ROYAL AERONAUTICAL SOCIETY
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MQ-9 Reaper RPS operations

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With extensive RAF aircrew and UAV crew experience and a subsequent career in a key role that provides an insight into international operations legislation development, there can be few speakers more able to refute the idea that unmanned air vehicles (UAV) are nothing more than big model aircraft. The presentation concentrated on the core topic and was expanded to conclude with an invaluable review of past and current operational experiences.

General Atomic MQ-9 Reaper with underwing ordnance

His presentation started with a down-to-earth commentary that outlined RAF experience with the General Atomics MQ-9 Reaper, in RPAS (remote piloted air system) or UAV (unmanned air vehicle) roles: and thankfully debunked the expression 'drone' which is the usual press heading for all un-manned aircraft.

He stressed that all current UK remotely-piloted military applications use real-time communications via secure data-links that use ground stations for line-of-sight periods of operation, and satellite links for long-range communication. The latter involves about 1.5 second delay and is used for long-range operational application (the links are two way – they convey display data such as systems status and outside-word views to the ground-based crew, and the crews' control decisions are transmitted back to the vehicle). This is analogous to data flows in modern civil or military aircraft where almost all crew-related information to/from the flight-deck/cockpit passes along electronic links.

Although he concentrated on the most common UAV military applications to date he stressed the range of UAV models already available:

HAPS	High Altitude Pseudo-Satellite	e.g.: Zephyr
HALE	High Altitude Long-Endurance	e.g.: Global Hawk
MALE	Medium Altitude Long-Endurance	e.g.: Reaper/Predator
Tactical	e.g: Hermes 450/Watchkeeper and smaller devices with diverse applications (military and civil), down to:	
Mini	usually multi-rotor devices (used by corporate/individual owners)	

The General Atomic MQ-9 Reaper has been used by the RAF for a decade (and its predecessor, the MQ-1 Predator has been in US use for over two decades). The deployments

being strategic and the fleet size relatively small, its operations are rarely evident in the UK. Major Ground Control Stations are at RAF Waddington, UK, and a facility near Las Vegas in the US. Aircraft and associated systems can be deployed using transport aircraft and therefore based close to the operational zone. The majority of acknowledged UK deployments have been to Kandahar in Afghanistan.

Each mission is controlled from a two-place workstation (pilot and sensor operator) that is manned as a cockpit. With operations spanning typically 14 hours (and up to 20 hours) there are crew shifts: most crews do 8 hour shifts. The two sections of the workstation offer redundant back-up to one another. There was little positive to say about the ergonomics of the disposition of screens and relationship with controls. In general, issues quoted related to the stress created by computer-based menus that are poorly tailored for human memory. He stressed that shortcomings were addressed in training, but the ancestry of the MQ-9 means that software is difficult to update in accordance with safety certification requirements. In fact it is not a unique example and in this case the remoteness of the aircraft and the control centre has created even more tricky systems compatibility problems than in aircraft.

Two-seat control station: this shows the wide-range of displays and controls

He described a typical operation in terms of three phases:

- launch : from a control station with line-of sight (LOS) communications, i.e.: no delay.
- mission : the mission command element (MCE) phase, handled from a master control centre with sat-comm links between vehicle and crew).
- recovery : usually from a LOS comms-equipped site.

The speaker commented on the difficulties of conducting runway operations, even with a fast response data-link, as the aircraft are relatively light and have flexible wings. The simple landing gear is akin to that of many light aircraft and is prone to bounce on landing, plus he cited also that the concentration of mass fore and aft in the fuselage has a 'dumbbell' effect on pitch control. He was willing to express an opinion that automatic take-off and landing systems (ATOLS), already used on more recent designs, are likely to become commonplace.

If an aircraft loses communications with its ground station a 'lost link' procedure is triggered, and the aircraft – provided it has been appropriately primed by the crew prior to take-off – will follow recovery instructions from its memory. All operations are in 'Zulu' time (GMT), but he quoted how piloting an aircraft 11½ time-zones away could lead to day/night confusions.

The communication, navigation and surveillance (CNS) systems on the aircraft are critical to their current use, and will be increasingly crucial in the future. All existing RAF-operated Reaper operations carry a Mode 3/C and S transponder and military IFF[1] (but not TCAS[2]), and use V/UHF radio communication systems with civil and military waveband coverage. The aircraft are 'transparent' to normal air traffic management system.

Commercial use of UAVs will require a fully compatible CNS suite to have access to civilian airspace, and the speaker outlined the areas where major legislative development is in progress:

- The European Aviation Safety Agency (EASA) has commenced the drafting of notices of proposed amendments (NPAs) to complement/change existing aircraft safety certification requirements
- International team members are applying Specific Operations Risk Assessment (SORA) methodologies common to modern safety legislation applications to draft compatible future systems requirements for UAVs
- Compatible Flight Crew Licensing (FCL) requirements are being considered for a 'remote piloting licence.'

Outstanding issues are:

- The proposal to use ATOLS on UAVs
- The imminent acceptance by airspace providers of ACAS-X (next generation Airborne Collision Avoidance System) to replace TCAS – the latter applies only vertical manoeuvres to solve conflicts, whereas the UAS elements of this concept plan to include lateral manoeuvres.
- More complex 'detect and avoid systems' in UAVs.
- The influence of International Traffic in Arms Regulations (ITAR) – US-based regulations that restrict/control the export of defence and military technologies.

In the near future ICAO is expected to issue Chicago Convention Annex amendments (he quoted Annex 2 – Rules of the Air) and equivalent legislation changes will emerge from safety-related bodies: he quoted JARUS, EUROCAE/RTCA, EASA and FAA.

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[1] Identification Friend or Foe (a transponder system on NATO wavelengths)

[2] Traffic Collision Avoidance System

Reaper undergoing pre-flight checks

The latter content of his presentation reflected his role as a QinetiQ representative, acting on behalf of UK interests, in the international safety community, and illustrated the way that automation is making strides in everyday civil aircraft and UAV operations.

One could believe from the speaker's perspectives that the combined operation of manned and unmanned aircraft in the future can be made seamless, and that raises the prospect of the proportions of manned and unmanned operations changing considerably, with unmanned operations potentially becoming the major way in which air vehicles make their way about the planet. It was a very well enjoyed presentation that kicked off the Branch's new programme with a bumper audience (about 150) who posed wide ranging questions, and expressed their satisfaction with warm applause.