RAeS Conference 3-4 July 2014

"**TECHNOLOGY: FRIEND OR FOE?** The Introduction of Automation to Offshore Operations"

Report by Jim Lyons.

At 17:17 hours on 23 August 2013, an AS332 L2 Super Puma Helicopter, with 18 persons on board, crashed into the sea whilst on approach to Sumburgh Airport in the Shetland Islands. Four of the passengers did not survive. This was the fifth accident to the Super Puma range of helicopters in the UK sector of the North Sea since 16 February 2009.

The UK Parliamentary Transport Committee announced on 10 September 2013 that it was to hold "…an inquiry into helicopter safety, following the crash of a Super Puma helicopter into the sea off the Shetland Islands in August, in which four people were killed, and other recent incidents involving helicopters carrying oil and gas industry personnel to and from offshore installations in the North Sea." This report was published on 08 July 2014.

On 12 September 2013, the Canadian TSB issued Aviation Investigation Report A11H0001; this accident report was issued with respect to an 'inadvertent descent during departure' of an S92A from an offshore platform on 23 July 2011. The report also contained a description of two other serious incidents - August 2007, and 12 November 2008, both whilst on approaches to offshore platforms. Neither of these two earlier incidents had been previously investigated by the TSB.

The UK Civil Aviation Authority (CAA) announced on 24 September 2013 that "… a review of offshore helicopter operations in the North Sea would be instigated. This review was to study current operations, previous incidents and accidents and offshore helicopter flying in other countries to make recommendations aimed at improving the overall safety of offshore flying." This review was published on the 20 February 2014.

On 21 November 2013, the FAA published the 'Report on the Operational Use of Flight Path Management Systems' to "…address, for current and projected operational use, the safety and efficiency of modern flight deck systems for flight path management (including energy-state management)."

During the process of the CAA producing the 'Safety review of offshore public transport helicopter operations in support of the exploitation of oil and gas', it was becoming clear – from documentary evidence and anecdotal reports available to Challenge Team members – that, in addition to the issues discussed and addressed in CAP 1145, automation of the more complex helicopters being operated might had been a contributory factor in a number of incidents (and perhaps accidents) in the UK and world-wide.

In early 2014, after extensive discussions in the RAeS Rotorcraft Specialist Committee, it was decided that the RAeS was best placed to organise, and facilitate, a two-day conference on the issue of 'operating with automation in offshore operations'. The conference entitled "Technology Friend or Foe – the introduction of automaton to offshore operations" was arranged and 'directed', in the sense that speakers were invited to present on appropriate and related subjects that would ensure adherence to the specified narrative trajectory.

The conference was held on the 03 and 04 July 2014 in the lecture theatre of 4, Hamilton Place, London.

Report on the RAeS Conference: Technology Friend or Foe – the introduction of automation to offshore operations.

Keynote day one:

‘Safe Operations in an Age of Constant Change – Oversight and the Continuous Improvement Cycle’

The conference opened with a keynote speech by Air Commodore Mark Swan, CAA. This set out the role of the CAA with respect to two questions: “what safety risks does aviation pose to the UK passenger and general public?” and, “are the risks being managed effectively?” The programme that the CAA was following in their transformation to a performance-based regulator was laid before the attendees. Mark explained what that meant with respect to the CAA and the Industry – using the Offshore Helicopter Review as the case study.

Session 1 – Setting the Scene:

‘Overview of Offshore Operations’

Captain Steve O’Collard gave brief recap of the history of offshore operations - from the early days of VFR operations in the GOM to the present day IFR operations in deep water locations.

‘The Introduction of Automation to Offshore Operations – the Chronology’

Captain Mark Prior provided a view of the ‘introduction of automation’ starting from standard ‘T’ instruments and basic stabilisation with minimal or no ‘upper mode’ - which required manual flying at all times - and navigation using ground-based aids and DECCA. With the 80s came the introduction of 3-axis analogue autopilots (trajectory control through pitch, roll and yaw) with height and heading modes followed quite quickly by 4-axis coupled ILS and vertical speed modes with primitive collective control (but prone to over torque). The middle of the 2000s saw the introduction of 4-axis digital autopilots with envelope protection and LNAV via FMS; developing almost immediately into ones with integrated: engine control (FADEC); navigation and autopilot (VNAV) functionality; and (more) complex glass displays.

