

09252017 Envision Digital Transformation Keynote Judson Althoff

**Envision**  
**Digital Transformation Keynote**  
**Judson Althoff**  
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**ANNOUNCER:** Please welcome Executive Vice President, Worldwide Commercial Business, Microsoft, Judson Althoff. (Cheers, applause.)

**JUDSON ALTHOFF:** Well, good morning and welcome back. I'm really excited to be able to spend the next 45 minutes with you talking about digital transformation in real life, and all of the work that we're doing together across the industry.

My aim over this next period is really to do two things with you: One, to talk about the four solution areas that Satya in his keynote really went into depth and showed you where we're innovating and developing new solutions, and bring them into context for how they drive digital transformation.

And then the second thing I want to do is talk about the business impact, the things that we're doing together, the great solutions that you're building with your technical counterparts to truly drive digital outcomes and business impact across the industry.

I want to start with this notion of the intelligent edge and the intelligent cloud. And Satya spoke about this this morning, but I really want to bring this paradigm shift into context and talk about how it's driving digital transformation.

There are really three characteristics around the intelligent edge and the intelligent cloud that are important to contemplate in this notion, this journey of becoming digital.

The first is this construct of multi-device and multi-sense. Just to be clear in terms of definition, when I say "multi-device" I'm no longer just speaking about the notion of having multiple cell phones, tablets, PCs that you can use to harness productivity in a working environment. I'm talking about the fact that literally every experience we have today, whether it be social, your private lives, in your work lives, is surrounded by this notion of ubiquitous compute.

If I were to simplify or add simplicity to this notion of the intelligent edge and the intelligent cloud, it really is just that. It's this notion of ubiquitous compute and limitless data and how we marry the two together to drive transformational outcomes.

In multi-sense and multi-device, there are literally sensors that surround everything we do, whether it be the intelligent agent that you use at home, a social experience that you have maybe going to a concert, snapping in some photos or video, posting that through social, to work experiences, to travel, to conference, to entertainment that you do with your friends and family.

Whether that data that comes from that experience is used to enrich your personal lives or to fuel better productivity at work, it's fair to say that just about every experience we have today is grounded in some form of compute. Again, personal lives, your autonomous vehicle or semi-autonomous vehicle, your conference room experience, everything is capturing data.

But why? The only real outcome that we want to drive as business leaders is to either enhance employee productivity or drive operational efficiencies or help to transform our products, use the data to actually inform, to become better at what we do.

Which brings me to the second characteristic of the intelligent edge and the intelligent cloud, and that is that artificial intelligence and AI is really being incorporated into just about everything we do, every application we build, every solution we think forward is being grounded on how do you improve that same experience using artificial intelligence.

I want to bring this into context and talk a little bit about what we're doing here at Microsoft relative to AI. In fact, we're drinking our own wine with this underlying technology, both in terms of how we run our support organization, and how we've transformed our sales organization.

In my role, I own the global support organization at Microsoft. So if something goes bump in the middle of the night with your kid's Xbox or in the business environment, somebody in my organization is getting that phone call and those agents are doing everything they can to make sure your experience with our products is the best it possibly can be.

We have taken and fronted that entire experience with artificial intelligent agents. Those agents reason over every data asset that we have from our knowledge base to the continued learning that our support agents provide back into the knowledge base so that we can provide information back to our customers across all of our products around the world better, faster, and more efficiently.

The outcome you might expect me to say is, well, gosh, Microsoft is probably saving some money in this regard, and in fact, we are. We're on track to save about a half a billion dollars in our support organization over the next three years.

But the outcome that you may not predict is that our customer satisfaction is actually going up at the same time. Why? Because once again, we're providing better answers, more effectively and efficiently to our customers than ever before. As well, at the same time, our agents are human agents. When they take over a problem, they have complete visibility to everything the artificial intelligent agent has done to try to solve the problem. So you no longer have to go through this experience of providing your name, your account number, and rehashing everything you've been through to try to solve the problem already. That information is transferred over to our human agent, and so they are empowered to do more interesting work, to solve the real problems at hand, rather

than to simply take you through, well, gosh, is your Xbox plugged in? Have you inserted the disk? Better solutions, faster, more effectively and efficiently than ever before.

We're also using the same thing on the sales side of our business to enhance customer engagement, to really fuel this journey from anonymous engagement all the way through to advocacy.

Our inside sales people come to work in eight centers across the globe, and every morning they have a list of about 1,000 phone calls they could make. But which are the three phone calls they should make first? While they're at home at night with their families, the AI agent was reasoning over their actions, reasoning over our data, reasoning over the next best action to provide daily recommendations to how they can be most effective about going to work each and every day.

When they get on the phone with that customer, the agent is then providing them with the information that's the next best action for that customer.

