# Seventy years creating cutting-edge solutions

**With the potential of pioneering the development of commercial regional electric flight in the pipeline, and a new Saab 340 to serve as the National Flying Laboratory Centre, Cranfield University and its commercial arm, Cranfield Aerospace Solutions, is quietly leading the way forward in aircraft development. LARA's Glenn Sands went along to find out.**

Located on the site of the former WW2 airfield of RAF Cranfield between the UK cities of Milton Keynes and Bedford, Cranfield University oozes aviation heritage, innovation and ideas related to the aerospace industry. No matter where in the world the postgraduate students are from, they and the lecturers and research professors all possess a common thread that runs through their DNA: To make aviation better, safer and more environmentally sustainable.

To achieve these goals the university has a unique facility: Its own airport, aircraft and air navigation service. These offer unrivalled access to 'at-scale' research, and a teaching environment that's directly adjacent to the specialist technology centres and laboratories.

Perhaps the most dynamic and visually impressive aspect within the university is the National Flying Laboratory Centre (NFLC), which operates a Jetstream 31 as a 'flying classroom' and engineering laboratory. It's a capability that's rare within the global academic sector and is used to support pioneering teaching, research and consultancy. The NFLC is regarded as a key national asset by the UK's aviation industry and the Royal Aeronautical Society (RAeS).

The Jetstream 31 provides the flying component of the broader Cranfield Aerospace Solutions future strategy and is critical for flying Cranfield students, both in terms of official accreditation and for the quality of their learning experience. It is used by many UK universities in order to deliver flight test experience, which is required as part of the RAeS accreditation for aerospace engineering students.

A single flight can show students the lift, drag and pressure tests which they will become very familiar with later in their careers. The specially instrumented Jetstream can supply real-time data on a range of performance parameters, allowing students to be flight engineers during the flight.

The NFLC's remit extends to industry research and consultancy, and the aircraft has been used by a host of organisations like Rolls-Royce, BAe Systems, Airbus UK and several specialist agencies within aviation. Industry partners use the aircraft to test new parts and equipment, develop advanced airborne systems and sensors, trial future technologies, including those associated with UAVs. The NFLC is regarded as a viable alternative to flight test research work more commonly carried out in simulators, wind tunnels or more expensive jet aircraft.

## NEW FLYING CLASSROOM

However, despite the benefits the Jetstream offers, the aircraft is old and is now due for replacement. Fortunately, a replacement aircraft has already been sourced, a 1998-built Saab 340B, which previously flew with Northwest, a regional airline based in the US and was leased directly from Saab.

Professor Nicholas Lawson, the lead for the NFLC group, explains the need to

ensure that industry and students are supported in the best possible way.

"We acquired the Jetstream about 15 years ago and it has done a lot of flying with us. It's probably flown over 10,000 of our own students since we bought it for NFLC and we have flown around 20,000 students in total, of which most have been from the UK. Many of whom are now out working in the industry since graduating.

> "We are able to take the students up to 2G which no ground simulator can currently replicate in the UK. So, the trainee student engineers can get a feeling of what it's actually like. It's a far more immersive teaching experience for them."

## INDUSTRY BENEFITS

"Having the Jetstream also allowed the us to support industry. BAe Systems operated a similar type until they retired it. We were involved in the development of autonomous systems with BAe's aircraft and helped plan the test flights. At times we flew the aircraft for them. Theirs was equipped with a pod under the fuselage which could house additional electronic kit. Our work focused on developing the so called 'see and avoid' concept for BAe's autonomous flying systems programme. When you have similar unmanned systems flying in the same area, it's important they are not crashing into one another. As a result, we developed a lot of experience in this field."

