

Aviation 2050: The Vision for Science and Innovation

Date and Location: 17th July 2019 at The Royal Academy of Engineering

Chair:	Professor The Lord Mair CBE FRS FREng Emeritus Professor of Civil Engineering, Department of Engineering, University of Cambridge
Speakers:	Professor Iain Gray CBE FREng FRSE Director of Aerospace, School of Aerospace, Transport and Manufacturing, Cranfield University Simon Burr Director, Engineering & Technology, Civil Aerospace, Rolls-Royce Martin Rolfe Chief Executive Officer, NATS
Panellist:	Dr Julia Sutcliffe FRAeS Chief Technologist and Head of Engineering Strategy, Global Air Sector BAE Systems
Sponsors:	Cranfield University and Rolls-Royce
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PROFESSOR IAIN GRAY Director of Aerospace at Cranfield University, began his talk with a question that was also a challenge: is the vision set out in the Government's consultation paper Aviation 2050 ambitious enough? He felt that it was not. To be sure, this is a great deal of amazing research and innovation taking place, but is it all being brought together – and are these advances taking place fast enough? This year is, in addition to the 50th anniversary of the Moon landing, also the 50th anniversary of the foundation of Airbus and the 100th anniversary of BA. In aviation terms, 2050 is just round the corner.

At this year's Le Bourget Air Show in France, sustainability was the key theme. At the event, seven major aircraft manufacturers agreed to cut CO2 emissions to half the 2005 level by the year 2050. The CTO of Airbus described her top three priorities as: 'zero carbonisation, zero carbonisation, zero carbonisation'. So the aim for 2050 is clear.

However, Professor Gray felt this still did

not go far enough. He argued that the industry should be more forward-looking. It should be setting priorities for 50 years time, not 30. And the change over the next half century could be something truly transformational. In fact, the way people use transport will be radically different.

The recent Uber Elevate Summit in the USA set out a vision for bringing together different modes of transport and different technologies into an integrated, overarching system. The UK, too, needs a 'big picture' vision, he argued. We have world-leading developers in specific elements of the overall transport landscape but no-one is bringing everything together into one vision for the future. For example, Defra's recent 25-year environment strategy does not mention aviation, aerospace or airports.

There is already much being done by universities, businesses and Government. But in order to realise the potential economic, environmental and social benefits that this transport revolution can deliver, all those

players must collaborate on a scale never contemplated before.

SIMON BURR, Director of Engineering & Technology, Civil Aerospace, at Rolls-Royce pointed out just how much the world economy – and our modern lifestyles – depend on aviation. Foodstuffs and manufactured products are regularly transported across continents by aircraft. There are social benefits too – travel brings people together and helps break down barriers.

The aviation sector is growing at nearly 5% per year. Aircraft being delivered today are likely to be in service for up to 25 years, which means that the situation in 2050 is already being created – at least partially – today. The sector also accounts for 2% of global CO2 emissions and that is growing.

The experience of Rolls-Royce in electrification technology is one area where he felt the company could bring significant benefits to aviation. And there have already been great steps forward: carbon emissions have dropped by 80% from the days of the first jets, while today's planes are 50% quieter. However, the industry is under no illusions about the aggressive targets facing it over the coming years.

The company's targets include continuing improvements in the efficiency of gas turbine engines, collaboration with others on the development of sustainable aviation fuels and exploring radical alternatives to existing technologies. Full electrification, hybrid power, vertical take-off – these are just some of the developments that are in preparation.

Yet this is just part of the transformation needed if the industry is to deliver a cheaper, faster alternative to road and rail for many customers.

MARTIN ROLFE, CEO of NATS, explained that he had three priorities: to ensure that the operation of aviation across the country remains safe; to get everyone to their destinations on time; and helping the sector achieve sustainability and get to 'zero carbon'.