‘Automation Upsets in the Complex Helicopter – the Accidents and Incidents’

Captain Simon Harlow and Captain JJ Gerber presented the ‘reveal’. We saw, from the evidence of FDM video clips provided by Cougar Helicopters, that automation upsets have been increasingly present since the introduction of integrated systems to the modern fleet in the mid-2000s. Simon provided evidence of complexity added to the cockpit with: the addition of congested displays; diverse ways of controlling autopilots; and, flying controls with diverse and complex trim functions.

Necessary changes required in piloting skills when converting from flying with basic instruments and stabilisation, to managing the on-board systems, have not been fully recognised and implemented; there was ample evidence that the necessity for managed transition had not been understood (by regulators or operators) or put in place.

It was suggested that we had not learnt the lessons from the airlines where a culture change had accompanied the introduction of increased complexity of on-board systems. It was also unfortunate that the move to a more appropriate operating concept for offshore operations had been held back by the presence of mixed fleets with diverse capabilities.

<u>Session 2 – A Look Back in Time:</u>

'The Future Flight Deck - 1995. Were the Lessons Learnt – the Carry Across to Offshore Operations'

Captain Lloyd Watson looked back at the discussion paper produced by RAeS/GAPAN in 1995 to see what, if any of it, would have been applicable to future rotorcraft. The conclusion reached by Lloyd (in hindsight of course) was that it had applied equally to rotorcraft as aeroplanes. In a review of recent accidents - where the use of automation was a factor - it could be seen that the causal chain was very similar. Clearly, heed had not been paid to the sage words of this, and similar papers of the period (Billings), nor to issues that had been experienced during the introduction of complex systems in the aeroplane world in the previous decade.

'Experiences from fixed wing – are the lessons transferrable'

Captain Mark Cameron shared his experiences of transition from offshore helicopter pilot to Captain on the Airbus 380. From a relatively unfettered operational flight regime to a disciplined, and mostly scripted, environment. Operations in modern airline fleets are now conducted using the procedures provided by the major manufacturers informed by cooperative and representative bodies. The one phrase that resonated from the presentation was the no-compromise fact that 'automation = procedures'.

<u>Issues from Sessions 1 and 2:</u>

- There needs to be a re-assessment of recent displays – they are too complex and cluttered;
- The industry would benefit from a less diverse approach to the provision of Human Machine Interfaces (HMIs) and autopilot controls;
- There is great benefit to be had from sharing the experiences of operators (as the video replays demonstrated) and a process by which this could be achieved should be investigated;
- Video replays of incidents, on their own, do not provide sufficient information and it is necessary to provide context; in addition, replay functions of the Flight Data Management (FDM) systems provide much greater understanding if they show an accurate representation of what was seen by the crew members;
- Evidence shows that we have a problem that will require a change of culture to address. We have not learnt from the lessons of others;
- The experiences of the airlines in adopting, and adapting to, automation is germane to the effective and safe use of automation in helicopters.

<u>Session 3 – The Modern Cockpit in Complex Helicopters:</u>

'The Role of the Pilot – Human Centric Design'

Professor Guy Boy introduced the three automation loops (previously seen in another form in the 'reveal') which characterised the move from 'control' to ‘management’ of flight in the ‘first revolution’. The optimum level of transfer of functions from the human to the machine is driven both by knowledge and technical limitations. It was clear that the fatal accident level in the commercial jet fleet had dropped significantly to the present day, mostly because of the introduction of the automated fleet. Statistics show that the introduction of novel features almost always resulted in a temporary blip before having a beneficial effect. His conclusion: automation can be good if it is human centred.

Professor Boy moved to the issue of complexity and integration – agreeing that the cockpits of the latest helicopter models were extremely complex and had to be reduced by a design process that involved: participatory design; integration (behind the scenes); a thorough test regime; maturing the process; training; and using change management to understand the effect and control the introduction of solutions. He suggested that the model of design where the engineering process was separated from the user by a user interface (designed by human factors experts) was outmoded. Human centred design required the cooperation of people, technology and organisations working in unison.