Despite the long and impressive teaching career the NFLC Jetstream has racked up, it's old now and Lawson admits that the aircraft requires a lot of maintenance hours to keep it airworthy. He is keen to promote the benefits the Saab will bring: "The Saab 340, which we now have, is at the stage where we are beginning to fit the aircraft out in a laboratory configuration. It's a bigger and more capable aircraft, it has a cargo bay in the back, and this means that we will be able to work more regularly with industry. It will allow us to fly the aircraft around with other people's kit in the back, and our students in the front. So, we can have test equipment on a semi-permanent basis in the back. If a company wants to trial aspects of a new digital aviation solution or to develop new autonomy techniques, we can have the equipment mounted in the rear of the aircraft for longer. It opens the possibility of industry flying the aircraft one week, and the university the alternate week."

The new NFLC Saab 340 will enter service in autumn 2020 and is regarded as a big step for Cranfield. It will serve alongside the university's two light aircraft, which offer students one-to-one flight experience. It was discovered that a lot of the aerospace students that were on the courses had not flown in a small aircraft before, and simply didn't know what it felt like. It's regarded as a massive positive for students to be able to have a "hands-on approach and let them handle the controls," says Lawson. A flight can easily point out to a student how an aircraft handles at specific flight envelope points, which may well link in with a lecture the day before. It's all part of the core teaching process to demonstrate "aerospace," as Lawson calls it.

Professor Helen Atkinson CBE, Pro-Vice-Chancellor of the School of Aerospace, Transport, Manufacturing, was on hand to explain how the acquisition of the Saab was achieved: "It's a big financial commitment and the university has covered a large percentage of the cost, but a lot of industrial partners have also contributed, which is an indication of just how important they think it is for the UK's aerospace industry.

"Companies like Rolls-Royce, Airbus, Boeing, BAe Systems, GKN, Meggitt and Spirit Aerosystems have also made a contribution for the new aircraft. We are now building up the last part of the funding which will allow all the final modifications to take »»



**Professors Nicholas Lawson (left) and Graham Braithwaite of Cranfield's National Flying Laboratory Centre taking delivery of the Saab 340 (pictured below). Inside the cabin of the Jetstream 31 (centre images).**

place," she adds.

But why the Saab 340B? Lawson explains why the aircraft was selected: "If you look at the turboprop market, it's quite difficult to find something that fits our needs. We wanted a large aircraft, but we didn't want it so big that it would be expensive to operate. So, the Saab fitted the bill. It's one of the final examples of the 340 to come off the production line. There's about 400 still flying globally, so it's a well-supported aircraft. And the additional capacity in the back is a real bonus.

"The reason why we bought the aircraft rather than lease it from Saab is due to the modifications that we need to do to it. We couldn't really lease it, because you have to return the aircraft in the same condition you acquired it at the end. With the modifications we are making, we'd simply not be able to return it in an original configuration."

Atkinson continues: "The modifications are quite extensive, and they all need to be certified so it means there will be sensors all over the aircraft feeding data into the cabin during the students' flight."

Once in service the Saab will allow the NFLC to respond to the needs of the industry far quicker when a manufacturer requests a flight trial. It may simply mean putting a 'widget' in the back of the aircraft to explore a certain data parameter, and the scheduled student flights will still be able to continue unrestricted. An example of this could be autonomous flight. "We can do a dual role approach of a flying lab for both students and industry requirements at the same time. Such as a surrogate autonomous flight, where we will be able to keep pilots in the loop, as a safety element. The CAA is far happier with this style of approach," explains Lawson.

## FLYING A DESK

For a regular teaching flight, the aircraft is configured in its flying laboratory role. The students are referred to as 'task specialists' which is the term used at the top of the forms they are handed prior to any flight. Every flight is planned with an academic angle and the booklet the students are given is to record data during the sortie, which they then collate to produce a written report. It's an academic log where they record all details of the flight, so allowing the students to get a thorough understanding of why certain manoeuvres are performed. Lawson explained what's coming up for the students: "We are able to take the students up to 2G which no ground simulator can currently replicate in the UK. So, the trainee student engineers can get a feeling of what it's actually like. It's a far more immersive teaching experience for them.

