Typhoon Future Capability
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The lecturer's opening comments included a reminder that the aircraft first flew as long ago as 1994. However, he promised to say little about the past, and stuck to that by concentrating on an overview of the future. The majority of his lecture described the company's and the UK MoD's work, showing that new capability would continue to evolve with the aircraft in RAF service. It was a reminder that while new aircraft projects are now rare, a purposefully-conceived and executed approach to the alignment of operational needs with the capabilities of flexible systems has been at the root of the Typhoon and its systems platform capabilities from its inception. It has always been expected to do a lot, and the speaker clearly explained how it should be able to remain an enviable front-line defence asset for another 25 years or more.

The RAF's mission requirements are increasingly demanding, in terms of the distance over which an attack aircraft has to be able to detect, track and identify targets in both air-to-air and air-to-surface roles, and with the high degree of certainty of a successful execution that justifies the burgeoning unit cost of modern weaponry.

He talked us through the technology programs in place and proposed. We were given an insight to the weapons in use and in prospect, and the systems that will be used to ensure their effectiveness. He covered emerging weapons and their sensor needs, the operational scenarios advances that are requiring extensive data and information, and the integration of the aircraft and its crew member into the systems platform (which we were to discover is advancing quickly at the current time). The lecture integrated the progress in these three areas more subtly than it is possible in a brief report, so headings condense the material here (acronyms are indexed at the end of the report).

Weapons and sensors – initial fighter/defence capability was based on Sidewinder (now replaced by ASRAAM[1]) for close-range air-to-air combat, and AMRAAM[2] for longer range combat. The latter can be into the BVR[3] regime, and requires either radar-supplied track and identification data, or information from an alternative (passive or cooperative) source. The prevailing air-to-air weapon in future deployment will be Meteor (ramjet-powered with an extended engagement range). Integration flight trials of Meteor and Typhoon are underway currently. Initial air-to-surface weaponry was ballistic and precision-guide (LGB[4]) ordnance and this is to be supplemented by Storm Shadow, a European-developed jet-powered cruise missile that has autonomous guidance and long-range capability. Future weaponry plans include the Brimstone air-to surface missile. The Mk2 variant is already used by Tornado and is in prospect for Typhoon. The aircraft's deployment in all mode of operations is becoming increasingly 'stand-off,' calling for more detailed and precise target information – especially to keep crew workload at a manageable level, and illustrative of the way that 'in-theatre' operations may become less common roles – as manned aircraft supplement 'stealth' and/or unmanned air vehicle operations with advanced fire-and-forget munitions.

Data and information – the 'eyeball' approach to target detection has been of diminishing value for many years, and already Typhoon crews use an integrated infra-red sensor (visible as a protrusion on the fuselage ahead of the windscreen frame, and offset to the left). It can detect targets and convert track information into weapon-ready data that will prime its

sensors and enable precise release information. The identification of targets is still done either by the nose-mounted radar (although this is not a stealthy procedure) or through information relayed into the aircraft from co-operative sources – these can be other front-line aircraft, AWACS[5], or ground/sea-based facilities which exchange information through MIDS[6]. The replacement of the exiting radar with an E-Scan phased-array radar will open more passive modes of operation: thus minimising the chance of detection, and enhanced target detection and tracking capacity. A significant improvement in the way that data is displayed was intimated in new helmet technology – which leads into the next section.

Advanced machine-crew integration – he alluded to the phrase 'wearable cockpit,' a term used increasingly as crew member nowadays often carry significant display technology in their personal kit. The evolutionary route has been from the 1970s HUD[7] into helmet-mounted systems, and with the latter integrating more and more capability. This is clearly where research is close to being turned into implementation on the next phase (tranche 3E) of Typhoon development. He illustrated the configuration of the current Typhoon cockpit displays and controls alongside a possible layout that mirrors the F-35 Lightning II cockpit (shown in Graham Tomlinson's lecture report / Oct 2013: see F-35B under 2013/14 on Past Lectures page), with a schematic of the ultimate 'wearable cockpit' concept which he attributed to UK research at Birmingham University. Most significant in terms of how it might influence the crew-machine interface was the newer generation of helmet. The 'bone-dome' of old – designed for safety – is superseded with an equivalently protective system that includes a head-tracking system and image generation capability that exceeds the performance of early-generation systems, and will integrate with the DVI[8] oral-based command/control capability already in use. The 'Striker' helmet, developed by BAE Systems, meets essential mass requirements, attaining all needs with only 1.8kg total mass (essentially 'lightweight' for such a sophisticated unit).

He introduced some airframe-related development possibilities too, including a common-carrier rack which allows multiple stores to be accommodated on a single pylon, and mid-fuselage mounted conformal fuel tanks. As Storm Shadow must occupy the only 'wet' pylon on each wing, the streamlined tanks offer a substantial combat radius improvement with the new weapon. (An illustration of the tank design is added to this report).

The lecturer presented information that linked many facets very capably while simultaneously showing that what he had to 'sell' was a justifiable evolutionary process that minimised overall risk. Given some audience response it was clear that he did not hearten everyone as there was still concern expressed about the vast cost of modern military aerospace programmes. However, his approach was succinct and made clear where the hub of technological development is maintaining the cost-effectiveness of what is an existing and substantial national asset and investment. It is fair to say that this lecture, whether by design or not, was very appropriate to the venue, with the multi-disciplinary 'systems' concepts that have been championed and shared by Loughborough University and alumni and adherents in the company for over two decades particularly well show-cased.

The event was attended and clearly enjoyed by the 200 or so attendees present.

Lecture notes by Mike Hirst

[1] ASRAAM	Advanced short range air-to-air missile
[2] AMRAAM	Advanced medium range air-to-air missile
[3] BVR	Beyond visual range
[4] LGB	Laser-guided bomb
[5] AWACS	Airborne warning and control system
[6] MIDS	Military information distribution system or Management information and decision support
[7] HUD	Head-up display

Eurofighter Typhoon with conformal fuel tanks