The final series of slides introduced the fourth loop – automation of the ATM; this would require multi-agent integration in the move from Air Traffic control to Air Traffic management – i.e. the ‘second revolution’. Professor Boy left us with the thought that continuing development of automation in aviation will depend upon: modelling and simulation (creativity); human-systems integration (participatory tests); complexity management (maturity); and change management (training).

‘Working with Interface Limitations’

Doctor Steve Jarvis showed how, by taking different perspectives on any subject, opposite conjectures can be shown to be correct. Even such well used phrases such as ‘situational awareness’ mean different things depending upon context; the crew need to have ‘awareness’ of where they are in the patterns of an instrument approach but also need ‘awareness’ of the current parameters of the flight (and might be ‘aware’ in one but not the other). Understanding that situational awareness is a multi-level concept will have an effect on the roles specified for the crew members and the subsequent division of labour and responsibility.

The roles of pilots in managing and monitoring are more complex than first imagined and simplistic views of what solutions may be required are often misguided. Monitoring for example has always been problematical because it is difficult to know what is being viewed, and when; Steve discussed a project that uses eye-tracking to try to understand some of these processes.

‘The Development of the Autopilot’

Hervé Jammayrac gave a presentation that included: basic definitions; why autopilots; principles of operation; steps in autopilot development; interaction means; design considerations; and operational considerations. He outlined the compromises between constraints, needs and solutions - and described how Airbus Helicopters had met these challenges. He described the development from the basic SAS, through 3-axis and 4 axis analogue, to 4-axis digital autopilots which now included: inputs from FADEC, Air Data systems and navigations systems; redundancy, reconfiguration and fail operative architecture; envelope protection, AEO/OEI power limitations, airspeed (low, high) and altitude priority level off; and the new functions of TCAS2 coupling, and flight path angle hold.

Hervé showed how control panels had changed from early models with 'actuator monitoring', through complex control panels containing many buttons and knobs, to the latest integrated systems with their reduced HMIs resulting from sophisticated integration. Pilots' displays had also been integrated into the system but, notably, the FMS retained its awkward alpha-numeric display and anachronistic functionality.

Where previously, design was technologically driven with complexity being added to complexity due to increased functionality, there was now a clear imperative to move to human-centric design – recognising that the pilot was becoming the weak link in the system. In the future, it would be necessary for the autopilot to be more integrated and be an 'active member' of the crew using voice messages and simplified panels and displays to communicate their actions and intentions.

'Reducing Complexity in HMI Design'

David Speed presented two common control units (CCU) that were based upon the 'touch screen concept' – one military and the other civil. These CCUs included management of: flight plans; communications, transponder and navigation; digital map setting; avionics status; pre-flight check lists; communications back up. They also contained control of: fuel systems; hydraulic systems; environmental system; internal and external lights; circuit breakers; re-allocation of electrical loads.

The layered architecture provided abstraction and isolation from the underlying hardware, reducing the probability of obsolescence and increasing portability. David provided examples of functional screens to show: how complexity had been reduced; reduction of the number of pages; and, elimination of many layers of menus (exchanging depth for width).

Following the presentation, one attendee commented that whilst there was an overall reduction in the level of complexity in the cockpit, certain functions (the example of the landing lights – used for conspicuity) would require eyes-in-the-cockpit and several selections rather than just a single button press on the collective. For that reason, each transfer to the CCU should be considered on merit.

'Flight Simulation Devices for Complex Helicopters'

Captain Nick Norman provided his experiences of the introduction of the EC225 into his company and, in particular, the Full Flight Simulator. He explained that FSTDs for complex helicopters are not used for basic training – all conversion and training is conducted on already 'qualified' pilots. For this reason, basic handling, without the autopilot connected, accounts only for about 1% of time in the simulator. Most of the time the simulator is used to increase the understanding of the automation and to facilitate the use of Standard Operating Procedures (SOPs).

Nick postulated that whilst the fidelity of the basic flight model is important (including the visual elements), accurate simulation of the automation and their degraded modes are of paramount importance to crew training. He stated that accurate replication of the systems behaviour is not reflected in the certification requirements "Out of 11 pages of FSTs, there is only a single test containing the word "autopilot" and a tick box, and elsewhere another test with a reference to

“SAS” with a tick box. There is also a single test entitled “Flight data displays”.” He continued by stating “To an outsider such as the author, the whole document reads as though it were written for a helicopter dating from the 1980s, not one designed and built in the modern era”.

