantum Technologies in conversation with Kris Østergaard on why Airbus is exploring the cutting edge of technology in quantum computing to create the future of aerospace.

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Kris: So we're here on the Corporate Innovation Podcast with Thierry Botter. So, Thierry, he is the Head of Airbus Blue Sky. He's the Deputy Head of Airbus Central R&T and the Strategic Advisor to the European Commission on Quantum Technologies. He also has been a postdoctoral scholar at NASA Jet Propulsion Laboratory and a Doctoral Researcher at UC Berkeley.

I'm talking to Thierry about, one, how Airbus designs for innovation in a very difficult industry, or set of industries, if you like. And more particularly, we will spend the majority of our time talking about how they are exploring quantum technologies and why they are exploring quantum technologies. But first off, welcome here on the podcast, Thierry.

Thierry: Thank you, Kris. Delighted to be here.

1:37

Kris: So before we start talking about how you design for innovation and specifically how you are exploring quantum technologies, I would love to just hear a little bit about, you know, your journey so far. How do you get into, you know, aeronautics and how do you get into quantum technologies and what's your journey been?

Thierry: Growing up, I've had two passions, two interests, on those very two topics. On the one side, aerospace and especially the space side of aerospace. And on the other hand, it's been physics and quantum physics in particular. I've had the luck, the fortune to be able to explore both doing a master's degree at the University of Illinois in aerospace and thereafter a pHd in physics, specifically called atomic physics at Berkeley.

And so that gave me the opportunity to explore both worlds. Following my studies, I was given a first work opportunity at the Jet Propulsion Lab and that itself was sort of a nice environment to marry the two fields together. On the one hand, aerospace for space exploration that JPL is leading. And there I was working specifically in the quantum sciences and technology team, supporting the team to develop a number of different quantum set sensors, especially quantum accelerometers.

So it was quite, quite interesting to have this first opportunity. And from there, I was given the next opportunity to lead a team at Airbus. I packed my bag, moved over to Europe and started off in the optics and optronics team where the focus was more on using light for different applications, communication, sensing, and even in those two fields, quite different in applications. The communication was both inside of a vehicle, be it an aircraft or a satellite or between vehicles to try and interconnect them. And for sensing, there too, it was both local within aircraft or within a set body. Health monitoring was a big topic, but also remote sensing. So long range sensing and trying to leverage different types of technologies. A few years after starting at Airbus, as part of a larger reorganization, I was given the really exciting mandate to start a new domain, one that was going to be focused on basic research in our blue sky.

We'll get more into it in just a moment. But Blue Sky has been a wonderful experience where I was able to reconnect with that quantum side of my person and be able to really forge that and push that topic on behalf of Airbus for a wide variety of applications that we have.

4:23

Kris: Wonderful. And we're going to talk some about the work that you're doing at Airbus Blue Sky and also really the set up and how and why you chose to set off the way that you did. But maybe it's helpful for our listeners also just to get a short general introduction to our boss as an organization. So maybe a few words on what kind of thing Airbus actually is

Thierry: Yeah, certainly. So Airbus, I think, is very well known for the civil aviation products and solutions that we have. Many people have flown in our airplanes. There are, pre-pandemic, there was an A-320, which is the largest family class of aircraft that we have taking off or landing somewhere in the world every two-ish seconds. So it just gives a sense of the magnitude of the number of aircraft that we have flying around.

But Airbus is not only producing airplanes, we also have a helicopter business. We have a defense and space business. So developing both military aircraft on the one side, satellite system, we're a leader as well with telecommunication solutions. So are engaged in a number of different

fronts, a number of different areas. And the type of research that I've had the pleasure leading at Airbus is really designed to address all of these individual areas.

5:46

Kris: Yeah, and so given the nature of the work that Airbus is doing, the need for research and the need for innovation is massive, right. And everything is sort of complicated. And so tell us a little bit about one, Airbus Blue Sky that you had the opportunity to sort of found from scratch. And also the work that you're doing at Airbus Central R&T. And so what I'm interested in here and what I think it could be really interesting is to understand how you are approaching research and innovation through those entities and what is your design thinking around that.

Thierry: Yeah. So you're absolutely right in saying that for a company like Airbus, research is essential. We're constantly looking to anticipate the future and prepare for that future. Blue Skies specifically was given a very unique domain to begin with, and or rather a very unique mandate. And that mandate was to dive into the basics and even speculative research so somewhat removed from Airbus's day to day activities. Pick out some of the more promising activities. Some of the more promising scientific areas. And to work then with academics, with research centers to explore and understand if and how these areas could eventually become critical solutions for the aerospace industry. So it's such an exciting mandate. How do you then make a choice?

Kris: Yeah. So that is wonderful and really exciting and open, right. Which of course also might make it really difficult because you know where to focus, where to head off with all that opportunity out there in the world. So how, I mean, how do you decide, how do you know which areas/domains to look into? Start exploring or start to experiment?

Thierry: Yeah, if it is up to us, we'd love to touch on and explore diving into all of these areas. But we do need to make a choice, as you say. And so for us, the process of selecting those areas, picking out those projects ultimately start off with establishing a clear thesis.

So we want to have a clear vision and a language to accompany this vision articulated around known pain points in the aerospace industry, the state of the art and ongoing research activities in designated or identified scientific areas, and even some of the larger societal trends, because ultimately our solutions are there to serve people and future generations. So the blend of those three and the storyline that we create underpins the activities that we do. And it's based on an evaluation of these species that we pick out the ones that we think are most promising are most impactful. And it's in those areas that we decide to engage in.

8:48

Kris: Can you give us sort of an example of what a process looks like sort of when you start to ideate? Do you get together in a room and just brainstorm? You know, what kind of milestones, what kind of processes do you go through in order to reach a certain result?

Thierry: There is indeed a coming together of sorts where many different people sometimes have different background ones as well. We'll exchange. We'll ping pong ideas. We also have built into our processes designated exchange forums and exchange plot forms where ideas are floating around. People get to think about them, reflect on them and ultimately together start to crystallize these ideas and these species and these proposals, and then start to articulate them, start to solidify them.

There is then a review. So these ideas will be reviewed, maybe challenged in a way ultimately to try and make them even stronger. And then a selection is done by committee, both at least at Blue Sky with myself leading it. And in a moment, we'll talk about R&T and the process is very similar, but involves a slightly larger panel. So there's a whole build up to it. And yes, it really leverages the creativity of our people. The capability of our people. And quantum technologies has been one of those topics that have come through the pipeline that way.

10:27

Kris: Yes. And we will dive into that in a few minutes. But before we get to that, let's also talk a little bit about, as you also just mentioned, central R&T. So what goes on here and how does it differ from what you do at Airbus Bluesky?

Thierry: So Central R&T is at the very base of Airbus's broad research and development chain, Blue Sky is a part of that base. But it's not the only part. There are other domains that are part of Central R&T and they're all touching on one or another area relevant for Airbus.

Those domains include artificial intelligence, virtual product engineering, which is about advanced simulations, modeling, digital twin, electric electrification. So pushing towards ever more sustainable flight, advanced materials as well, and future communication technology solutions spanning a whole series of media, be it in the RF spectrum, optical spectrum, inside of an aircraft between aircraft. And so the organization as a whole is quite large. It spans over many of Airbus's primary locations.

And again, just as described in the case of Blue Sky, the way we work as a whole, as an organization, is really trying to leverage the group of individuals that we have, the ideas that we have floating among them, and to center them on these thesis and these project proposals blending in both scientific development and future needs for Airbus.

Kris: And so the sort of the synergies between Airbus, Blue Sky and Central R&T, which comes first, if that is a question that makes sense or do you sort of run in parallel and how do you interlink?

Thierry: By design, we try not to have silos. I think one of the crux of many organizations is the ability to have this exchange of information. And this growth of ideas almost in an organic way by blending in different perspectives and different knowledge bases. Central R&D is designed in this way to really promote that very activity so that you can get a very effervescent research environment. Bluesky is a part of it but we don't operate in isolation. We don't operate in a silo.

We really try and work with our colleagues and partners from other domains. And so it's together that we explore different areas. One of the other research areas at Blue Sky at the moment, again, selected on one of these thesis has been bio based solutions for aerospace. And one of the areas, one of the projects that we're focusing on at the moment is sustainable recycling of materials.