So AI is truly embedded in every experience that we drive at Microsoft. It's how we run our business, it's fueling the development of our business applications, it's inherent in the core cognitive services that we provide on Azure so that you can capture and harness the same.

This third characteristic of really bringing the intelligence and the intelligent cloud to life and having it go to work for all of you is this notion of serverless computing. Why? What's the importance of all of this?

Well, if you think about what I've said so far, if we've got all of these devices collecting all of this data and we're trying to reason over all of it with an AI agent, that's actually an expensive computing notion. Spinning up virtual machines, containers, to constantly rationalize every data asset that you have in your estate is taxing on your compute environments.

In fact, it's actually the genesis for why we're doing all of the work on cryogenic computing and quantum computing that you heard about in Satya's keynote. So we can solve these more complex problems faster and more effectively.

But serverless computing allows you to spin up processes and spin them back down again in a sub-second behavior. In fact, in Azure, we'll actually be billing you on a per-second basis so that you can spin up these back-end functions and processes to rationalize over the data and spin them back down again so you can provide all of these results in an effective and efficient capacity.

These three characteristics fuel the paradigm shift that we see in the market, they fuel our strategy, and they're what bring focus for us in how we develop and innovate so that we can do more with all of you.

The result in business terms is just this fantastic opportunity that we all have to harness. And I'll be transparent with you; when I first put this chart up, it was built for internal use so that I could actually motivate people inside of Microsoft about the technology opportunity that's forthcoming, because it talked a little bit about the journey that we've all been on together from harnessing a PC on every desktop to the client-server realm of computing to mobile first and cloud first, and now digital transformation.

But I share it with all of you because this isn't just Microsoft's opportunity. It's not just high-tech's opportunity. It's our opportunity, with a capital "O." Because, in fact, every commercial customer we have is becoming a digital partner, they're becoming software companies, you are becoming software companies. And this opportunity to harness digital transformation and the economic opportunity and lift behind it is actually for all of us.

Let me give you an example. I want to share with you some work that we've done with Maersk over the last couple of years. And we've been on a multi-year journey with them. It's spanned from working with them first on container design, container production, putting the containers to work, but equipping them with that multi-device, multi-sense capability. Every container that Maersk builds today now has an array, a sensor fabric that harnesses data coming off the ship.

We then take that data and rationalize it. We've created this massive data lake over which we can reason with algorithms, machine learning, and artificial intelligence so that we can actually help them make better decisions about route optimizations, fuel consumption.

So these things may seem quite obvious to you, but what may not be is what has come next. And that is that we've actually taken Maersk's software assets, their intellectual property, and we've put them on Azure. And we've created a digital partnership that actually allows them to extend that IP to the greater ecosystem.

Now, instead of having a business that's all about moving a container from point A to point B, which is a very competitive business with low margins, they are, in fact, a technology company that's creating an ecosystem where digital port builders can take their APIs and actually have some sensibility about when containers come to port so that the cranes are ready, the crews are ready to take materials off the ship and hand them off to last-mile delivery.

It's creating end-to-end supply chain management as a service. Maersk isn't just about big ships and containers now, they are, in fact, a technology company. And their market opportunity now is an order of magnitude more than what it has been historically.

So, in fact, this is our opportunity. And I want to use the balance of my talk today to talk to you about how to harness that. What's involved in becoming digital? What are the steps you need to take? What are some examples across industries of companies that are doing this well?

I'll have a guest join me on stage to actually show you how they've used the four solution areas that Microsoft has, our areas of innovation to put them to work for their digital transformation.

So Satya talked about these four solution areas. In fact, the essence of his keynote was bringing these to life for all of you. And, again, as I said in my opening this morning, we've done this deliberately. We brought all of you together here at Envision to have a business dialogue about transformation.

And at the same time, running our technology conference, Microsoft Ignite, in parallel so that all of your peers can get a deeper understanding of the organization that we have so that the two can come together in this marriage.

In fact, our four solution areas are purpose built to be the ingredients for digital transformation. If you think about the notion of empowering your employees, you have to equip them with modern workplace technologies that enable them to be more creative, that enable them to collaborate, that provide simplicity, and above all else, security.

You need to equip them with business applications that are no longer systems of oppression, if you will, but rather, systems of intelligence.

And our approach here is very, very different to what you may classically see in this space. Our aim at Microsoft is not to sell you a refreshed CRM system or ERP system, but rather, to very nimbly work with you to deliver business outcomes.

I'll give you an example. One of the customers highlighted in the opening video before I took the stage is Ecolab. And we've done some fantastic work with them on enabling them to deliver clean water as a service.

So you might say, "Well, gosh, how did that begin?" It's really cool to hear about these end-state stories, but how did they get started?

Well, honestly, it was with a CRM RFP, believe it or not. So we get these things and we respond to them, just like any technology vendor would.

