How Rolls-Royce is improving engine sustainability with real-time data and digital twins

By Derek du Preez April 5, 2021

Dyslexia mode

SUMMARY: Rolls-Royce is using cloud-based technologies to help its customers in the aviation industry avoid unplanned grounded planes, with real-time data from hundreds of engine sensors.

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Rolls-Royce powers 35 different types of commercial aircraft and has over 13,000 engines in service around the world. It's a household name in the aviation industry and in 2020 the company brought in over £20 billion in revenues. It's a company that also prides itself on its technological innovation, where it is making huge strides in the fields of data analytics and AI.

(Image by Alexei Chizhov from Pixabay)

For example, we have written previously about how Rolls-Royce has servitized its business model through the use of data and how it has created one of the most comprehensive ethical frameworks for AI we have seen being used by a business.

planes.

Whilst this will obviously reduce costs for Rolls-Royce customers, and prove to be a valuable new revenue stream for Rolls-Royce itself, Hughes says that the real driver behind this is improving sustainability of engines in the airline industry. The company claims to have already saved 22 million tons of carbon, using the data feeds from planes in flight, providing guidance to pilots on how to fly their planes better.

Hughes explains how digital-twins of engines is enabling this. He says:

> *What I wanted to talk about today really is how we use data analytics to improve sustainability. - so reducing carbon and optimising our inventory.*
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> *The last few years, as part of our digital transformation, we've been building a digital twin of our engines. So the way I want you to think about it is we've got a new generation of intelligent engine platform, which is built on cutting edge data analytics.*
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> *In the past, we would have 30 sensors, and they would capture data like five times in the flight at key points. Whereas, the latest generation of engines going into service now capture hundreds of data points every second. So we've kind of moved from floppy disk to half a gig of data per engine flight, so you can see the change is very, very real.*

Real-time, live streams

To deal with this amount of data, Rolls-Royce has created a new platform that brings in data from its airline customers, with their consent, which is then fed into a Microsoft Azure data lake. This is then turned into a Databricks Lakehouse and analysed using Databricks machine learning and AI tools.

Because the platform is running in the cloud, Rolls-Royce only pays for the seconds it's running the models, and then deploys that model in the cloud, with the aim of using energy when it is only absolutely essential. As noted above, each engine generates

We now have to process the data in real time as it flows in, as opposed to in the past, you could just do a whole flight as one batch. That's just because of the volumes. The cloud is elastic so we can scale when we need to, we can do multiple things at once, and that's a really important part of what we're trying to do.

Hughes says that the "raison d'etre" of his team is to try and avoid unplanned grounded planes. If a plane can't take off for any reason, that can affect dozens of flights in the network, impact dozens of passengers, and with all the rerouting that takes place, can mean more carbon is emitted. But equally, if maintenance is optimised using digital tools, this will mean parts aren't being wasted too. He explains:

> *Building up that digital twin of all of the information about the engine, we know about the parts that went into it, we know where it was assembled, we know that when it went to a maintenance shop, which parts were replaced. We're capturing all that in one big asset.*
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> *What that allows us to do is really improve the decision making in every single way. In the past the engineers, when thinking about improvements or the next generation, would physically create a part, and then they might add it to the engine and test it.*
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> *This of course consumes metal when you build it and then there's an engine test that happens. Whereas now we've got this great data set where we're able to test the impact of our designs, against the operational data set. And actually that operational data set is bang up to date. There's nothing more modern and it's huge and vast and wide. So this has really started to change how we've been able to design and simulate what we're doing with the engine.*

Predictive maintenance

Hughes compares this to how someone might get their car serviced every 12 months. When the car manufacturer came up with that policy, they probably took quite a

Over the last 18 months Rolls-Royce has been able to shift to a model whereby it is able to treat every single engine as an individual engine and has built a mobile app for its customers to see clearly how long each of the engine parts have left before needing replacing or repair. Hughes says:

> *The way we're able to better predict maintenance is using this personal approach to understand how each engine is flown, understand the context it's flown within - the environmental conditions. Did it fly over specific pieces of land? Did it fly over specific levels of pollutants? And build that into the maintenance planning, so that we can say actually, this engine had quite an easy life, so we will extend the period between maintenance.*
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> *This is obviously great for the airline because they keep the engine flying for longer, but also it's also great because we're not replacing parts that didn't actually need replacing. We're able to treat each engine as an individual, and we're able to simulate lots and lots of different maintenance regimes based on the profile of how it flies, and then we're able to plan better. Making sure we have the right parts in the right place with the right people and the right skills - making sure everything is optimised. We've been able to move from simulating one at a time to simulating 100 at a time.*

As noted above, the core metric that Rolls-Royce is measuring success by is avoiding unplanned grounded planes. With its new platform, it has already been able to avoid about 5% of these events, using the data simulations. For its predictive maintenance modelling, Rolls-Royce has also seen examples whereby it has extended the time between maintenance by up to 50% and has reduced inventory (parts and spares) by millions and millions of pounds.

It's an exciting time for Rolls-Royce and the digital team [redacted] keen to get the word out there of the company's work, so that people know that Rolls-Royce isn't just an engineering business. He says: