Flight Standards Directorate

# Concept Paper

## Making the Case for Helicopters in Evidence Based Training
## RMT.0599 – Udate of ORO.FC

 

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# 1 Executive summary

The existing international standards and regulations for helicopter pilot training were originally derived in response to accidents involving early generation jet aircraft. Whilst some elements of helicopter operations are included, they have in essence been 'bolt–on' additions to the core programme, usually in the form of manoeuvre-based practices. Standards have remained virtually unchanged since inception. During the same period progressive changes in aircraft design, including the developments in automation, system integration, reliability and significant changes in the operating environment have demonstrably improved operational safety, but also revealed new operational challenges.

The Evidence-Based Training (EBT) project was undertaken as a global safety initiative, which arose from concerns that recurrent and type-rating training were no longer meeting the needs of airline pilots. At the inception of the EBT project, a review of available data sources, their scope, and relative reliability was undertaken. This was followed by comprehensive analyses of the data sources chosen. The objective of the analyses was to determine the relevance of existing pilot training and to identify the most critical areas of training focus according to aircraft generation.

A key output of the EBT project, the IATA Data Report, corroborates independent evidence from multiple sources, including LOSA, flight data analysis, reporting programs and a statistical treatment of factors reported from an extensive database of aircraft accident reports. Both process and results were peer-reviewed by experts in pilot training drawn from airline operators, pilot associations, civil aviation authorities and original equipment manufacturers, so as to provide transparency and to bring a qualitative and practical perspective. During the study, critical core competencies were examined, in technical and non-technical areas presenting the opportunity to train and assess flight crews according to a defined, useful and comprehensive set of measurement criteria to ensure that pilots have the confidence and capability to operate their aircraft in all regimes of flight and to be able to recognize and manage unexpected situations. Results showed that manual aircraft control, management of go-arounds, procedural knowledge of automation and flight management systems (FMS), monitoring, crosschecking, error detection and management of adverse weather were issues of concern. The IATA Data report also revealed a significant and pervasive rate of unstable approaches continued to landing, illustrative of an endemic culture of intentional non-compliance across many flight regimes.

Training programs constrained by repetitive testing in the execution of manoeuvres to comply with outdated regulation, lack the variability to train effectively and the following key issues were identified as priorities for focussed improvement in crew training systems:

(a) integration of assessment of non-technical performance in all aspects of training.
(b) maintenance of Situation Awareness whilst working with highly automated and reliable systems
(c) exposure to rapidly developing and dynamic situations, including complex and unexpected scenarios
(d) focus on Leadership and Communication competencies as key risk reducing measures

The IATA Data Report indicates significant differences across what can be considered as different aircraft generations and while overlap in training clearly exists, there are quite distinct generational differences in patterns of existing risk that are not adequately addressed by current training.

The assertion that the perpetuation of historical airline flight training regimes leads to less than optimal output is supported by the helicopter community, as is the implementation of change in both the regulation and development of recurrent airline pilot assessment and training. Whilst helicopters were outside the scope of the original EBT development plan and are not referenced in ICAO Doc 9995 or the IATA EBT Implementation Manual, the offshore helicopter community, operating multi-pilot, multi-engine, instrument flight rules (IFR) aircraft, increasingly equipped with cockpits equivalent to 'Generation 3' aeroplanes (as described in ICAO Doc 9995) has expressed a need to have access to EBT.

This concept paper outlines the process by which the case made for EBT for airline operators can be described, developed and evidenced to support EBT for helicopter operators.

## 2 Background

The Evidence-Based Training project (EBT) was a major safety initiative in the commercial air transport sector. It arose from an industry-wide consensus that, in order to reduce the airline accident rate, a strategic review of recurrent and type-rating training for airline pilots was deemed necessary. Essential to ensuring regulatory support for this initiative was the objective consolidation of empirical data that provided substantial evidence that current training and checking practices were not, of themselves, fulfilling the safety needs of the industry. Keeping in mind that international standards and commensurate national regulations for airline pilot training largely evolved from the evidence of accidents involving early generation jet aircraft, the analysis of safety data involving other groupings of more modern aircraft did not always show a relationship to those prescriptive requirements. For the most part, the belief was that simply repeating pilot exposure to "worst case" events in training was considered sufficient to satisfy the industry's safety needs. Over time, 'novel' events resulting in serious occurrences were simply added to the requirements of progressively crowded training programs, which eventually resulted in an inventory or "tick box" approach to training being adopted. As a result, the industry was being forced to focus on their flight crews meeting the ever-increasing regulatory imposed minimum performance standards rather than enhancing their overall abilities.

The project required the demonstration of an evidence-based case to support the required changes to current training methodologies and that case was made in the generation of the IATA EBT Data Report. The report clearly demonstrates that training methodologies must and can be significantly improved. This improvement process begins with applying a different philosophy when developing and implementing recurrent training programs; a philosophy that inculcates best operating practices, which are relevant to both the equipment in use and the specific needs of the air operator.

The IATA EBT Data Report leveraged the improved availability of data from both flight operations and training activity which has become increasingly accessible over the last 20 years. Sources such as flight data analysis, flight observations (e.g., line observation safety audits (LOSA) programs) and air safety reports give a detailed insight into the threats, errors and undesired aircraft states encountered in modern airline flight operations as well as their relationship to unwanted consequences. In light of evidence from these data sources, it was considered timely and important to review current training practices. A large-scale comprehensive study of a range of available data sources and analyses was conducted and important differences emerged between what can be considered as six different aircraft generations. The process and results of this quantitative analysis were reviewed by a team of internationally recognized experts in pilot training, representing airline operators, pilot associations, regulators, and original equipment manufacturers. This provided transparency as well as a bringing a well-rounded and experiential perspective to the data. Analysis of multiple sources using differing methods and tools revealed consistent findings and it became apparent that, while there remains overlap in areas of training needs across aircraft generations, there are also quite distinct differences in patterns of risk in the later generation aircraft that are currently not addressed. Certain critical pilot competencies emerged in technical and non–technical areas that clearly illustrate the need for a change of focus of airline pilot training, both in terms of concept and curriculum with respect to generational characteristic.

The IATA EBT Data Report contains the methodology and results of a meta–analysis and makes a strong case for changes in recurrent airline pilot training. The definition of an Evidence-based Training Program specified to different aircraft generations is outlined in ICAO Doc 9995 – Manual of Evidence Based Training - and guidance on implementation is offered in the IATA EBT Implementation Guide. Generation of both documents involved experts from many fields in the area of operational and flight data, pilot instructors, scientists, academic research professionals and a statistician, in addition to volunteer pilots and analysts from various locations around the world, experienced instructors, to build the training scenarios for the Baseline Recurrent EBT Training Program.

As EASA rulemaking task 0599 develops the roadmap for regulatory implementation of EBT for commercial airlines, the helicopter community sees the need for access to EBT and sets out in this paper to build the case for extending any regulatory framework to be applicable to helicopter operators and to make an equivalent case for the development of a baseline helicopter training programme supported, where possible, with operational safety data as well as applicable data from industry research.

# 3 Description of the issue

## 3.1 Identification of the issue

The EBT initiative resulted in the generation of ICAO Doc 9995 (Manual of Evidence Based Training) and the IATA Implementation Guide. Doc 9995 outlines the concept of EBT and defines a Baseline Programme for Generation 2-4 aeroplanes which, in conjunction with the IATA Implementation Guide, can be used by operators to adopt an EBT programme and by regulators to approve an EBT programme.
The process of developing ICAO Doc 9995 did not address the helicopter community, although it is accepted that the operation of modern helicopters, the later generations of which are equipped with EFIS cockpits and increasingly sophisticated automatic flight control systems, involves similar crew competencies and skills sets. Therefore, there is a compelling case for the alignment and development of EBT for helicopters.