There are increasing demands being placed on the air traffic control system with the increase in airborne technologies. It is not just airplanes that want access but also the various drone-based services and then there are the plans for the UK to become a space hub. Providing coordination and control promises to become much more complicated in the coming years. One advance that will improve the situation is already coming into effect. Until recently, knowing the position of an aircraft depended on its being within range of the land-based tracking systems – so when entering the North Atlantic Ocean zone, planes had to be 'metered'

in at 60 miles separation and a constant speed and height. This does not lend itself to optimum operating efficiency for different types of aircraft. However, a new satellite-based tracking system went live in March this year, so now planes can be tracked in real time around the world. Being space-based, the hardware is also more secure. There should not be a repeat of the type of incident involving Malaysian Airlines flight MH370 which completely disappeared from air traffic systems.

Accurate information on position allows the distances between flights to be reduced, different speeds can be accommodated and improved fuel efficiency achieved.

Airspace is currently filling up quickly, especially given the new demands that are being made on the system. He noted that people do not tend to think of the airways as a 'network of roads in the sky'. At the moment, he commented, they need to be transformed into a 'network of motorways' in order to keep up with demand.

When the current system was designed, there were 100,000 aircraft movements every year. That figure has risen to 2.7 million today. If new runways are going to be added to increase capacity, then people will have to be consulted about the changes required. Yet all the London airports are within 20 miles of each other – just one minute of flying time. To consult with all those affected involves 35 million people. The biggest single problem for people on the ground, he noted, is noise. Further reductions in this through enhanced aircraft performance are therefore vital in convincing the public to accept more runways.

The UK deserves a system as capable as the one it has had up till now. Yet, in order to achieve that goal, he concluded, we need to bring in new technologies and new practices to make this happen. The existing procedures can no longer provide the level of service required.

DR JULIA SUTCLIFFE, Chief Technologist, Global Air Sector, BAE Systems, joined the panel of speakers when the meeting was opened to questions and comment from the audience. She explained that her background was primarily in defence applications, where the aircraft were typically designed for just one occupant. However, she could see parallels between the challenges facing civil and military providers. For one thing, the skills agenda should cover both, they should not be seen separately. How can test facilities, which involve high levels of investment, be made available for the benefit of the wider industry? In order to effectively galvanise the development of skills and technologies,

the deployment of large-scale demonstrators will almost invariably be needed, she noted.

In the DEBATE that followed, the question of the ratio between male and female engineers and technicians by 2050 was raised. While all agreed that it should ideally be 50:50, it was noted that action needs to be taken now if that is to be achieved. However, organisations large and small are setting targets in this area and change is happening.

The aviation sector has not had sufficient engagement with Government Departments other than BEIS. However, the Future of Flight Challenge is now bringing a focus to activities across the industry and will attempt to bring Departments closer together on this issue.

A strategy for regional transport – taking people from city to city – is needed as we shape the future of this industry. Innovations, including vertical take-off, lower noise levels and hybrid-electric power will enable aviation to be brought into the centre of cities and offer savings on infrastructure costs.

Common standards are vital if the industry is to move ahead together. Working with other industries will allow incorporation of advances made elsewhere. For example, the automotive sector is making progress on batteries and power conversion which might be applicable to aviation.

It is important not to focus just on the final endpoint of the process. Totally-electric solutions are unlikely ever to provide a complete solution for long-haul flights. Yet just achieving low-noise electric travel for the initial/final mile or so around an airport would allow many more planes to access these locations.

The future of aviation needs to be seen in the context of a more integrated, efficient transport system. The time taken to get to an airport can often be much longer than the time spent in the air flying to another part of the country.

Sustainability means more than zero-carbon. It means zero-waste, much more recycling and a move towards a circular economy. Manufacturers are already addressing these issues but more needs to be done.

Among the newer technologies vying for airspace are drones. How can these be integrated into our future air traffic systems?

A move towards electric-powered aviation will mean more demand on the power supply systems of the country. However, it is expected that take-up will occur first in the regional airports which gives an opportunity for decentralisation of supply.

Useful Reading:

Aviation 2050: the future of UK aviation

<https://www.gov.uk/government/consultations/aviation-2050-the-future-of-uk-aviation>

The Future Flight Challenge

<https://industrialstrategy.blog.gov.uk/tag/future-flight-challenge>

Combat air strategy

<https://www.gov.uk/government/publications/combat-air-strategy-an-ambitious-vision-for-the-future>

25 year environment plan

<https://www.gov.uk/government/publications/25-year-environment-plan>