So can we leverage mother nature over millions of years of evolution who has developed a plethora of different bacteria, so small living organisms that are chewing on different materials, digesting a number of different materials? Can we use that for the purpose of our goal of having a sustainable aviation sector, helping us to digest some of our parts, some of our components at the end of an aircraft's lifetime? And this work is one that we'll do in collaboration with our material scientists, colleagues, bringing in their knowledge, their expertize. And it's this interplay, this blend between the domains that I think really makes CRT both a unique but also very strong research organization.

14:06

Kris: And so one of your core focus areas here, which is also at the core of our conversation here, is quantum technologies. And so now whenever it comes to quantum right, and maybe it's different if you're a pHd, but for the rest of us, everything gets weird, right?

It's sort of like a common sense and common scientific knowledge seems to, you know, not really be at play at the same levels at all. And what we're used to, right. So that, of course, also makes it really interesting. So maybe we'll sort of take it from "A" here in order to sort of paint a picture of what we're talking about. What are we talking about when we're talking about quantum technologies? Why is it exciting what is going on at the quantum level here? So I threw up a couple of balls here. Maybe you 'll take it from where, you know, it's smart to to start with lay people.

Thierry: It's funny that you mentioned that quantum technologies get fuzzy very quickly, partly because by design in its fundamental aspects, it is fuzzy. But also it's to a point where we've even developed language. Talking about the classical world is the world that you and I know every day in the quantum world, which is its own special thing.

Let me try and unpack all of those questions by starting off with the concept of what is a quantum technology or what are quantum technologies. Fundamentally, there are technologies that harness fundamental properties that underpin our world. Quantum mechanics. Quantum mechanics is around us. It operates in everyday life. We simply don't realize it and we don't realize it because they manifest themselves in very unique conditions.

So they're elusive, these properties. They're difficult to get to. But once you do, once you are able to isolate conditions where those properties, quantum mechanics, becomes the dominant force and the dominant factors at play, you enable a whole new series of capabilities which can then be applied for different purposes, and this is where the technological dimension comes in.

There are several streams that are being explored at the moment within the broad umbrella of quantum technologies. Three important ones, in my opinion, are one, quantum computing and simulation. Two, quantum communication and three, quantum sensing.

Each of these has its own characteristics. We can certainly take the time to go through all three of them. But I think in a nutshell, trying to give a language that wraps around the entire concept of quantum technologies, I think that's the best way to put it.

16:57

Kris: Yeah. Wonderful. And let's spend a little bit of time maybe just highlighting the three different areas and what is particularly of interest here.

Thierry: So, starting with quantum computing, the characteristics there is that information is processed not through the usual bits that you and I know, the zeros and the ones that circulate through a computer and through our WIFI system and across the World Wide Web but instead, we are working with quantum bits, cubits for short. These cubits have a unique property in that they are not zero or one, but rather can take on the property of the values of both zero and one. This is known as quantum superposition. It's a well-known characteristic.

In addition, instead of having these cubes operate as single, isolated entities, they can actually be interconnected and actually interconnected in an inextricable fashion, which means that the information that one carries is intimately tied to the information of another or more cubits around them. So this characteristic is known as quantum entanglement. And by leveraging the two entanglement and superposition, what you end up doing is having the power to process information, a wider spectrum of information with fewer cubits.

Let me try and give an example. If I wanted to represent the numbers zero and the number one, I would need two bits. I would need a classical bit zero and a classical bit one. In the quantum world, I can consider both of these numbers simultaneously with a single cubit. And then I can start to extrapolate, well, what if I wanted to carry the information of zero one, two and three. Here, I would need four classical bits, but only two cubits. And if we keep going. We realize that it's actually an exponential scaling. So when it comes to high-performance computing, some of that more heavy duty calculations that we have, where one needs to explore a very large calculation space, consider many different parameters and many different free variables.

This ability to have exponential scaling in information with a very small number of cubits is really what gives quantum computing a huge amount of power. And that's the reason why Airbus is researching this topic, why there's an entire industry forming around this topic. It's to really be able to capture this property. Now, it still remains difficult to do today.

Quantum computers are just starting up. Computer sizes are small, but very powerful. And it was demonstrated very well by Google last year, who had a paper that demonstrated what they called quantum supremacy. They had one calculation. It's very mathematical, and doesn't have much of an impact for day to day application. But this one mathematical problem that they were able to solve. They were able to do it better than any classical computers, at least faster than any classical computer. And that was quite a pivotal moment, I would say, for the development of quantum computers.

So we can see that it's starting to pick up today. It's being able to answer some very fundamental mathematical problems and soon in the future, companies like Airbus and others are going to want to use it for, quote unquote, real world applications to help us solve more difficult, intricate airplane design, for instance, optimizing our distribution of parts in a very complex supply of parts and supply chain organization. These are sort of the problems, the types of problems that we're after.

Kris: Yeah, just a quick note here, sort of, because it can be sort of hard to wrap your brain around, right. But what we're talking about, once we are able to leverage quantum technologies to maybe not just full effect, but a larger effect is and you can give examples better than I can.

But some of the examples given are that while even supercomputers today might need to spend hundreds or thousands of years doing calculations, we are talking seconds or minutes with quantum computing. Is that correct?

Thierry: This is where we're going. We're not there today. I think the larger super duper computer is for much of the, again, quote unquote, real world problems remain the more powerful computers. But the activities that are going on now is to try and understand how do we maximally leverage these quantum computers, these cubits, to help us answer these real world problems.

And it's a matter of both the software side and the hardware side. On the software side, what are the algorithms? What are the approaches? How do I orchestrate my computer in order to produce an answer that I can then utilize for the very application that I'm looking to answer? And on the hardware side, it's making them bigger, more cubits. It's making these cubits themselves better.

So to be able to hold information for a longer period of time and more accurately, to get them to talk to each other in a better, more consistent way. So all of these are individual steps that are being taken in parallel. Many different companies, many different research organizations, all working towards the same goal. It's a very exciting time to be in the quantum computing area and to see this development happening.

22:33

Kris: And what are the timescales that we are looking at here? I don't know how precise you are able to be giving that is a lot of this or most of it is highly experimental, right. But we're talking,

you know, dramatic changes to the world in a 5 year time, 10 year time, 100 year time. Nobody knows. What are the boundaries here?

Thierry: If I knew the exact solution, I'd be a millionaire. I think it's a million dollar question in our field. I think different people will give different answers. For me, my answer is based on what I see when I look back in time. So if I may for a moment, if we look back over the last decade, we started off in 2010 with just about no quantum computer. Maybe a few systems that had isolated cubits that you could address. And one organization or one company that was really on the market at that point in time, D-Wave, that has a very special flavor of quantum computers.

If you fast forward through those 10 years, we now have many more companies that are actively engaged in this area. Some of the big players like IBM and Google. Many, many startups that are coming up as well. Algorithms have been developed. So the rate of progress has been tremendous over the last 10 years. And so if I take that and I then project myself over the coming decade, I think the number of capabilities and the number of real world applications we will be able to solve with a quantum computer will start to manifest themselves in the next 10 years.

In which area? And for what purpose? This is, I think, very difficult to answer. Different sectors will have different needs. We believe, I believe, that the aerospace sector will be one of those to capitalize, but it'll be in very specific cases or for very specific applications. And as we continue to mature the technology, you'll see more and more fields being able to benefit from it. The types of fields that are today engaged in it are the transportation sector, like aerospace, for instance. We also have the chemistry pharmaceutical industry looking at it. Finance world is looking at it for portfolio optimization, energy sector for distribution of energy and energy resources. There are a number of industries looking at this. And again, fast forward to 10 years from now, I think you'll see that many of them will start to capitalize on this technology, which will mean even more development for the following 10 years after that.

25:04

Kris: And so what do you think then? If we look 10 years from now, being a normal person in the world, how will we experience the impact of quantum technologies?

Thierry: I think for the everyday person, it might not be so transparent. I think that in 10 years time, your laptop, my laptop will not necessarily carry with it a quantum co processor. But I think a lot of the resources we will use around us, some of the drugs we might consume, how we invest our money or the the organizations who hold our money and invest it on our behalf, types of tools they utilize and the airplanes in which we fly, the automobile sector and the distribution of cars so car fleets.

I think all of these have a strong potential of being impacted to varying degrees by quantum computers. So without necessarily realizing it as we go about our lives in 10 years time, I think a lot of the solutions that we rely on for everyday life will have a component that will be coming from the quantum ball.

Kris: And I guess this also points to that, you know, our listeners here are primarily, you know, executives, professionals from a variety of industries. But I guess it points to more and more professional shoots, you know, become more than just curious about quantum technologies but actually start to figure out how to investigate and how to experiment, right?

Thierry: Absolutely. And I think not only are we seeing this by some companies like Airbus, you know, being bullish on the technology and forging ahead to look at how it can become an important part of their toolset. But you also see governments getting heavily engaged.

The European Union already back in 2018, launched the quantum flagship - billion euros over 10 years to catapult the domain within Europe. Individual member countries are now as well adding money to that. You've seen a few countries like the Netherlands who are early to move forward. Germany has now announced its own program, two billion euros. France is in development outside of Europe. The United States has put in a first amount of money. They've recently announced an extra billion dollars. China as well has been quite active in this sector.

So we're seeing this large public sector pushed. I would say movement towards capitalizing and harnessing quantum technologies. So it's very much emerging, in my opinion, from an upstream research topic to an important publicly backed mainstream research activity that will become important and strategic over the coming decade.

28:46

Kris: Yeah, and I know you're also an advisor to the E.U. on that specific flagship program that you mentioned here. And so that's another thing that's interesting. One is what companies are doing within this field. Another is what countries and regions are doing. And similar to A.I, there is some discussion around the notion of who comes first, right?

And is this a winner take all scenario with whoever cracks a certain not first, then they will have, you know, the power within this field and or multiple other fields. How do you use it? How do you see this?

Thierry: I think it's topic dependent. So between the different quantum fields, quantum computing being one, but also communication and sensing is the other two, I think each of them has a slightly different characteristic. If I focus on quantum computing, my impression is that with different flavors of quantum computers without going into details, simply to know that there are some quantum annealers. And then with what we call digital quantum computers, you even there have different sub flavors with superconducting connecting cubits, ions, photonic systems called atoms. Each of these have their own characteristics, advantages, disadvantages.

My suspicion is that depending on the problem or the nature of the problem that you're looking to address using one of these computers, one or another, one of these flavors will be the better one for you to utilize. So, to the question, is it a winner take all scenario? To me, it's not so crystal clear. I think it will depend more on the particular application area and the particular method that

is used to solve it. And I think we'll see a few different winners coming out, popping out because of that.

Kris: And which area in the world or region in the world, the U.S., China or EU I guess, are the three big ones sort of the most bullish on this?

Thierry: All three of them, I think, are very actively engaging in this area. And they're not the only ones. Other regions of the world, they're also developing their own programs, developing their own ambition. So I think really, as a planet, as a globe, it's a very exciting time to be in this field.

There's a general desire to want to pioneer this capability and to bring it to life, so to speak, to really enable the new solutions that we expect to get out of quantum systems. So I think all of the different regions of the globe are engaged, have a program.

What we're seeing at the moment, what we're experiencing is an acceleration of that trend with even larger programs, more public funding being put forward. And I suspect that this will continue for a certain period of time still. And which one, which one of these regions will come out on top is, I think, not only difficult to say, but also to some extent not completely relevant in that we as a people, I think, globally want to enable this capability, and there's, we're still in a very early stage that we understand that we're coming to a bit of a tipping point.

I think everyone wants to see this field succeed and everyone wants to help and enable this to come to.

32:22

Kris: Yeah. And looking at it from a global perspective, what is your thinking here? And so I don't want to put you on the spot because it's a big and very difficult question. But now we're in the midst of a pandemic, right? We have global climate change, a climate crisis, some of these very, very big global issues. What is your thinking around the role of quantum technologies in helping the world solve these massive, massive challenges?

Thierry: I think we have a number of different challenges, as you say, that we need to address collectively in unison. And we rely on a number of technologies to help us do that. Better technologies are coming up. Quantum technologies are among them. And I think that the ability to leverage them together as a species, to be able to provide better climate models, better weather prediction as one example, to be able to better understand the spread of viruses through changes, et cetera.

That requires heavy duty computation, heavy duty calculations. Quantum computers, I believe, will have an important role. And so to me, it's again, it's a bit of a Pandora's box. It's an area where multiple actors can come together and really contribute to this. And I suspect that over the coming decade, it's only going to continue forward and accelerate even in that direction.

