Tempest Programme Case Study
GE Aviation

Name: GE Aviation
Location: Bishop's Cleeve, Gloucestershire
Overview: GE Aviation signed a collaboration agreement with Team Tempest in 2020 to support the development of key power management technologies for a future combat air system. GE Aviation are working on open architecture and infrastructure for electrical power and avionics systems at its Bishop's Cleeve facility.
Spokesperson: Andrew Carlisle

Case Study

The Promise

"The promise for the UK of Tempest is exciting. It will be a leap ahead of any flying platform today. That's what's stimulating for everybody involved," says GE Aviation's Andrew Carlisle.

Blank sheets of paper can paralyse some. Others see that leap into the unknown as the start of their next adventure. GE Aviation falls into the latter. A company with outstanding credentials in both military and commercial aerospace, they have a clear-eyed view of the ambition that's wrapped up in the Tempest programme.

They joined Team Tempest during the 2020 Virtual Farnborough Air Show, when the company signed a collaboration agreement. As well as a wealth of experience and intellectual property, GE Aviation brings a track record for innovation, a willingness to partner and an enthusiasm to be involved in a once in a generation project at a time when the foundations were being laid.

Open Flexibility to All

On Tempest, GE is working in open and flexible architecture and infrastructure for electrical power and avionics systems and digital. "The open systems approach is a guiding philosophy. You often hear that Tempest is about collaboration — well, the open systems approach is the thing that actually drives that collaboration.

"From a UK taxpayer perspective, it gives us the opportunity to pick the best of the best, breaks the cycle of obsolescence and enables rapid deployments of new capability."

The combining of these fundamental infrastructures could one day provide a new standard for data and power management for other aircraft even beyond Tempest. In technology terms it's a generational game-changer because it delivers a highly configurable solution. It's also an enabler of interoperability, which is another Team Tempest aspiration.

"The open systems environment, and tools we are developing, enable people to work together from the earliest stage. It's a collaborative eco-system where different software developers can each host their applications. And it's one that enables simple configurability both during development and through the whole aircraft life-cycle."

Electrical power management tools are available too, that allow requirements to change and be flexible. This allows the infrastructure system requirements to be frozen later in the programme, closer to entry-into-service, so accommodating those unknown design points that are only identified during final testing.

This flexibility reduces cost and schedule risk within an aircraft's development life cycle; it also creates opportunities to easily change the mission systems on aircraft throughout its platform lifecycle.

Existing constructs can put up barriers to this kind of collaboration and run counter to what Tempest has set out to achieve. Says Andrew: "Our discussions with BAE Systems, Leonardo and other partners are all around how we can help create the right development and support ecosystem. One challenge is making sure the supply chain sees the value in this new approach as some may feel threatened by it."

Made in the UK

Andrew says Team Tempest is focused on maintaining and securing a level of capability in the UK. "We want to demonstrate and showcase the intellectual property that the UK has and bring it to bear to support the UK and enable the export. At that same time, this will sustain a level of engineering and manufacturing capability in the UK."

"When we talk about sustainment of capability at GE Aviation, we often do that through our commercial programmes where we develop next generation technology, but in the absence of those programmes you need something else to continue that journey. That's why Tempest and the Typhoon Long Term Evolution programme are really important.

"This sovereign capability idea is a central theme. Making sure the UK is able to develop the necessary software and mission critical systems in its own right is massively important. It's important for us to be part of that undertaking and it is important to the UK as a whole."

Saving the Talent

Tempest has always been seen as an important programme for maintaining and developing skills, capability and IP. But since the Covid-19 crisis hit the aerospace industry harder than most, it has assumed even greater significance, as the UK works out how it can sustain a level of skills, knowledge and capability and bring new talent through.

"The reality is a lot of the commercial programmes are being deferred. Programmes like Tempest make sure that we keep employing the right level of resource and that we make better use of the capabilities that we develop.

"When you're trying to attract new talent into the aviation industry at the moment, it could look very bad to those young university and school leavers. The Tempest programme gives us a story to promote jobs in aviation. It helps draw young people into the industry so we can grow this new generation."