And you sit back and you process, what is this customer really trying to get done? And so, in fact, we actually just elevated the debate and the discussion with them and said, listen, we'll respond to you on your CRM RFP, we have a great product, but can we have a discussion about what you really want to do?

Nalco Water, prior to their transformation, was a company that basically sold cooling systems for industrial-sized energy plants, even to customers like us and our data center. They basically sell water valves that enable them to provide water in manufacturing scenarios across many, many different industries.

And so you might imagine that the gross margin and profitability on delivering advanced plumbing is not very high. The complexity around providing service professionals to go do break/fix work, also very costly, and not delivering great bottom-line results.

So we set out on a digital journey with them. Again, multi-device, multi-sense IoT capabilities across every product that they now build. We then harnessed that data. We've created a data estate for Ecolab. It's not about a siloed relational database here or a Hadoop cluster in the cloud, it's about having this common frame, this data estate because, in fact, the system can only be as intelligent as the data over which it reasons.

Once we built that, we then could fuel their field customer service applications, their CRM applications, enable a different discussion with the customer so that the business application pursuit actually creates a new form of customer engagement.

Their field service people arrive long before there's ever an issue. Their sales people speak in terms of EROI, what is the ecological return on investment that a customer might be making? And the result is that they're saving companies like Ford billions of gallons of water on a per-annum basis. In fact, Ford already has saved enough water for 3 million human beings to drink on a per-annum basis.

Fantastic digital outcomes come from the harmonization of these four solution areas. In applications and infrastructure and data and AI being used to fuel customer engagement scenarios and true product transformation, there's such rich work being done here.

In fact, this notion of becoming a software company is not an easy business, so the DevOps capabilities, the open framework that we have on Azure so that you can lift, shift, modernize, and truly rethink how you take your IP assets to market on our platform can be done very efficiently.

We want to actually help our customers write the code. We've restructured even our own field force so that we have that code-level capability to work with you to hack out new ideas, to build new product, to modernize your environment and at the same time teach you the efficiencies of how to become a software company, how to do code releases.

And then the investment in data and AI, I can't over-emphasize the importance of these categories being adjacent. I will tell you that AI gets all of the attention. In fact, I would be willing to bet that as you saw Satya's keynote today and you saw the Bing and Cortana excerpt and you saw Li-Chen get up and demo that environment, you were wowed by the agent, by the AI interaction with the human, that's what caught your attention.

You were wowed by the graphical output and the rich UI that we can create. But I will tell you, if that is all you focus on and you don't get your data estate in order, all you will do is make mistakes with greater confidence than ever before.

The data is the important thing. And I emphasize it because it may sometimes feel like you're putting a new roof on an old house or new tires on an old car, but you have to

invest in the richness of the data estate, and it's why we spent so much time having heterogeneous capabilities out here at Microsoft, we now even run our SQL Server database on Linux. We have open capabilities to run Cassandra and Mongo and any data set and structure that you may want to run on Azure so that we can harness and build that data estate for you.

In effect, what we want to do with you is we want to partner to create a two-sided business plan to marry the technology assets that we have with your business outcomes.

In fact, no two digital transformations are alike. They are the marriage of your potential in your industry and the elegant use of the technology assets that we have to bring the same to life.

I want to highlight some scenarios with you, work that we've done with customers across different industries to help spark that interest, to help simulate the journey that we're on and want to be on with all of you.

The first example I want to talk about is Auckland Transport. Look, depending on your background and the work that you do each and every day, you may not think of a government entity as a sort of thought source or thought leadership for innovation. But, in fact, many governments in many cities and municipalities around the world are really investing in technology and digital transformation to bring better taxpayer ROI and enhance citizen engagement, improve the lives of people around the world.

And the City of Auckland has, in fact, done that with the Transport Authority. I'd like to share a video with you that actually brings that to life. Please roll the video.

(Video: Auckland Transport)

**JUDSON ALTHOFF:** Today, more than 80 percent of the world's largest banks run on the Microsoft Cloud. We're investing in security, privacy and data sovereignty to bring digital transformation to life in what has otherwise been a very regulated industry, one that has been plagued with legacy technologies, and frankly, one where it's harder to transform. It's harder to take advantage of new technologies and leap forward to create this notion of a digital outcome.

The work we've done at UBS is one that I'm sort of exceptionally proud of because the bottom-line result that we've created with them has been materially impactful.

Once again, the story follows this same similarity and familiar path that I described earlier of becoming digital. We worked with UBS to take and harness their data assets. We worked with them to actually study the data about their products.

Again, one of the questions that has to be asked and answered in digital transformation is: How can I take the data about my product and create a service that enables the data to be more valuable than the product itself?