Nick indicated that it was very difficult for an independent simulator manufacturer to gain access to information which permitted the behaviour of software-driven elements such as the Automation and EFIS to be accurately modelled (unlike aeroplanes). “This lack of information probably arises for two reasons: where so much work has been done to produce such an effective system, there might be a desire for commercial confidentiality and a reluctance to reveal all the secrets. However, it is not necessary for the pilots to know how the thing works, they only need to know how it behaves.” It was his view that flight safety should take precedence over the protection of intellectual property. The issue of software versions was also important because of the necessity to avoid negative learning experiences.

Issues from Session 3:

- Displays and HMI are too complex, and getting more so - simplification is required by employing human-centric design principles;
- Involvement of the end user in the design and integration of automation is essential; rapid prototyping systems can assist with definition of effective user displays;
- The rules and guidance for the certification of displays, autopilots and HMIs must be contained in the helicopter certification code (Parts 27 and 29) – as they are for large aeroplanes (Part 25) – and used in the process of certification;
- There is a need to understand the essential roles of crew members so that effective strategies for managing the flight, and monitoring its progress, can be established.
- Autopilots are increasingly omnipotent and few pilots understand them – there is a need for pilots to have access to conceptual models so that they can gain, and retain, a mental picture of what is happening within the system;
- HMIs need to be simplified in order to move away from cockpit clutter and to reduce the workload associated with management of automation;
- Type ratings and training for complex types require effective use of FSTDs - the fidelity of simulators needs to be improved along with the certification process to reflect this dependence;
- The certification process for complex helicopter FSTDs should take (more) account of the integrated/automated system when they are essential to the operation of the aircraft;
- There is a need for manufacturers to provide better access to conceptual information on software-driven elements, such as automation and EFIS, so that third parties can simulate these processes with accuracy; the guidance attached to the Part 21 OSD should reflect this.

- To reduce the probability of negative training, the system of attaining and retaining approval for complex helicopter FSTDs should ensure that the version of simulated automated systems keeps pace with the current aircraft fleet.

Keynote Day Two:

'Safe Operations in an Age of Constant Change - Keeping the Operator/Crew in Control'

The second day opened with a keynote speech from Captain Tim Rolfe. He stated that, in spite of extensive research on the future cockpit, "…increasing application of cockpit technology does not work in practice if it is simply designed to replace the human, and operational weaknesses develop if the human does not know what part they play in the overall system. We know also that the expected benefits of automation do not materialise if the designer's assumptions on intended use do not match the actual use of the system(s)."

Even though the actual level of accidents is low, incidents relating to automation and monitoring suggest that there is still work to be done and the CAA has captured some of this in CAP 1145. That there is still work to be done is also evident in the CAST Flight Deck Automation Working Group report – released September 2013.

Tim suggested that we have not aligned ourselves closely enough with our fixed-wing colleagues and we do not, even when offered the opportunity, participate in many of the work-streams. In fact we have actively fed the myth that Rotary is different from Fixed-Wing because it is more flexible but, there is extensive evidence that in SAR, HEMs, Offshore and Onshore Operations, the flight-path and automation management principles look pretty similar to those in aeroplanes.

He concluded that our future success requires three main building blocks: the provision of robust training programmes; the development of optimised operating practices; and building resilience into crew performance. In order to achieve this success we need a cooperative process which includes: a strong regulator; ATOs to lay the foundations for continued learning beyond the constraints of the current initial type rating programmes and be based upon competency and appropriate SOPs; OEMs who provide access to improvement programmes - post service introduction; and, active participation from the operators.

Session 4 - Operational Control

'The Role of the Operator – Ensuring Operational Safety When Introducing an Automated System'

Captain Ian Scott, using his own experiences with the introduction of the EC155 to offshore operations and the change-over from the S61 to the S92 in Shell Brunei, explained how it required attention in four main areas: keeping pace with changing technology using formal 'Change Management' processes - ensuring that this captures non-technical as well as technical risks; ensuring the amended SOPs build on the assembled knowledge that already exists – not specifically for rotorcraft but all aviation; addressing specific areas of exceptional risk – i.e. the introduction of Stable Approaches; and providing assurance that SOPs are being observed - taking Shell Brunei's methods for introduction of the S92 as a case study.

