Rotary Training Solutions for Military Requirements: A Blue Print for Rotary Wing Training for Today, Tomorrow and Beyond

The development of the effective military aviation capability of a modern multi-role military helicopter is a challenging task; its sustainment adds another layer of complexity. The introduction to service and sustainment processes requires full commitment to the delivery across every Defence Line of Development (DLOD)[1] - not least that of Training. Get it right and the solution can be a key enabler for successful operations around the world. Get it wrong and the costs and efficiency of the aircraft fleet operation is degraded and flight safety can be compromised.

This paper focuses on how modelling and simulation has been applied to deliver a comprehensive rotary wing training solution to both Royal Navy and British Army aircrew and maintainers within the context of the AW159 Wildcat Training Centre (WTC).

The WTC applies a wide range of simulation and multi-media assets to train aircrew and maintainers to fly, operate and sustain both naval and army variants of the AW159 Wildcat helicopter. The solution demonstrates the successful partnership between helicopter OEM and training equipment manufacturer (TEM) that has integrated OEM software and simulation technology within a purpose built training centre, enhancing the learning experience and delivering operational capability more safely and more cost effectively than has been possible in the past for a platform of this complexity. Recently introduced to service, the WTC is gathering significant interest as a blue-print for future comprehensive training solutions.

At the end of 2010, the then AgustaWestland was contracted by the UK MOD's DE&S agency to design and deliver a comprehensive training solution to the Army and Navy Wildcat communities to include a facility that would deliver all engineering, aircrew ground-school and Army Conversion to Type (CTT) training. Army Conversion to Role (CTR) training would be supported by the facility but delivered by serving instructors. The centre would also support Navy aircrew ab-initio and conversion training plus continuation training for both services delivered by military instructors.

AgustaWestland in turn selected the TEMs to be Pennant Training Systems Limited to partner in the delivery of the engineering training devices and Indra Sistemas for the aircrew equipment. A workshare was established such that the TEMs would provide the core simulation components; and lead the integration effort, with AgustaWestland providing the models for the OEM bespoke systems.

The provision of a complete training delivery and support system inevitably required a properly integrated and synchronised approach to the design and development of the solution. AgustaWestland would be charged with the provision of the:

- Facility
- Courseware
- Classrooms & supporting lesson delivery infrastructure
- Maintenance Training Equipment (MTE)
- Aircrew Training Equipment (ATE)
- Civilian Instructors for Army CTT delivery
- Administration, Maintenance & Planning Staff

Given a Joint Helicopter Command aspiration to conduct 70% of non-deployed flying in a synthetic environment the requirements placed upon both the air vehicle and the mission related system models demanded a high fidelity approach. The MOD intent was for a simulation of the entire

[1] Concepts & Doctrine, Equipment, Information, Infrastructure, Interoperability, Logistics, Organisation, Personnel, Training – see MoD Acquisition Operating Framework (AOF) - DLODs

platform at a specific level. Arguably, the only way that this level of fidelity can be assured and sustained on the training devices is to engage the aircraft OEM directly.

Value for money is inevitably another driver and it was quickly apparent that potential synergies existed between the training equipment domain and the helicopter development and support programmes. A strategy was adopted to utilise existing engineering developmental simulations within the company and commercialise them into more complete and robust training simulations. In addition, mission Software (SW) would be rehosted as far as possible in order to maximise fidelity and avoid duplication of effort. Thus the provenance of the flight mechanics model within the Wildcat simulators is the engineering development model used in the design and certification of the live aircraft. The core of the mission systems; the Tactical Processor (TP), is the same core SW as the live aircraft but running on a different operating system – the principle of a rehost.

The very same SW that is used within the aircrew equipment is also used within the maintainer training devices and desktop environments – providing a consistent fidelity over and above that strictly required but being a cost effective, efficient strategy. Commonality of SW modelling across multiple uses, whether providing courseware graphics through desktop trainers and employment on the MTE and ultimately within the ATE, provide a cost and quality mechanism that is valid both in initial manufacture and also in through life maintenance and obsolescence management.

The training media analysis identified a requirement for two Full Mission Simulators (FMS) – a mission capable FFS, a Flight Training Device (FTD) – essentially the same device as the FMSs but without the 6-DOF motion system and a Cockpit Procedures Trainer (CPT) – an FNPT with mission systems added.

Military training places high demands upon the fidelity of both the cueing systems and the mission equipment. High gain tasks such as deck landings place significant demands upon visual and motion systems. The Wildcat FMSs have both a 6-DOF motion system to provide onset cues, and dynamic seats that can provide more enduring cues to the pilot. Equally the display system needs to provide high performance – every cockpit transparency needed to be filled – including the overhead, demanding an unprecedented 240^{o} x 170^{o} field of view.

First flight of Wildcat occurred in October 2009 a year in advance of the training equipment commencement. Given the immaturity of the aircraft prototype at the ATE programme start the only way to provide a representative flight model in time to support the aircraft into service and be valid throughout the whole flight envelope, was to use engineering models; rather than flight test captured data. These models having already been developed to support the design and development of the prototype aircraft. The implication of this was a divergence from the traditional training simulator methodology of building a flight mechanics model based upon flight test data, towards the principle of validation of an engineering, physics based model using flight test data captured from within a progressive live aircraft development.

The definition and measurement of the fidelity of modelling for flight mechanics and performance related systems is a well-trodden path through the civilian market certification processes developed by the FAA, EASA and ICAO organisations. However, the customer needed the simulation to duplicate the performance and handling characteristics in normal and malfunction conditions throughout its full design envelope. Put simply, the JAR Level D specification was just a starting point. The flight mechanics handling and performance models were subjected to the usual QTG examinations but were also validated against OEM performance data augmented by ad-hoc data requested for particular manoeuvres not contained within the JAR profiles and also subjectively assessed by the same Test Pilots who were flying the prototype. A strong relationship between the training equipment team and the flight test department was fundamental in the development of a flight mechanics model to the fidelity demanded by the customer.

Another area of demanding fidelity is that of airwakes associated with the land and dynamic ship platforms. Indra has employed a sampling methodology using offline generated CFD turbulence fields that accounts for deck pitch and roll as well as relative wind. The ship motion modelling is driven by the 3-dimensional sea and was extensively tuned to provide representative deck behaviour. With the turbulence field married to the deck motion, the resulting environment was compared to the data collected during the actual sea trials using the very same pilots who had flown the live aircraft. The deck landing modelling is considered to be highly representative allowing much of the initial deck qualification and continuation to be conducted synthetically.

The Wildcat mission systems are complex and fully integrated. In order to achieve the mission training requirement and enable the 70% of non-deployed flying, these systems would also need to be simulated at high fidelity. A straightforward representation of the HMI would not be sufficient. While the TP is a re-host of the OEM developed system, other systems such as the Selex ES Seaspray radar and Wescam MX-15 electro-optical and designating system enjoy both ITAR and IPR protections. As a result, access to and provision of data both internally and to the TEM was problematic both in terms of the permission to share and the timelines required to obtain such permissions. Additionally, a complete simulation utilising manufacturer data would lead to a high security classification which would cause problems with a foreign – albeit EU and NATO nation, supplier. In the event, both these systems were developed, having achieved the appropriate licences and Governmental permissions, without the use of complete supplier datasets. Coupling Indra's broad engineering expertise and access to high quality generic models with MOD operator expertise the mission system fidelity could be incrementally developed to such a level that they are now indistinguishable, from a training perspective, from the live fielded prototype versions.

The WTC has proven to be a high quality training facility that has delivered all that the MOD customer asked of it. The demands placed upon fidelity have been achieved through the exploitation of OEM privileged data, the reuse of engineering derived modelling from the live aircraft programme and a close partnering relationship with both the TEMs and the MOD's end-user community.

Increasingly, military flying training will demand more use of synthetic environments to deliver cost effective capability development and pre-deployment training for crews. This will demand enhanced realism and simulation fidelity requiring strong partnerships between the aircraft OEMs and simulation TEMs to succeed and to integrate the training service with the live aircraft deliveries. Multiple use of SW at various levels of devices exploiting modelling already performed within the prototype aircraft programme provides a cost effective approach to achieve the high fidelity simulations demanded by the modern warfighter.