So that's exactly what we did with UBS. We took their risk management systems, we helped them form their IP to production-class software as a service, placed it on the Azure platform. The results are we improved their performance by over 100 percent, and we've lowered their cost by 40 percent. If you do the quick math, three times return on productivity for all of their financial analysts. And it really translates to fantastic outcomes. Their people engage with three times as many customers as they otherwise would. They provide them with better information and how to respond to real-time financial considerations like never before.

We've transformed UBS's business to be beyond just a consultancy and a financial risk management provider, but to be a true digital partner for their customers.

In manufacturing, consumer-packaged goods, one of my favorite examples to share is the work that we're doing with Karlsberg. And you might say, "Hang on a second, Judson, why would you want to digitally transform beer? Can't you leave well enough alone?" And that's fair. But I'd like to share this video with you to give you a sense of the culture at Karlsberg and maybe sort of provide some insight as to why they're so interested in transformation. And then I'll unpack some of the technology for you, so please roll the video.

(Video: Karlsberg)

**JUDSON ALTHOFF:** So I have to admit. When my team came to me and said, "Hey, how would you like to work with Karlsberg on their digital journey?" I didn't think about it for too long. (Laughter.) I said, "Yeah, sure, sounds great."

But in getting to know the company, they have one of the most diverse workforces that you can imagine. Of course, there are people working in the bottling environment and people working in marketing to harness this sort of balance between being a large brewer and, you know, getting time and attention for people who enjoy craft beers.

But then there's a different class of worker inside of Karlsberg that's actually a scientific community. And, believe it or not, you can actually get your Ph.D. in beer-making. I feel like I sort of missed a huge opportunity in my career. In fact, I was introduced to Dr. Beer at Karlsberg.

And he said to me, "Judson, I've got this problem. I really don't understand why the rest of my company can't understand this. I've got all of this data about yeast strains. Look, Karlsberg has been in business for over 100 years, and we know how to make beer, and we know the flavor combinations that actually make people want to drink our beer, which is a good thing if you're a brewer. But what we can't do is mash that up in a palatable way such that our employees are empowered to make the right decisions about bringing new products to market."



So you guys are going to kind of think this is a little repetitive, but step one, data estate in order. Worked with Karlsberg to rationalize all of their data assets and worked with Dr. Beer to not only sample his products, but actually to make sure that other people could make sense of the work that he was doing and communicate the value of understanding how a yeast strain could be matched up with a taste preference.

Our first experiment yielded an outcome that said you want to take your Russian pilsner and rebrand it and launch it in Sao Paolo, because the taste preferences in Brazil line up with the beer you're producing in Russia.

Marketing department about lost their wigs. They said, "How could we possibly do this? This makes no sense." But they took a leap of faith and they did and they sold 30 percent more of that beer than they had ever sold before. Harnessing the data, providing the outcomes, rationalizing the intelligence, and then using products like Microsoft Teams so that their marketing department can collaborate well with their engineers. Fantastic outcomes.

Now, they're actually even reproducing a keg management system that's driven by IoT so that a bar owner can understand how to take those taste preferences and run sales promotions in their given local markets. So they're engaging with their customers like never before.

Retail. You may not think this outside looking in, backup the world of high fashion is actually an incredibly complex market. Very, very demanding. Every season, can you imagine this for a minute, every quarter, they basically have to reproduce their entire product portfolio and come up with never-before-seen product and designs. How? How do you do that?

Well, the back-end processes are really complex, they're not the glamorous, high-fashion, highly creative type of things that you might imagine. They actually have a supply chain management problem because they have to, in order to produce all of these new products every quarter, they have to have relationships with up to 50 new suppliers and vendor partners every week to rationalize how they're going to build these products and get them to market in time for the seasons of relevance.

Before working with Marc Jacobs, the processes that they had kept creative people from being creative. So we leveraged Dynamics 365 with Azure and a great partner that we have in the retail space called MediusFlow to completely rationalize their supply chain process, empower their people with mobile solutions. The result is a process that is now 93 percent automated and there's been a 75 percent reduction in the total time that people have to spend on the supply chain process. Again, keeping creative people creative.

There's perhaps no more noble task that we have at Microsoft than empowering students and empowering the educators that help those students learn.

We've invested a lot in this space, and Microsoft 365 brings creativity and collaboration to the classroom in connected school systems and disconnected school systems. The majority of kids still go to school in 2017 in disconnected environments, and being able to have rich capabilities democratizes the technology divide between the haves and the have-nots in the classroom.

Further, the investments we've made in STEM and Minecraft actually make it fun to learn, make it fun to code, make it fun to code for everyone in a diverse and inclusive fashion. So I'd like to share this video with you about how the Omaha Public Schools has used the technology to create a digital environment for all students.