He recommended that we should take note of the information that is contained in the FCOMs of Airbus and Boeing (and other aeroplane manufacturers) and use them as a foundation for the provision of appropriate SOPs. The provision of such information should be a model for the rotorcraft industry and be adopted by the major manufacturers.

Ian concluded with the messages "An effective Change Management Process embedded within the Company (Safety) Management System is the mechanism to capture these requirements, and the criticality of addressing the Human Factors operating requirements should not be lost in the overall project plan when purchasing new types" and "Once (the type is) introduced, effective monitoring, and adapting if required, will allow us to maximise the efficacy, and adoption, of the SOPs and minimise the risk of operational divergence."

'Achieving Common (Best Practice) Operational Standards'

Captain Colin Milne, using two recent accidents as case studies, explained how the lack of specific procedures and prescribed use of existing automation, had resulted in the aircraft being placed into a situation where recovery had not been possible. He also brought attention to the fact that, in many of the accidents/incidents experienced in the North Sea, the PIC was PF and the SIC, PM; this was contrary to the practice in the airlines where the more experienced pilot assumed the monitoring role - ready to advise corrections or, in extremis, to take control.

He broached the subject of achieving best practice operational standards by addressing the following points: the need for common operating procedures; understanding the OEMs design philosophy; sharing lead customer experiences; agreeing common procedures; incorporating those procedures for all training providers; and mandating those procedures.

'Making Appropriate Use of FDM Information – "you don't know what you don't know"'

Eddie Rogan provided an insight into the use of FDM as an events-based system providing a record of excursions from previously defined areas of concern. In addition to this he showed, using examples from airline use, how the data could be leveraged, using statistical methods to provide evidence of adverse trends and clusters in the data.

Under normal operations, after the data has been pre-processed to 'flag-and-retain' sections surrounding 'events', it is placed into a data-warehouse for retention. However, there are systems which provide a filter tool (in some systems called Flight Data Measurements or MAXVALS) which can be used to extract derived parameters from <u>all</u> flights and place them into a relational data-base. This data-base can be accessed directly (and without the need for mining in the data warehouse) and analysed, providing information to the operational audit team or, more likely, to the training department.

British Airways uses the FDM system for: safety investigations; proactive risk assessment (data driven); the provision of data to inform the ATQP process; fuel efficiency; emissions trading; [to bring attention to] Airport and ATC procedures;

[to provide] information to engine and airframe manufacturers; information for the CAA (who have a confidential analysis function); and to establish 'normality' in operations.

Eddie showed a recent project that has used data 'contained in the warehouse' to provide information to the CAA EGPWS flight envelope project – who are investigating the modification of the envelopes contained in the GPWS Classic Modes. It had already been shown that the warning period could have been increased (without increasing substantially the number of nuisance calls) in a number of the North Sea CFIT and LOC accidents - perhaps allowing a longer period during which recovery would have been possible.

The presentation ended with the description of a project to include FDM into an integrated SMS^{360} system.

'LOSA & Threat and Error Management – Understanding and Tolerating Automation Upsets in the Automated Systems'

Simon Stewart provided an insight into a system of operational data collection and analysis that could provide a risk assessment weighting system. Some airlines are using Line Oriented Safety Audit (LOSA) to provide information on observed behaviour in normal operations; this is not used in isolation but is collated and analysed to inform the ATQP and Evidence Based Training (EBT) approval process. When part of a continuing process, FDM and LOSA data can also be used to enhance (and modify) the training programmes. This provides a dynamic element to the system that can be used to capture and address (in the training system and SOP development) emerging risks; it also acts as an audit tool which can be used to assess the efficacy of measure taken in the 'constant improvement cycle'.