Additionally, EASA RMT.0696 developed a regulatory pathway to allow airline operators to move towards an EBT mixed implementation programme, for those aeroplane types covered in ICAO Doc 9995. As ICAO Doc 9995 does not apply to helicopters, access to EBT is not possible via this process.
The terms of reference (ToR) of RMT0599 outlines (in paragraph 3.6) the desire to extend EBT principles to the helicopter community, citing similarities between the modern airliner and the modern helicopter (multi-pilot, multi-engine with complex automatic flight control systems). Whilst the terms of reference allow for extension across the wider helicopter community, it is recommended that the process of developing a helicopter EBT programme should prioritise the following operational activities:

- Offshore operations
- SAR operations
- Onshore IFR CAT operations
- HEMS operations
- Firefighting operations

In order to apply the principles of EBT to the helicopter community, it is necessary to compile a data report similar to the IATA Data Report for EBT to support the case for helicopters access to EBT training programmes and to shape the development of a Baseline Programme for helicopters. The key tasks to be achieved are:

(a) Development of an EBT Data Report for helicopters.
(b) Development of an equivalent to ICAO Doc 9995 Appendices for helicopters (to be published by EASA).
(c) Development/amendment of existing regulation to provide a pathway for helicopter operators to transition to EBT.

In compiling a Data Report for helicopters, it is preferential to mirror the philosophy and methodology[1] of the IATA Data Report for EBT, using similar data streams comprising several data sources. The data streams represent not only a potentially large set of relevant data, but also a variety of different kinds of data. This cross sectional approach mirrors the approach used in the IATA EBT Data Report, providing compensation for bias inherent in any one data type, strengthening the basis of the overall analysis.
The publication of an equivalent to ICAO Doc 9995 Appendices for helicopters is planned by the Agency in co-operation with HeliOffshore, helicopter pilot associations.
Once the case for Evidence-based Training has been made for helicopters, it is intended to follow the regulatory development path for aeroplanes and generate regulations offering access to an EBT training program for operators as an alternative pilot training and checking option.

## 3.2 Identification of the possible options

In line with Article 2 of the Basic Regulation, the specific objectives of the proposed approach are:

— to ensure that Member States, industry and the Agency develop harmonised concepts and rules for addressing the identified safety risk and regulatory-coordination issues to achieve and maintain a high and uniform safety level for commercial helicopter operations; and
— to assist Member States in fulfilling their obligations under the Convention on International Civil Aviation (the 'Chicago Convention'), by providing a basis for a common interpretation and uniform implementation of its provisions, and by ensuring that its provisions are duly taken into account during the development of rules.

The possible options considered for the implementation of Evidence-based Training for helicopter operators are outlined in Table 1 below. In analysing the possible options around the generation of a helicopter EBT programme, it must be understood that, unlike commercial aeroplane operations, there is currently no regulatory allowance for an ATQP programme approval process for helicopter operators.

**Table 1: Possible options**

| Option | Description |
|---|---|
| 1 | Do nothing |
| 2 | Transpose the EBT Training Programme Development Guidance for Aeroplanes directly to Helicopters without a supporting Data Report that is specific to helicopter operational risks |

[1] The methodology planned is broadly similar to the IATA Data Report for EBT aeroplanes, however the ECCAIRS taxonomy instead of the IATA taxonomy may be used. In such case mapping may be made.

| | |
|---|---|
| 3 | Create a specific Helicopter EBT training programme supported by a specific Helicopter Data Report and develop a regulatory framework to allow Helicopter EBT implementation |

## 3.3 Analysis of impacts for the possible options

### 3.3.1 Safety impact

The safety benefit of developing an EBT programme for helicopters should be demonstrated over time by continually improving a system targeted at focused learning. The impact of **Option 1 – Do nothing** would deny this potential safety benefit.

The impact of **Option 2 – transposition of Aeroplane EBT directly to Helicopters** carries a risk of the inappropriate application of training principles and would not effectively allocate helicopter types to defined generations nor would it address helicopter specific operational risks. This option also carries the risk of an inappropriate focus on safety priorities and training criticality,potentially increasing the helicopter accident rate through the application of invalid training focus and content.