GE and Tempest Innovation

There are a number of innovations GE is looking to bring to the project. It is currently discussing the possibilities with the end customer and the partners around those capabilities. At the heart of these discussion are five key enabling technologies. They are:

1. underlying open avionics infrastructure,
2. electrical management and distribution capability,
3. open human–machine interface,
4. on-board vehicle health,
5. the tools, the environment, the ecosystem.

1 Underlying Open Avionics Infrastructure

Previous generations of fighter aircraft were designed with electronic systems in federated boxes each carrying out a very specific niche function. However, next generation platforms will have integrated resources, essentially a highly configurable mix of applications/functions talking to one another in the same eco-system.

An open system like this allows operators to make changes quickly and more affordably. And, rather than having to rely on one key Avionics provider for the whole of the aircraft's life, they will be able to select the best of the best for different functions and complete those upgrades themselves. For the end user it's important for three main reasons. One, the ability to effect change increases, two, the cost to effect change is much lower, and three, it sparks innovation.

"We're already doing this today in the commercial market on the aircraft like with Boeing 787 and 777X," says GE Aviation's Andrew Carlisle. "On both of these we provide that Common Core resource. It's about giving the system a high level of configurability. You can select from a series of different applications from different vendors and this gives the end user the ability to pick the best option. This approach also drives innovation, by creating a market for specialist providers who would have an opportunity to be part of the eco-system."

There's another angle here too — the export market — which for Team Tempest is a clear goal. "What this means is you're creating the right environment to support export penetration. For example, a nation might want to develop a specific sovereign capability and not want UK eyes to see that capability. This infrastructure allows them to develop that capability in isolation, but it could still be hosted on this integrated environment."

2 Electrical Management and Distribution Capability

GE Aviation's specialists are looking at how they bring the latest thinking on electrical management to the project. Again, their focus is on flexibility. Making sure the next generation system's end user is able to effectively manage electrical power loads is going to be critical. The company has proven experience in this area as it's the integrated electrical power management system provider on F-35 amongst others.

That experience is supported by its state-of-the-art Electrical Power Integration Centre (EPIC) in where GE is able to assemble and test complete aircraft electrical systems. This facility is used for a range of activity, including, testing and proving new technologies, shaking down power systems so aircraft first power on is uneventful, and offering civil customers a complete ATA 24 certification testing service. "We see our lab capability in Cheltenham as a national asset, allowing the UK to compete as a Tier 1 electrical power system provider to the global aerospace industry," says Andrew.

3 Open HMI

The same philosophy that supports the open avionics infrastructure work is being applied to the human–machine interface (HMI). Again, the benefits from a next generation platform perspective are around the speed and affordability of integration. It's quicker, from a certification aspect too. At its heart the work allows multiple vendors to provide the display applications for the aircraft. GE Aviation has carried out significant UK government-backed research into HMI work. Primarily focused on commercial markets, the exploitation path is dual use. In essence, the system allows a component of a visual interface to be changed without disrupting any of the other components in the HMI. The ability to do this safely and securely is obviously important as pilots make decisions based on the information they can see.

4 On-Board Vehicle Health Management

This is about fusing the data from the aircraft's sensors in a way that gives you the ability to predict when the aircraft is going to have health issues and make proactive decisions. And again, it's taking an existing concept but delivering it through an open system approach. GE Aviation has a wealth of experience here ranging from novel sensing solutions fielded on the F-35, to open, total health management platforms. Within an open system like this, different vendors are able to supply their own application within the overall health management framework whilst maintaining IP and data ownership.

"Another benefit to the end user is something we're terming 'self-healing'. This is where when you have access to all these different systems and they're all talking to one another collaboratively. If one of those goes down, the other systems can compensate and take decisions to make sure that the aircraft keeps flying. It's a huge benefit. This is how we bring all of the open architecture benefits and deliver real life in theatre advantages as well."

5 The Tools, The Environment, The Ecosystem

Flexibility and configurability are goals for Tempest engineers, but they can only be achieved if they are underpinned by having the right tool sets. The tools allow airframers and vendors to prototype, test and integrate their software quickly.