Issues from Session 4:

- 'Change management' must be used when any changes to the equipment or operating regime is contemplated;
- Changes to the 'culture' of offshore operations are necessary to address the issues that are currently being seen in automation upsets, such changes need to be assessed, 'considered', defined, and achieved as part of a cooperative process between all interested parties;
- Automation = SOPs;
- The provision of best practice SOPs can only be achieved in a collaborative process between the OEMs, the Operators and the Regulators;
- The rotary world should have a system of information production and distribution similar (both in style and content) to that provided by Airbus and Boeing in FCOMs (or their equivalent);
- SOPs must be all-pervasive; they have to be an integral part of all training and operations from the type rating to flying on the line – this requires that conversion and training on complex types be conducted with crews (these are already trained operational pilots);
- The information collected in Flight Data Monitoring must be leveraged to: provide audit of current operations, provide evidence of exposure to emerging risks, and to inform the training system;

- Additional measure, such as Line Oriented Safety Audit (LOSA), should be used (alongside FDM) to provide information on operational risks;

Session 5 – Ensuring Competency is Attained and Retained

'Regulation of Training – The Need for Vision in Regulations'

Captain Richard Dane emphasized the importance of a system based upon a central philosophy. In the military the philosophy is to 'train hard and fight easy' and in civilian operations 'train as we operate, operate as we train' - which were essentially the same.

He postulated that, under the current regulations there were three silos: the qualification for a Type Rating – which is informed by FCL, with a syllabus that is prescribed in Part 21 under the Operational Suitability Data (OSD); the Licence Skills Test – which is an annual requirement 'prescribed' under FCL; and Operational Conversion and Proficiency – which is a bi-annual requirement 'prescribed' in the Operational Regulations. Unless an operator had an integrated training establishment, these three requirements could result in training that: was not informed by the Standard Operating Practices; did not use SOPs as a basis for managing automation; and/or, lacked operator control over the whole process. In addition, FCL regulations exist in environment that has not changed with the advent of the complex helicopter.

Current regulations do not facilitate the use of competency-based training – i.e. are performance oriented; provide an emphasis on standards of performance and their measurement; nor permit development of training to the specified performance standard. Because it is necessary to show compliance with the elements in the three silos, it is difficult to concentrate on facilitating the development of the pilot to provide resilience.

The current thinking with respect to training in the commercial environment is that it should address core competencies - "A group of related behaviours, based on job requirements, which describe how to effectively perform a job and what proficient performance looks like. They include the name of the competency, a description, and a list of behavioural indicators." These core competencies include: communication; aircraft flight path management - manual control; aircraft flight path management – automation; leadership and teamwork; problem solving and decision making; application of procedures; workload management; situational awareness; and, knowledge.

Richard summarised by indicating where we need to go from here: the use of operational profiles developed, rehearsed, supported and tested within a framework of collaboration from the OEM, NAA and Operator; predictive and not reactionary training – ATQP & EBT; holistic and not simplex training; and the development of LOSA and FDM packages to leverage operator knowledge – thus aligning training with the extant risks.

'The Introduction of ATQP in British Airways'

Captain Keith Dyce provided a comprehensive review of the introduction of ATQP to British Airways. He described how they had moved away from traditional training programmes addressing fixed training and check items which were identical for all aircraft types and operators. The new ATQP programme had a syllabus specific to each operator, and fleet, where training was based upon the operational risks. Keith explained that the reason for the change was not to save money – the cost was almost identical the only saving being the move of the line check from annual to biennial.

The balance of training had moved from a predominance of checks to one where Line Oriented Flight Training (LOFT) and Line Oriented Evaluation (LOE) were the main components. Keith described the construction of the new training syllabus – and its constituent parts, and explained the required competencies. He went on to explain the BA introduction of ATQP and the main differences for trainers and trainer standardisation.

Keith showed how BA measure if ATQP is working - providing a slide to show it was; addressed the attitude of pilots to ATQP – they like it, particularly LOE; and described the benefits that ATQP has brought to BA.

In the final slide, the move to EBT by industry was predicted by stating that: most UK fixed wing operators use ATQP; the regulations currently only allow ATQP; BA, Virgin and EasyJet are now looking at EBT; it is natural progression for BA; it provides better integration of safety/training data; it fully embraces competency based training and assessment; and, it will provide a final move away from fixed checks*.

* ATQP is only a stepping stone to EBT and has the disadvantage that the annual requirement for the LPC (and its prescribed elements) is still applicable.

