HELICOPTER TRAINING: ENCOURAGING PROGRESS AND PROMISING PROSPECTS

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Abstract

At the time the EASA is replacing the JAA in Europe, Helicopter training is starting to develop specific training approaches. The paper intends to present a picture of the present status of helicopter training:

- the various types of devices now available in the market and the new technological approaches that have been made possible,
- the services offered with some recent and telling examples,
- the problems faced: IPR, data availability, harmonisation, … and the relating questions still to be answered,
- the perspectives and the necessary conditions for the development.

Introduction

At the time the European Air Safety Agency (EASA) is progressively taking over the Joint Aviation Authorities (JAA) responsibilities in Europe, Helicopter training is starting to develop specific approaches that are - at last and fortunately - different from those adopted for fixed wing aircraft and take into account the specific requirements of helicopter training. This results from a very pragmatic and exemplary approach of Authorities, manufacturers and operators who have invested a lot of effort to resolve an almost "impossible" economical equation.

Regulations have greatly contributed to this revival in the approach to training by granting the necessary training credits to new devices. Authorities have contributed by establishing technical criteria tailored to helicopter training safety improvements, while staying within affordable limits.

Manufacturers have cooperated to conduct full size experimentations to demonstrate the relevance of new training concepts. They have introduced to the market new, low cost, devices dedicated to helicopter training and they have also developed new services to address a whole range of helicopter training requirements.

Operators are starting to assess the possible savings and the safety advantages that can be obtained by using Synthetic Training Devices instead of the real aircraft in the rotary wing world.

This is a good start, in which Europe has often taken pioneering positions. It is a starting point that gives encouraging signals to those who put their energy into the development of these new trends for the benefit of all contributors to the helicopter industry.

Despite real and unprecedented progress made by the whole rotorcraft community in many areas, there is still a long way to go to equal the ideal (?) status of the fixed wing world :

- In terms of regulations: national implementations of new European regulations are sometimes delayed, harmonisation with the highly respectable FAA could be further increased, requirements and credits for certain special operations training could be further investigated, …

- In terms of products and services: the FTD concept could be further developed, new independent training services dedicated to helicopters could require further adaptation of regulations, different approaches depending on helicopter categories and sizes, on operator – large or small, civil or military - and missions, could be encouraged.

- Operator's awareness of the advantages that can be taken by "synthetic training" in terms of cost savings and safety could be increased and jointly explored.

- Rotorcraft manufacturers' acknowledgement of their desirable contributions to ease the progress of synthetic training for increased safety could be increased.

Facts and Figures

Even the most ignorant readers who are not involved in cockpit crew training activities have some ideas on the numerous training centres that are providing high quality type training to airline crews around the world and are quite familiar with the big Full Flight Simulators in use in these centres. *Flight International* magazine publishes a yearly census of Civil Flight Simulators. The most recent census published in April 2004 was recording 979 Airline Flight Simulator and only … 18 civil helicopter simulators.

A 2 to 100 ratio that is not likely to reflect the respective sizes of actual aircraft fleet.

For reference commercial airlines fleet were scoring a total number of 18230 airplanes in 2004 according to *Jane's* database. This represents a ratio of about 20 airplane per simulator. At the same time worldwide civil helicopter fleet were totalling 29670 rotorcraft i.e. ... 1650 helicopter per simulator.

Same figures are less easy to gather in the military area. Relying on the most recent *Flight International* census published in November 2003 there are 1146 military simulators of various types in the database of which only 248 are helicopter simulators for a worldwide fleet of 23690 rotorcraft i.e. 95 helicopters per simulator.

These figures lead to the evident conclusion that helicopter simulation is still – and by far - lagging behind the fixed wing simulation.

There are some good reasons including:

- The average fleet sizes - about 4 helicopters – that prevents operators from procuring qualified training devices
- The weight of training habits favouring actual flight
- The ignorance of real synthetic training devices' capabilities

These can be addressed by educational, advertising and marketing actions by the simulator and rotorcraft manufacturers and by encouraging actions by Regulators and Authorities but "money is the sinews of war" and the most critical reason which must be stepped around is the difficult business case.

A difficult business case

Again we need to keep in mind some reference figures to show a true picture of the present situation.

The prices[1] of airliners ranges approximately from USD 40 M (B737, A320) to USD 170 M for a Boeing 747-400 for Full Flight Simulator prices ranging from USD 10 M to 15 M.