(Video: Omaha Public Schools)

**JUDSON ALTHOFF:** So you saw a fantastic HoloLens demo earlier today that showcased the work that we're doing with Ford. But HoloLens isn't just sort of limited to manufacturing and engineering collaborative environments, it's designed to actually bring collaboration and new worlds of compute and sharing ideas to every industry.

In healthcare, Stryker has created pharmaceutical devices that are used in more than 235 million operations on a per-annum basis. Yet, at the same time, they're never really able to interact with the people that use their products, the doctors and surgeons that perform lifesaving procedures in those operating rooms. Those decisions have, historically, been made by hospital administrators and people that are removed from the craft.

With HoloLens, they can actually simulate the creation of an operating room and share with doctors and surgeons the layout of that operating room and the use of the equipment, and then at the same time carry through safety procedures and proactive maintenance procedures that need to be done to the equipment to keep the operations flowing, to save lives more effectively and efficiently than ever before.

So digital transformation is alive and well in every industry. In fact, I like to say digital transformation in real life is what we all need to contemplate. What is the value for your industry? What is your potential in your industry? How can you use technology to drive better business outcomes, run your business better, faster, and more effective than ever before?

So in the spirit of "in real life," I'd like to bring a guest to the stage to share how they've done exactly that. We're going to show you not a demo, but rather the real systems that they use, real product, real customer, and show you the impact that we're driving digitally.

Please join me in welcoming Thomas Lee-Warren, the chief technologist and digital strategies for Rolls-Royce Aircraft Engine. (Applause.) Thomas, how are you?

**THOMAS LEE-WARREN:** Thanks, good to see you.

**JUDSON ALTHOFF:** So, Thomas, obviously, Rolls-Royce, very incredible brand. In fact, I'd be willing to bet that a good part of the audience here traveled to Orlando through the use of your product. Why don't you tell us a little bit about the company?

**THOMAS LEE-WARREN:** OK. Rolls-Royce, founded 1906. So we've been around the block.

**JUDSON ALTHOFF:** Yes.

**THOMAS LEE-WARREN:** We're a leading manufacturer of highly efficient and integrated propulsion and power solutions in the aerospace, marine, energy and off-highway applications.

We're also the No. 2 company in regards to aircraft engines worldwide. We've got 50,000 employees around the globe, and we're headquartered out of London.

Now, we're going to be focusing today on our civil aviation business. I think we could talk about the excitement and the innovation of many of our businesses. For example, right now, in Turku, Finland, in our marine business, we've got people working on how to solve autonomous shipping by the end of the decade.

**JUDSON ALTHOFF:** Fantastic.

**THOMAS LEE-WARREN:** So I think today, though, we're going to show -- back to our civil aviation business, about how we're achieving our aim, which is any aircraft that's powered by Rolls-Royce engines, that's every takeoff and landing is on time, every time.

A bit of warning for any of you who have come thinking that you might hear something about cars and you might get to know a guy who might give you a discount on a new one, Rolls-Royce don't do cars. So you're out of luck.

**JUDSON ALTHOFF:** Awesome. So, you know, I use the word "journey" a lot because I think these digital transformation efforts are just that. They sometimes involve a multi-year strategy to apply technology to business outcomes. Why don't you tell us about your digital journey at Rolls-Royce?

**THOMAS LEE-WARREN:** Sure. AI and data engineering has been trending now for a while, but at Rolls-Royce, we've really been wrangling data and looking at algorithms for probably 30 years or so.

At any one time, we've got 900 planes in the air, sporting our engines. And those planes are sort of sending millions of data points back to us at our service centers.

With that, also, we're really excited about the visualizations and how those visualizations are bringing our workforce together, and how we can create that dialogue with our customers.

**JUDSON ALTHOFF:** Awesome.

**THOMAS LEE-WARREN:** And, really, what we're looking to do through all of this, through our data, through our AI, what's that really about for our customers? And it's really about increasing the availability. And we're really looking to reduce the engines on the ground, our EOGs, because that costs both the airlines and ourselves in terms of our end-to-end supply chain in an optimum way, that doesn't work for either of us.

**JUDSON ALTHOFF:** Cool. So one of the things that impresses me most about the journey you've been on is how you've actually been able to transform the product and the business model that you use and employ at Rolls-Royce to help drive your growth and better satisfy your customers.

Share with us what the meaning is there.

**THOMAS LEE-WARREN:** So, really, the key focus for our business is about providing optimized, predictable costs for our airlines. I mean, airlines run a really, really tight group. And so they really like to -- they really look to us for our after services, which has really differentiated us in the marketplace.

And you've probably heard about our Total Care product and about this concept of "power by the hour." And our configuration has been moving from off-wing optimization, where we're worried about, OK, when we got it off the wing, were we doing all we could at a cost-effective rate? But now we're really thinking about how do we improve the availability for the airlines? Because that costs them. And we're also looking at how do we increase the efficiency of the actual engines themselves?

