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Tempest challenge puts the wind beneath wings of aircraft industry

Manufacturers must embrace radical technologies and work practices to ensure the fighter plane takes off by 2035

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A second world war hangar in northern England has become a test bed for British-led efforts to build the next generation of combat aircraft.

BAE Systems, Britain's largest defence contractor, has repurposed the facility at Warton in Lancashire to experiment with advanced manufacturing techniques, such as 3D printing and customised robots, to make complex structures for the Tempest programme.

It is also a crucible of co-operation, involving multi-nationals such as Rolls-Royce and MBDA; the UK arm of Italy's Leonardo and Sweden's Saab, as well as dozens of smaller suppliers.

The challenge is enormous: to radically alter the way combat aircraft are manufactured to ensure Tempest takes to the air by 2035, a timeframe roughly half that of previous programmes.

Moreover, Tempest is more than just a fighter plane. The centrepiece of Britain's combat air strategy is expected to include manned and unmanned aircraft, swarming drone technology and, possibly, laser weaponry.

The aim is to deliver on the government's desire to retain cutting-edge expertise after being left out of a rival Franco-German project. Its success is vital if Britain is to secure the future of its £6bn-a-year combat air sector and its 18,000 jobs as production of the Eurofighter Typhoon, an Anglo-French-Italian-German operation, winds down.

It is also a big commitment by the Ministry of Defence, which has long been criticised for signing up to huge procurement programmes that run over time and over budget, such as Britain's aircraft carriers.

The MoD has committed £2bn to Tempest over the next four years and the companies involved are collectively investing £800m over the same period. The department said: "By spearheading the use of digital ways of working . . . the programme is seeking to achieve significant efficiencies which could slash time and costs."

A milestone is looming. The companies hope to secure in a few weeks a contract for the next phase, to do the concept and assessment work, which would mark the first proper step to the launch of the fighter. The aim is to start the main development programme in 2025.

For BAE and its partners, the focus is on that 10-year time to market. It's a "big challenge given the [aircraft's] capability is significantly higher than previous generations," said Michael Christie, director of BAE's combat air acquisition programme. "It's a bit of a double whammy. More capability in a shorter time."

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To meet the deadline, the partners have replaced the traditional playbook on how they co-operate and engage with the MoD.

Mark Hamilton, managing director of electronics at Leonardo UK, said the MoD was taking an integrated role rather than acting simply as the customer. Meanwhile, the traditional hierarchy of prime contractor and subcontractors had been replaced with a more equal partnership.

The new approach is conspicuous at Warton, where BAE has been assembling combat aircraft for more than half a century. Inside the hanger there are none of the fixed rigs common in most such facilities. Instead, robots from the automotive industry have been modified to operate at the tolerances required for military aircraft.

The companies are also testing ever bigger and more complex shapes to see which parts of the aircraft can be made through additive manufacturing or 3D printing. BAE aims to use 3D printing for about one-third of the Tempest components, compared with less than 1 per cent on Typhoon, which came into service in the mid-1990s.

Dave Holmes, BAE manufacturing director, admitted that to "get anywhere near half the time and half the cost there is going to be a significant step change in the level of automation of all steps of the manufacturing process".

But he insisted that robots were there for the "dull, dirty and dangerous tasks", rather than to replace people. Unions are generally supportive, arguing higher value jobs will be created. An independent report, commissioned by BAE, estimated the programme would support about 21,000 jobs a year.

The greater use of software to design and verify parts will also help cut down on the need for expensive physical prototyping. "You still have to physically test to prove your digital model but once you have proven your digital model you can do things digitally," said Christie.

The novel approach is drawing in other industries. About half the 50 companies at Warton are from outside the aerospace sector, ranging from multinationals, such as Siemens, to SMEs.

The companies are keen to stress the programme's overall economic impact and its ability to encourage wider industrial innovation. Some of the manufacturing techniques identified for Tempest could have applications in sectors such as civil aerospace, they say.

There are still many unknowns, however, not least what the final aircraft will look like and, crucially, the price tag. There is no official cost yet but Justin Bronk, defence analyst at the Royal United Services Institute think-tank, estimated it was likely to cost at least £25bn in total.

"The country can afford to develop its own fighter jet if it is a political, industrial, economic ambition," he said. "What I would question is whether defence can afford this as part of [its] equipment programme?"

Tempest would take money away from programmes essential for generating combat capability until the early 2030s, which is a "long time in favour of something that will hopefully be available in the late 2030s".

One looming strategic question is whether Europe's governments can really afford two combat air programmes, raising the possibility of some alignment with the rival Franco-German project, which will have similar requirements. Christie said there was "no particular convergence" at the moment but he did not rule out some given the need for interoperability between the two programmes.

For now, his focus is on securing that first contract for Tempest. "My target is to establish the acquisition programme. It makes it a reality."