Prices of helicopters ranges from the very basic R22 at USD 150 K to the USD 49 M CH-47 with EC120 at USD 800 K, Bell 206 / Squirrel at USD 1.3 M, Dolphin around USD 5.5 M and Super-Puma around USD 14 M.

Helicopter Civil Full Flight Simulators prices are ranging from USD 15 M to 19 M i.e. about 50% more than their fixed wing counterparts.

As usual, there are good reasons for such a situation:

- The type of operations of helicopters at low speed and low altitude mandates more sophisticated visual scenes with more detailed databases and a larger field of view
- The helicopter aerodynamics requires more modelling efforts due to the complex interactions between rotor fuselage ground effects etc.
- The limited market size also imposes more cautious amortization assumptions for all the initial non recurring effort.

Dedicated simulation standards

Simulator standards for helicopters have also been the "poor relation" to airplane regulations. FAA AC 120-40 was released early 1983 and was replacing the initial AC 120-14. AC120-45 for advanced training devices (FTD) was published in May 87. UK CAA CAP 453 was dated September 89,

The US FAA, which has been a pioneer in simulation regulations, only issued an equivalent advisory circular, dedicated to helicopter simulators qualification - AC120-63 - late 1994 and fixed wing AC 120-45 for FTDs has still no rotary wing equivalent.

Reading the background statements in the introductory statements is quite telling : *"The FAA has been involved in flight simulator evaluation and approval for well over three decades. As far back as 1954, air carriers were allowed to perform limited proficiency check manoeuvres in AIRPLANE simulators. […]*

In recognition of expanding flight simulator capabilities, as technology has progressed, FAR revisions have been developed to permit the increased use of AIRPLANE simulators in approved training programs. To date, the FAR have not addressed the training and checking of flight crewmembers in HELICOPTER simulators which, as a result, limited their use."

This must not be considered, at all, as a criticism against the FAA. FAA regulations have greatly contributed to the development of airplane flight simulation. It is only a confirmation – if necessary - that regulations have a deciding effect on the

[1] All prices quoted here are ROM prices indications obtained from open databases or news releases.

development of synthetic training device industry and training habits. Credits granted are determining in the operator's decision of procuring synthetic training devices.

No wonder then, that civil synthetic training for helicopters is still in its infancy. Fairness imposes to say that these recent progress have been made possible by the recent advances of simulation technology.

The situation has improved recently with the release by the European JAA – nearly another 10 years later - of a full set of dedicated regulations for helicopters' Synthetic Training Devices:

- JAR-STD 1H Helicopter Flight Simulators (April 2001)
- JAR-STD 2H Helicopter Flight Training Devices (September 2003)
- JAR-STD 3H Helicopter Flight & Navigation Procedures Trainers (May 2002)

Various training devices defined in JAR

These European regulations have fortunately been designed in full coordination with the US FAA which has been intimately associated to their development. They are defining several types of Synthetic Training Devices taking account of the distinctive characteristics of helicopter operations.

Flight Simulators (FS) are the most sophisticated devices. Four levels have been defined –A, B, C, D - level D being the most complex. Compared to their fixed wing counterparts, they offer a larger Out-of-the-window Field of View (60 deg vert x 180 deg horiz). Their JAA definition is quite similar to the standard defined in AC120-63 with some minor differences that have to be resolved as soon as possible: the most significant being about the requirement of collimated displays by the FAA.

They are sometimes fitted with Roll-on / Roll-off (Ro-Ro) cockpits that enable the operator to share motion base and visual systems between several helicopters types and thus improve their profitability.

Eurocopter and Thales Training & Simulation have opened the HeliSim Training Centre in Marseille that allows for Dauphin N2, EC155, Super Puma Mk I and Super Puma Mk II with only two motion base. All cockpits are or will be qualified according to JAR-STD 1H Level D standards. This is certainly the most recent example of what can provide modern helicopter simulators in terms of type training.

Fig. 1 - HeliSim Ro-Ro Level D simulator

HeliSim simulators are fitted – FAA oblige - with collimated visual displays and allows for NVG, SAR and Off-shore operations training.

Flight & Navigation Procedures Trainers (FNPT) are an innovation of JAR-STD 3H. They have been defined after experimentations and checks [1] involving JAR-FCL and JAR-STD working groups with the goal of proposing affordable generic devices fro basic training like Instrument Rating and Initial Licensing and for additional generic training for specific operations: landing in confined area, NVG, Off-shore, etc. They have been pretty well received by operators. Three types have been defined with options for MCC training.

Thales Training & Simulation received orders from various civil and military operators including the French MoD and HeliUnion[2], and the market will certainly continue to develop – at least in Europe - based on the credits granted by the JAA.

FNPTs do not require any flight tests (Proof of Match) and only reflect generic performances of a certain class of helicopter (light, medium, heavy). The JAR-STD 3H regulation allows for synthetic instrument panels which decreases the development cost, make it more flexible, increases reliability and reduces the maintenance cost. The regulation also permits projected visual systems which provide wider Field-of-View capabilities and do answer helicopter training requirements.

[2] HeliUnion is a major off-shore operator having headquarters in Paris. HeliUnion recently created a FTO " HeliUnion Training Centre" using a generic FNPT II MCC.

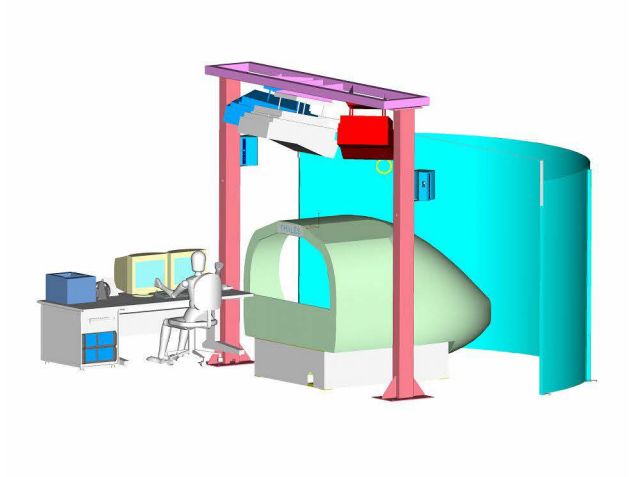

Fig. 2 - FNPT main components – design office drawing

Despite the generic nature of FNPTs – according to regulation - most of operators are requesting FNPT "representative of a specific type of helicopter". This means that they expect to have a "pinch" of specifics in the definition of the FNPT e.g. specific performances and parameters, main specific operational constraints, navigation displays looking like those of the helicopter type they are operating, etc.

Fig. 3 Fennec-like FNPT for the French MoD

Flight Training Devices (FTD) are the third on the list and probably the most promising devices. The final JAR-STD 2H regulation has only been published late 2003 and is applicable since January 2004, but the idea of type specific devices does answer the requirements of operators for type-specific low cost training devices.

To make it short, the requirements are quite similar to those of the FNPT: same Field-of-View (150 deg x 40 / 60 deg), relaxed *"correct trend and magnitude"* requirement for flight performances, same acceptability of *"the use of CRTs or "Flat Panel" displays with physical overlays incorporating operational switches/knobs/buttons replicating a helicopter instrument panel"*. The most important differences are that:

- Cockpit and systems have to be type-specific and replicate a specific helicopter. However, depending on the level considered, only part of the helicopter systems may be type specific.
- Flight characteristics and performances must be based on actual helicopter recording for level 3.

These devices will be suitable for

- Type training, including systems management, initial and recurrent training,
- Instrument training and IR revalidation/renewal
- Recency
- CRM Training, as part of approved course.
- LOFT (Route and area familiarisation)
- MCC training
- Type training, testing and checking within an approved testing and checking programme.

Suitability for type training and LOFT in addition to most of the training allowed on FNPT MCC should make these devices quite attractive to operators of medium / light helicopters.

One can consider that these new regulations

- have provided a better answer to the market demand with training credits granted to devices far cheaper than Flight Simulators,
- have defined technical requirements that takes account of specific helicopter requirements and are more adapted to rotary wing world.

Besides the devices, that are designed according to specific regulations, there are other devices – part task trainers - which are answering specific training requirements – especially in the military world:

- Tactical Trainers (AVCATT, EDITH, …)
- Rear Crew Trainers (for Mission Systems operators)
- Weapon Systems Trainers , Hoist Trainer, etc

Still some pending questions

Nothing is perfect and there are still some pending questions to be resolved.

FAA/JAA harmonization: Due to the worldwide recognition of FAA regulations, the deviations between the FAA AC 120-63 and JAR-STD 1H in terms of visual requirements partly ruins JAA opening for the use of projected display systems. Due to the narrow market size, FAA approval is mandatory for Simulator Operators to make their investments profitable. They are thus forced to select collimated solutions – despite the fact that direct projection displays offer larger field-of-view

– better adapted to helicopter training - at a lower cost. Furthermore collimated displays may provide misleading altitude cues when hovering.

An effort of harmonisation between regulators is still necessary to take full advantage of the JAA regulations.

Access to data: This has been a long standing question in the fixed wing world. Standardisation actions have been taken by airplane manufacturers (Airbus, Boeing) to rationalize their data offer and adapt them to the market and the devices. This is not yet done in the helicopter world. Efforts have been made under the sponsorship of the RaeS[3] to better define the data requirements for helicopter simulators. This document –which is quite demanding and intend to ease access to "Zero Flight Time Training" in the helicopter world, should be taken as a reference to incorporate simulation data requirements from the initial stage of a new medium / heavy helicopter development program.

But access to these data is still difficult and prohibitive prices might well compromise the development of type specific low cost devices.

Drastic actions must be taken by helicopter manufacturers, simulator manufacturers, regulators and vendors to

- reduce the cost of data,
- develop specific answers and … prices for low cost devices,
- avoid oversizing data requirements,
- ease access to data by incorporating data access requirements in their contracts with equipment manufacturers.

Some ways still to be explored by simulator manufacturers, regulators and operational staff

What is coming ? Is it pure dream ?

Visual Scenes development - With the recent development of PC-based high performance visual systems using off-the-shelf hardware, the price of visual systems channels' hardware has been drastically decreased. However it appears that helicopter training requires very detailed visual scenes - as operations are mostly low altitude VFR flight. The requirements are pretty much the same as those required for Land Tactical training (e.g. Tactical Virtual Environment). It is thus important to develop efficient and user-friendly database modelling software to decrease the development cost – and development time - of helicopter simulator visual databases. Ideally the future tools should easily data from various sources ranging from satellite data, aerial views, mapping agency, reconnaissance data, etc and should be compatible with the helicopter mission systems.

3D visual systems – 3D stereoscopic visual systems are already technically possible and might be economically possible very soon. They might be a relevant answer to specific helicopter training requirements: confined area, in-flight refuelling, tactical nap-of-the-earth flight, etc.

A process has to be initiated with Regulators and Operational staff – as followed for the initial specifications of FNPTs - to evaluate the new possibilities offered by such systems and incorporate them in the future regulations. They could provide valid solutions in addition to collimation and "classic" direct projection.

Helmet mounted visual systems are already in use in existing training devices (e.g. AVCATT). They provide an adapted low cost answer to the military requirements of mission rehearsal on the theatre of operations. They could also be more extensively used for some specific civil operations including hoist operator in SAR mission, etc. Again the development of these systems will require a close cooperation between all parties involved.

Mobile civil training centres – Economical constraints have promoted the development of third party training in the civil domain (Bell Flight Academy, HeliSim, HUTC, etc) and Private Finance Initiatives in the military domain (MSHTC, Lynx Eagle Training, etc). Despite these new approaches, it appears that helicopter simulator training is not yet developed as it could / should be. "If you don't go to Lagardère, Lagardère will come to you" said one musketeer in the famous Paul Féval's novel. Mobile training centres are already in operation for truck driving simulators. It might be also the answer for the development of civil light / medium helicopter simulator training… with the possible development of moving training centres incorporating low cost FTDs.

About the Author

JF Erismann joined TT&S in 1974 as a software engineer specialised in Flight, aerodynamics and automatic flight control systems. With an

[3] The Royal Aeronautic Society has sponsored a working group which published the "Data Package Requirements For Design And Performance Evaluation Of Rotary Wing Synthetic Training Devices" which is an equivalent to the fixed wing so-called "IATA Data Document"

experience in commercial aeroplane simulators, he was a member of various international working groups (IATA, IQTG,...) and has been the secretary of the JAR-STD aeroplanes working group. After three years at TT&S in UK, and various positions in Customer Support organisation, he is now a senior Sales & Marketing Manager in Helicopter Business Development TT&S organisation.

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