So the fuel is a major contributor to the cost of airlines, maybe as much as 40 percent.

**JUDSON ALTHOFF:** Wow.

**THOMAS LEE-WARREN:** And so every 1 percent that we can save is equivalent to almost \$250,000 per aircraft per year.

**JUDSON ALTHOFF:** Wow. Awesome. So, effectively, you're actually delivering aircraft engines as a service in this modern digital world, which is fascinating.

I like to geek out on this kind of stuff. I'm, in fact, you wouldn't believe it, but my degree -- my background is mechanical and aerospace engineering, which I don't use a lot these days. But, in fact, I couldn't be more enamored with your story. Maybe you could actually show us the tech that you're using in the background.

**THOMAS LEE-WARREN:** OK. So let's imagine we're going to go on a flight, maybe a 787 Dreamliner, sporting our Trent 1000.

**JUDSON ALTHOFF:** Sounds good.

**THOMAS LEE-WARREN:** Let's go on a journey.

**JUDSON ALTHOFF:** Right on, cool. OK, metaphorically, we're flying in a 787, which is a fantastic airplane. Let's say I'm flying through the air and enjoying my flight. Then what happens?

**THOMAS LEE-WARREN:** We get an alert.

**JUDSON ALTHOFF:** So an alert. As a passenger, to be honest with you, doesn't sound fantastic. (Laughter.) I think I have conference on that. What exactly does an alert mean?

**THOMAS LEE-WARREN:** Well, probably most of the people in here have been on aircraft where we have gotten an alert, and it's really nothing to be concerned about, nothing major has happened. But those sensors that we have on our engines have actually picked up an anomaly. And what they've done is with these small anomalies, we've probably bursted a bunch of information back to our service centers.

Now, before we had the sensors and we had the big data, we probably would have had a situation arising for a long period of time, which would have made our engines actually perform not on an optimum basis. And so what does that do? That actually increases the cost to our airline customers.

**JUDSON ALTHOFF:** Got it. An anomaly still doesn't sound fantastic. But maybe can you shed some light on what exactly that might mean and what the scenario would be?

**THOMAS LEE-WARREN:** OK. So I'm going to take you through our EHM system, our Enterprise Health Monitoring system. And what I'm going to do, if you can imagine you're now back at Rolls-Royce in Derby, I don't know how many people have been to Derby. It's a charming little town in England. And, really, what we're going to do here is we're going to look at some of our service engineers who -- let's say we take Microsoft Air, we're running a number of aircraft supporting our engines. And what we're going to look at here is we've got a number for this aircraft, a number of issues. Now, some of those issues could have raised an alert, and some of them are just something that we're going to keep track of.

**JUDSON ALTHOFF:** Cool.

**THOMAS LEE-WARREN:** And what we can do is we can actually delve down into the alert that was raised. And what we're seeing now is what might have contributed to that alert being raised.

So as you can see in the bottom left hand here, there's a number of contributing factors. So we're looking at the oil pressure. And these two colors here are actually showing the two engines, left and right. And what we have is on the left engine, it's all operating normally, but on the right engine, it looks like we've had a degradation in the oil pressure.

And we can then come along here, do a little bit more investigation, and we can see oil temperature. Actually, again, on one of the engines, it looks like it's increased.

**JUDSON ALTHOFF:** So you're getting real-time data streaming off the engine while the plane is in flight and your service professionals can actually detect these anomalies, even before the pilot might get an alert?

**THOMAS LEE-WARREN:** Absolutely.

**JUDSON ALTHOFF:** Wow.

**THOMAS LEE-WARREN:** And now, our service engineer can start to -- with this, start to actually look at putting a diagnostics together, which is then going to go off to our maintenance engineers. So here we are, he's going to start preparing a diagnostic. He's understood that this is about a low oil pressure problem, and then we've got an alert that's been raised.

**JUDSON ALTHOFF:** Got it.

**THOMAS LEE-WARREN:** And then what we've now got is very quickly we've got all the details through a templated e-mail, and now the service engineer is going to pass this across to a maintenance engineer with the click of a button, send.

**JUDSON ALTHOFF:** Awesome. So you've connected the physical asset, the aircraft engine, through the IoT data harness and the data lake that sits behind this application, and you've actually rationalized the data, shared the outcome and the action with your employee base so that they can be more effective at doing their jobs.

**THOMAS LEE-WARREN:** Absolutely.

**JUDSON ALTHOFF:** Super cool. Super cool.

**THOMAS LEE-WARREN:** And now what we're going to do is we're going to take you over to, effectively, what is our availability center, where our team service engineers are going to be, effectively, monitoring all the planes in the air or on the ground. And what we have here is we've got a visualization of all of our engines which are on the planes on the ground, we're actually showing what time they're going to take off. We've got the departure and where they're heading to. Just coordinated with that is the type of engine that engine belongs to.

**JUDSON ALTHOFF:** Awesome.

**THOMAS LEE-WARREN:** We've also got, as you can see here, all of the alerts, the ones that you're not worried about. (Laughter.)

**JUDSON ALTHOFF:** You know, I'm going to think very differently the next time.

**THOMAS LEE-WARREN:** We're still keeping track of those. And what we've got here is not only have we got the alerts in text form, but actually if you look over here, we're actually showing each of those alerts on which flight they're accompanying and where they are geographically located.

**JUDSON ALTHOFF:** Awesome.

**THOMAS LEE-WARREN:** We're starting to now bring in third-party information, which actually helps the engineers understand actually that plane with that alert is going into inclement weather, whether that should be a concern or not.

**JUDSON ALTHOFF:** Fantastic.

**THOMAS LEE-WARREN:** And now this is really exciting and this is really cool.

**JUDSON ALTHOFF:** Cool.

**THOMAS LEE-WARREN:** So the live flight information here. We can actually click on here, and now this is showing in near real time all of the planes in the sky. Here we've got 681 of them, and we can actually see where they're located at any point in time.

**JUDSON ALTHOFF:** Awesome. Wow.

**THOMAS LEE-WARREN:** Now, what we're going to do is we're going to find the imaginary flight we were on. I'm just going to come up here, click the box, look for your airline, Microsoft Air.

**JUDSON ALTHOFF:** Got it.

**THOMAS LEE-WARREN:** I'm just going to click on it.

**JUDSON ALTHOFF:** I didn't know we had an airline, that's pretty cool.

**THOMAS LEE-WARREN:** And what we've got now is we can see the plane that you're riding on.

**JUDSON ALTHOFF:** Awesome.

**THOMAS LEE-WARREN:** What's really interesting here, in terms of the visualization, we can really see where the plane took off from, it's heading off to Seattle, Washington. This starts to become important when we start to think about timing. What sort of intervention will we make? It's probably not going to be an intervention, but we could if we wanted to, send an engineer to go do some sort of an engine wash or maybe change a filter, which will increase the efficiency of that engine. Again, making sure that we don't have increased cost for our airline customers.

So then we can actually drill down here and, again, what we're seeing is this richness of data. So our service engineers and maintenance engineers can actually look at that engine in detail. What's been happening over a number of days, weeks, and months?

**JUDSON ALTHOFF:** Awesome.

**THOMAS LEE-WARREN:** And this is all about open issues. And we can see that, interesting enough, there was a bird strike, and we actually had other alerts. Now, this is helping the diagnostic and eventually the service engineer, sending the information to our maintenance engineers about what kind of intervention is going to be necessary.

**JUDSON ALTHOFF:** Very cool.

**THOMAS LEE-WARREN:** And what's the right time to actually intervene?

**JUDSON ALTHOFF:** And so by having all of this real-time information at your hand, being able to mash up the data coming off of the engine, all of the environmental information about where the plane may be flying, the altitude, the ground speed that it's covering, you can understand whether or not that anomaly is actually creating a safety issue, is the plane flying through a storm where the anomaly may actually create some sort of an impact where it might have to land? And/or, whether or not it's just sort of a normal occurrence that needs to be addressed through maintenance, you'll know because the speed over ground, when is the plane going to arrive, what people should be there with which part at the right time to actually make the determination of service? Fantastically efficient.

**THOMAS LEE-WARREN:** Absolutely. And this is why probably everybody out there didn't realize why they felt so safe with Rolls-Royce engines, but because we have this kind of detail behind keeping you all happy and safe.

**JUDSON ALTHOFF:** Awesome. So let's unpack the technology behind all of this, Thomas. Again, it's a fantastic outcome that you've driven for Rolls-Royce, but understanding the "how." Like, how did you get there? What technology is being used to make all of this happen behind the scenes?

**THOMAS LEE-WARREN:** Sure. So I think what we've demonstrated over here is that we're actually collecting millions of data points. And what we've done is we've looked at what kind of intervention that we should carry out. And what we've done is when we've



detected an anomaly with the sensors that are on our engines, we've been bursting that data through our satellite connections and down to the IoT Hub.

We've then taken the data, we're now starting to look at how we can put together our diagnostic networks and the algorithms that we've been building over the years and how we start to actually merge that with the machine learning algorithms that we have available to us from the Azure Suite.

Because we quite like this plurality of different techniques that we can use to train our algorithms to really evolve us to the next stage in how we actually detect at the earliest moment any anomalies in the efficiency of our engines.