33:53

Kris: And even if we're not trying to solve the climate crisis, as organizations start looking towards quantum technologies to figure out how they may be supportive in whatever missions we're having in our organizations, I mean, even building a quantum computer is not just an easy task. I mean, so maybe you can share a little bit about how do you actually go about as experimenting with quantum technologies.

Thierry: So let me come back from an Airbus perspective. I think for us, very early on, it was clear that we were not going to engage in this area to build a quantum computer. It's not our field of expertise. And we know that there are many, many players out there already working in that space. What we wanted to do was to be able to leverage this capability for our future needs.

And speaking of global initiative and a global topic, one of the ways in which we decided to do this was by actually engaging the quantum computing planet. And we did so through the Airbus Quantum Computing Challenge. This was an open source, open innovation challenge that ran through 2019. It was underpinned by five different problem statements.

So five problems that emanate from one of our most important areas of activity and development called applied physics, which is, broadly speaking, all of these scientific and engineering fields tied to the flight of an aircraft almost as existential to Airbus as an organization. And this challenge was an opportunity for us to capture some of the great ideas that are floating out there to see who are some of the contributors. And ultimately, we wanted to be able to select winners and work with them to further their solution, further their proposal, and bring them to work directly with some of our engineering team. This challenge has been an extremely powerful event, a very successful one. We were delighted to see a thousand plus people following the challenge, registering at our webinars, downloading the problem statements. And these thousand people were really scattered across the globe from top of my head. I think it's 70 plus countries on five continents. So I think it just shows the genuine enthusiasm and excitement there is for this field. And we're really excited about the way forward.

We'll be making an announcement later this fall on shortlisted candidates and the winners at the very end of the year. And starting next year, we'll be taking steps forward with the winners.

Kris: Yeah, interesting. And I guess it points to the need for open innovation doing initiatives like this. I don't know the numbers. I'm guessing there are not a lot of quantum technologies, superhero experts out there. Am I right?

Thierry: There are. There are not many of them. There are rare resources. And I think if you're in a sector in a business where you're relying on those experts to help you develop your hardware, your software or other technologies. I think you're fighting hard to try and recruit the best among them. And so precisely because it's hard to know who they are and where they are, I think this open innovation challenge was a great way to go about it.

Also for us, it was a clear signal that there's a genuine appetite from this community to understand how their knowledge, their skill set can be applied in a sector that they might not

master. Like the aerospace sector. And they're looking for entities like Airbus to come forward and bring forward some ideas. So we brought forward what we know best. The aerospace sector, the very types of problems that underpin our business and work with that community as best as possible and develop a tie.

And we're really excited to keep going and keep this momentum towards more collaborative work with the entire quantum computing community.

37:50

Kris: And then speaking of the people here at the core and and who you actually need to engage with in order to conduct your experiments and ultimately move forward to concrete solutions, how have you structured your organization? Which kinds of people do you have in the organization in order to move forward?

Thierry: Focusing again on quantum computing, we, I think, looked at the types of profiles that we have. We have a longstanding history of deploying high-performance Computing at Airbus. So some of our more heavy duty calculations, we've had to treat these problems for many decades. We have people who have that expertize. So it was clear to us very early on that we wanted to leverage that knowledge base, those capabilities, that human capital that we have.

And we wanted to do so in a constructive, collaborative way by bringing these folks in close contact with the quantum computing experts, those who really understand that new wave of computing technology that's coming up but don't necessarily have the background in aerospace. And I think this handshake between the two worlds was, for us, an important one. And it is at the core of how we want to work on quantum computing. And so far, it's been a very successful approach.

Many aspects go into it. Some of it is reaching out to that other community. The quantum computing community, getting them onboard, getting them engaged. One other dimension is also teaching, the ability to help people with more of a classical computing background to get familiar with quantum computing to attempt and get first steps there, too.

We've undertaken a lot of efforts, a lot of work to try and make this a core aspect of how we work. It means getting computing access. It means getting training in place. So it's a lengthy process, but it's an extremely powerful one. And I think for any of your listeners coming from an industry, we're thinking about first steps, first ways to engage. To think a little bit outside the box and to think that I already have capital resources, people who have knowledge in computing certainly have an appetite to keep improving, keep developing.

And I think finding formulas like the ones that we've developed, that we've pioneered at Airbus to get them exposed in this field, can be quite powerful and quite transformative. So it doesn't mean having to start from scratch - new team, new folks, new everything. I think there are different ways to go about. And I think this challenge and the way we've set ourselves up is a testament to that.

40:37

Kris: Yeah. And so, you know, you're pointing to sort of what we might talk a little bit more about than in the last five minutes or so of our conversation. The listeners who are, you know, running innovation labs or research labs or are executives running the entire company or whatever roles they may have, I mean, if they want to explore quantum technologies and they have this notion of there might be something in there for us. How do you go about that? In terms of taking the first initial steps to actually figure out if this is something they should explore more and then move further forward. What's your thinking here?

Thierry: I think the essential bit is not to stay inert on the sidelines simply because we don't know how to take that first step forward. I think there are many different paths forward. I know of colleagues in other businesses that have taken perhaps a more traditional path of getting a team around them, folks dedicated to quantum computing in this case and working in tandem with some of their internal teams.

So it's a different way to operate. It has its own set of advantages and disadvantages because there are different ways of working and different ways of going about, I think having simply the courage to make the first step and if a first step needs to be done at moderate scales, at reduce scales, to think about ways to engage with that broader community can be a powerful way to go about. I think there are different ways to do that.
The key take-home message is to not be afraid to take that first step. I think there are different ways to do it, and it's a matter of being creative and leveraging the resources that you already have internally as best as possible and marrying that with what the outside world has to offer.

Kris: And what are the great “easy” steps to take to start doing experiments and then figure out what the opportunities might be?

Thierry: I think if different industries go out and seek and try to reach out to two different quantum solution providers, they'll find that there is already a large number of them on the market. Many of them are there to try and provide solutions. Some of them have already developed types of coaching sessions or training sessions. So it's a matter of just tapping on the shoulders of either startups, research teams as well.

There are many of them across different countries. And to different extent, they've already engaged in one way or another with industries. So there's ways to kind of take those steps and learn from their initial steps. And I think ultimately what we will see as well within industry is a new generation of young graduates coming out who will have had a basic training, not just in the pure physics, the, you know, deep research level, but on a more engineering level of how to leverage quantum technologies, quantum computing in particular, and who are natively familiar with the basics of coding on quantum computers and the basics of operating a quantum computer. And that will in itself bring in a new generation of capabilities for enterprises.

44:06

Kris: And so in the end, bringing it back to you guys and the stuff you're experimenting with or working on. What are you most excited about right now, that looks really promising for you?

Thierry: There are things I'd like to share, but I can't. We have, I think one of the key things is that we've seen the transformation that I've been talking about, about trying to leverage our own knowledge base, our own people and the capabilities that they carry.

We've seen and we're experiencing a change within the organization, a larger and ever larger appetite to understand quantum computers and in engaging in this area, one of the things that happens is that people start to understand the potential and also the challenges of probabilistic programming.

What I mean by that is that quantum computers don't provide you with a single exact answer, but it gives you a probabilistic answer. And so you need to also understand how you deal with a solution that is not certain at 100 percent. And that's a powerful transformation that needs to happen. So for us to see this change happening internally, as well as the success of some of the ongoing projects and the fact that next year we will be taking this step with a quantum computing challenge. All of those are very exciting activities.

In addition to that, we have work happening now on quantum communication. So this is the ability to secure communication, making it resilient against potential hacking attacks from quantum computers, actually. So the very computers that we're developing, they're both powerful tools for simulation and modeling. But unfortunately, they can also be used for hacking and decrypting attacks. And so we want to safeguard our own communication against that. And we have a number of exciting activities there, too. Those are unfortunately a little bit more difficult to share at this present time.

Kris: Yeah. So regardless, thank you for sharing whatever you are able to share here. I understand there's a lot going on that is still for a number of very good reasons. No doubt that, you know, quantum technology is, broadly speaking, something that we will be hearing more and more about.

And so this is, I think, a great opportunity to take your advice and your insights into figuring out if you aren't already out there, really start to figure out and think about how are we sure that we get on this bus, so to speak, as well. So with that Thierry, thank you so much for being here on the podcast and sharing insights from this very exciting and weird place that you are working from. And thank you so much for being on the podcast.

Thierry: Thank you, Kris. It was a pleasure.