"The Saab aircraft seats will each have the capability to display flight data via an iPad, which the students will be able to take from the classroom and mount on the seat in front of them. They will be able to measure all sorts of calibrations from sensors located all over the new aircraft. In much the same way we do on the Jetstream. Students, under supervision, will be able to move in-flight to different seats, in order to demonstrate how the centre of gravity can shift. The new Saab will be a superb addition for us." ■

# Electric dreams – Project Fresson

The trend to develop electric flight has taken on far greater significance in the past few years as the push for aviation to become 'green' has gained momentum. Leading the charge in the UK is Cranfield Aerospace Solutions – a wholly owned subsidiary of Cranfield University – with its CEO Paul Hutton (pictured above) at the helm of Project Fresson.

I'd describe Hutton as an honest genius in terms of his outlook on the UK's current position in aviation, and the need for the nation to push forward in developing leading aerospace solutions.

He explains the current British predicament: "The UK has gradually lost the ability to design new aircraft concepts because we have focused on being part of somebody else's supply chain. What I mean by a concept, is somebody basically says 'I have a specification which I'd like an air vehicle to meet; here's the range, speed requirement and the operational scenario. What's the ideal configuration for an aircraft to meet this?' Although we have retained this core capability, albeit within a very small group of people. We are also able to perform complex modifications to existing aircraft and have both the military and civilian approvals. When you combine all these certifications, we're a unique facility. This is reinforced by the number of OEMs who we have worked with in the past such as Boeing, Lockheed Martin and BAe. We're able to do things for them far quicker and more cost-effectively than they can themselves.

"But this has meant that as a company we are at the discretion of the OEMs in terms of work. We recently reviewed our past work strategy and discovered that we have good and bad years which are solely dependent on if an OEM passes work to us. So, if our core abilities are really valued by the OEMs, we needed to change our approach by using our capabilities to develop our own products.

"We decided to focus on aircraft design and manufacture, although we're aware that we'd not be competitive immediately, but by focusing on a specific type, such as the sub-regional aircraft market, it would be the best place to start. This class has not had any large investment in the last 10 to 15 years because traditional aerospace wisdom was, with the cost of fuel increasing, the nine-to-19-seat market was not economically viable to develop. So, most manufacturers shifted to the 40-seat and above class. It's only when there's a need, when the aircraft is effectively a flying bus, where a nine-seater is advantageous. What it means is that the aircraft is doing the job very well, but no one is investing in its future, so the entire sector has been neglected.

## GREEN AGENDA

"It will only become attractive again if something significant changes, which will be electrification. Once you have invested in an electric aircraft its operating cost is a fraction of AvGas. Suddenly, this segment that didn't make sense, now does if the electric technology is applied. Globally the market competition is limited, and it meets the growing green agenda, too.

"It makes sense that if you seriously want to have a viable emissions-free electric aircraft, you will have to look at the nine-seat segment. Simply because the technology is not there for a large regional single-aisle aircraft and, adding the technology to a two-seater – there's simply little point. So, where we can do something credible is in the regional nine-12-seater market, which is how the source of this strategy was developed and formed Project Fresson.

"The quickest way to get commercial aviation up and running on electric power is to use an aircraft that the regulator already knows and has approved and simply change the propulsion system. We decided to narrow it down to the Britten-Norman BN-2 Islander (pictured below), which is a well-known type. When we spoke with Loganair, they love the aircraft, but were keen to improve the propulsion system and desired something more cost effective. Simply, a lower operating cost. This will be the quickest way to get an electric commercial aircraft in service in the UK.

"What makes this important to the UK is that it will allow us to create a supply chain off the back of this project, and it will be the first EASA-approved electric aircraft. Also, the first EASA-approved electric motors and the first EASA-approved power management system; all of which can be created in the UK.

"If we don't do this now, we run the risk of similar projects in the UK being created elsewhere such as in the US and Far East, after which it will be hard for us to catch up.

"What has to be remembered is that this is just Phase One of Project Fresson. Phase Two could mean converting a larger aircraft, such as a 19-seater like the Twin Otter, when we use what we have learnt in the first phase. And as I see it Phase Three is an entirely new 19-seat aircraft which is design-optimised for electric power. It's a staged approach and much like the motor industry, you never put a new engine and new car out at the same time. The same applies to aviation." ■