Really, what we're trying to do is through the visualizations, we're looking to see how we can get our people to work together seamlessly, easily, and also how we can actually communicate to our airline customers about when something does happen, how we can actually ensure the minimum disruption. Because we all know that if we have a 15- or 20-minute disruption in an airline, how much inconvenience that can cause to the traveling public.

**JUDSON ALTHOFF:** Right. So you're using Dynamics 365 to handle all of that intelligent routing of your employees, providing them with the information they need to keep those planes up and running as well.

Let's talk about the customer value and the impact for a minute because in this new business model you have, of course, you're taking care of your customers, but there's also some stakeholderhip, right? If you're providing as a service all of these impacts, actually, are directly tangible to Rolls-Royce's bottom line.

So customer value associated with the work that you're doing here.

**THOMAS LEE-WARREN:** So that's really important. I think what we've seen here is like it's a seven-step process for us. Really simple about how we get from detect to resolve across so many multiple parties who are involved in this. Because it's complex. These are beautiful machines and they're probably some of the most complex things on the planet.

And I think as we said before, we're really reducing these AOGs, these aircraft on the ground. An aircraft on the ground isn't being used and it's starting to affect the cost of our after-sales services. So by detecting the anomalies, by optimizing exactly in the supply chain when we actually get the right part to the right engineers to the right place, we can really minimize that disruption to the airlines, and we both win.

So, really, we've been looking at, through data, big data, the use of AI, and through Microsoft products, we're really looking about how Rolls-Royce is making better and faster decisions.

**JUDSON ALTHOFF:** Awesome. So well on your journey on digital transformation. You've clearly empowered your employees to better take actions, make decisions. You've transformed your product. Great progress there.

Tell us a little bit about this notion of artificial intelligence and how you're thinking about weaving that into sort of the next steps on your journey.

**THOMAS LEE-WARREN:** Certainly. So what we've got is we have got three key focuses at the moment. So we've got the digital twin, where we're really looking at this digital thread as we go through design, manufacturing, and our after sales. I know people have been talking about the digital loop, and we're really seeing that in each one of those stages, we can really take the data and we can take information from design and manufacturing and make sure that we're reducing any risk we have in the after-sales services through the operating of our engines, we can see from the after-sales services how we can perhaps build better -- we can design better engines in the future.

We're then also -- really, what that's doing is bringing the digital world and the physical world as close together as humanly possible. And, in data innovation, we're really looking to see how we can use data to actually create the optimum value to our customers. So we're looking at the data we hold, we're looking at third-party data, how do we mash that together to really evolve our next level of after services?

And also we're really concentrating on a digital-first mindset. So it doesn't matter who you are or where you operate within our company, we really would like you to foster a digital-first mindset.

**JUDSON ALTHOFF:** Cool. And the importance of AI and how you're thinking about using it?

**THOMAS LEE-WARREN:** So AI is really important to us and we're really excited about the opportunity it presents in the next evolution of our services in either designing or manufacturing.

And I think we're really looking to see how we can create new networks and partnerships, how we can sort of really drive this outside-in thinking. Because although we do things incredibly well, we can actually learn from others. And there's a lot going on in the AI world.

We're also really excited about how we can use some advances in AI. So whether it be genetic algorithms and we start to look at biological evolution and survival of the fittest, that's really getting us excited about how we can train our algorithms.

And I think, really, to end with, I suppose we're getting near the afternoon, so maybe a little bit of exercise. So I don't know how many people out in the crowd, business leaders, have got talented AI or data engineering teams. If you think you have, if you just

want to put your hands in the air. You think you've got them? Yeah? Put your hands in the air, don't be shy.

Now, just put your hands over your ears for a second like that. Yeah. OK. So all you AI experts out there and data engineers, there's no better time to be coming to Rolls-Royce. (Laughter.) We're doing amazing things. We're doing amazing things. (Laughter.) (Applause.) So don't be shy, come and find me and let's talk about what we can do together.

**JUDSON ALTHOFF:** Awesome. Thomas, thanks so much.

**THOMAS LEE-WARREN:** Thank you.

**JUDSON ALTHOFF:** Appreciate the partnership. Thank you. (Applause.)

I want to close off by talking to you about our mission and why it is so core to everything we want to do with all of you for your digital journeys.

Our mission is to empower every person and every organization on the planet to achieve more. And so when we do things like invest in cryogenic and quantum computing, when we invest in sensor technologies, when we invest in core AI, it's all about bringing your ideas to life, helping you achieve more in accordance with your potential in your industry.

We do, in fact, believe that digital transformation is a journey. It is this marriage of technology and business outcomes and we want to be your partner on that journey. We want to help bring your ideas to life and help you achieve more in that same frame.

So we welcome the opportunity to continue to partner with you, and we hope this conference actually helps stimulate those ideas and inspires new ways for us to engage together and partner. Thank you very much.

(Applause.)

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