‘Learning from the Positive – The Evidence-based Training Concept’

Captain Mike Varney gave an important presentation showing how EBT permits operators to build on the positive aspects of each pilot’s knowledge and experience. Mike showed with evidence from Threat and Error Management (TEM) indicators how an improvement in ‘Leadership’ and ‘Communication’ (two of the competencies described earlier) had considerably improved the management of threats, reduced errors and avoided undesired aircraft states.

By analogy, he demonstrated that huge improvements can be obtained by ensuring that the training system addressed the holistic improvement of pilots by concentrating on facilitation of the core competencies. The end product resulting in a more rounded and resilient crew member.

He explained that the EBT programme had resulted from an analysis of data collected over a long period - using a number of reporting and survey systems (including LOSA, FDM, ASRs and accident and incident reports). EBT also continues the ICAO initiative to establish competence based training; this has led to the construction of the eight ICAO competencies (nine for Airbus who – rightly according to attendees at this conference – include ‘knowledge’).

Mike enumerated the qualities required of the EBT trainers and the required attributes. These included: is patient and has a positive attitude; shows humility and admits mistake; encourages and is honest; is non-judgemental and shows empathy; is supportive, respectful and honest; and leaves good knowledge. This caused eyebrows to be raised among the attendees – and a ripple of amusement.

It was explained that EBT consists of three phases: evaluation; manoeuvres training; and scenario based training. The objectives and conduct of these phases was described. Mike went on to describe the current state of the programme including the grading system criteria, the weighting of that criteria, determining the scales (resulting in a scale of one negative and four positive), performance indicators, and VENN methodology.

Mike concluded with two slides: the first with a statement of the main issue “failures are less likely with modern reliability; when humans and technology interact, there are a huge number of possible outcomes; [there is a need to] develop resilience to events through exposure”. And the last, a description of the elements of ‘resilience’ and how it was to be achieved.

‘What are the Requirements for a Complete Training System?’

Duncan McKechnie provided a presentation which considered how training systems cope with the diverse requirements that result from the ‘three silo’ system of training regulations. He started by posing the questions “has the advent of digital avionics and complex automation in the modern cockpit changed the way we train?” and, “should it have changed the way we train and if so how?”

He described how the regulations do not mitigate towards a structured training system for small operators (and some large operators who outsource their training) with complex helicopters - without the resources to own, or control, the facilities for an integrated training system.

Three types of operator were used as examples: one which has all of its resources in-house and can integrate ‘type ratings’, ‘skill tests (LPC)’ and ‘operational conversion and training (OPC)’; one that does not own all of the resources but has the capability of dry leasing facilities and also can integrate all of its training; and, one that does not have access to dry leasing and has to rely upon outsourcing for all of its training.

In the last case, the problem that exists is that in order to make a commercial success, the contracted ATO has to cater for any number of customers – each of whom has its own SOPs and operating environment. The solution that was put forward in this case was the provision (by the ATO) of an interface document that could be used to specify the required manoeuvres, SOPs, the scenarios, and the operating environment. Each customer (who wanted to take advantage of such a system) would complete the interface document and supply an appropriately qualified trainer for assessing the candidate crew (it would have to be a crew unless the assessor was acting in the role as well as assessing). The contracted ATO would supply the simulator and operator who would set it up as required in the interface document.

<u>Issues from Session 5:</u>

- The current system for regulation of training needs to be enhanced so that it better addresses increased risk from the use of automation – there needs to be systematic bridging between the (apparent) silos of Type Ratings, Licence Proficiency and Operational Conversion and Training;
- The adoption of Operational Suitability Data (OSD) into the certification requirements has the potential to provide Type Ratings that are ‘tailored’ for each complex type – further guidance is required to ensure that this is achieved;

- More flexible systems for training - Advanced Training Qualification Programmes (ATQP) as a first step towards Evidenced Based Training (EBT) – have the potential to better align training to measured risks;
- Where non-integrated training schemes are envisaged (i.e. the operator does not own, or manage, ‘all’ resources for training), it should be under a system where the operator’s responsibilities can be fulfilled – i.e. training should include representation of the operator’s SOPs as well as the specific environment under which operations are conducted.