**Option 3 – Create a Helicopter EBT Data Report and develop a regulatory framework for helicopters** should ensure that the intended safety benefits gained through the definition of an EBT Baseline programme which addresses helicopter specific operational risks. These will be challenged and validated through the analysis of openly available data and the appropriate emphasis placed on criticality of training certain manoeuvres and scenarios as defined in the developed Baseline EBT programmes. The helicopter accident rate is expected to be reduced once the training benefits are fully realised.

### 3.3.2 Environmental impact

No environmental impact is anticipated through the adoption of Option 1.
It is possible that implementation of Options 2 and 3 will lead to an increased use of Flight Simulation Training Devices (FSTDs), to replace some ‘in-flight’ training. Whilst any such transition to FSTD use is positive in terms of environmental impact, the overall impact is considered to be neglible.

### 3.3.3 Social impact

No social impact is anticipated through the adoption of Option 1.
Option 2 offers the potential for negative social impact for those training organisations and/or personnel delivering EBT programmes where the application of invalid training focus and content based on aeroplanes may be subject to obvious social challenges.
Option 3 offers the possibility of a positive social impact for a number of training organisations with existing or expanding EBT expertise as they could expand their business to provide training to an increasing market demand. Training organisations offering an EBT programme and NAAs will potentially need to enhance their training development and provision capabilities through the development of their personnel. Finally, the fact that training focus and content will be based on helicopter specific risks will be obviously socially better.

### 3.3.4 Economic impact

No economic impact is anticipated through the adoption of **Option 1**.

The adoption of **Option 2** will incur limited costs in the transposition of the IATA Data Report output to cover helicopter operations.

**Option 3** will incur cost through the development of a specific Helicopter Data Report for EBT, however, the cost of producing such report is primary charged to the asociations and institutions developing the report (e.g. EASA, AESA, UK CAA, Heli-ofshore…etc). The cost of implementation of the EBT programme deriveted from the the Data report for the operators will be the same for Option 2 (EBT programme based on aeroplane data) than for Option 3 (EBT programme based on helicopter data). However for Option 3 these initial costs are potentially offset through the alleviations offered by an approved EBT programme specific to helicopters. To illustrate such aleviations this are the ones currently offered by the aeroplanes EBT programmes:

- An increase use of instructors instead of examiners during simulator sessions.
- Reduced number of line checks.
- The integration of CRM training during simulator training.

Such alleviations can only be introduced into the regulations though a sufficiently convincing data report that includes helicopter specific operational risk.

### 3.3.5 Proportionality issues

Option 2 and 3 do not create proportionality issues. EBT is only implemented on a voluntary basis. Therefore, small operators who are unable to change their training programmes, or who don’t have access to simulators, will not be impacted.

### 3.3.6 Impact on regulatory coordination and harmonisation

**Option 1** — Do nothing - would maintain the current situation.

**Options 2 and 3** represent an improvement of the existing regulations. Other countries are likely to follow, including ICAO. This is likely to encourage other countries to change their national regulations towards the European Union (EU) model.

Furthermore, specifically for **option 3**, adopting legislation for the implementation of EBT according to a data report will improve the chances of this happening.

### 3.3.7 Impact on existing organisations including the Agency

For the three options described above, there is a need for a guidance framework within the EU to assist NAA’s in the oversight over and standardisation of EBT in accordance with a consistent process monitored by the Agency.

It is likely that NAAs will need to invest time and money in the training of inspectors, and possibly in the recruitment of new inspectors with different skills or qualifications to those currently overseeing pilot training. This impact increases moving **from Option 1 to 3**.

**Options 2 and 3** have the potential to positively impact the regulatory activities of the Agency as they should address the difficulties and inconsistencies identified under related tasks, as well as contribute to integrating these tasks with RMT.0599:

- Interface issue between this task and RMT.0194 : Extension of competency-based training to all licences and ratings and extension of TEM principles to all licences and ratings.
- Interface issue between this task and RMT.0596 : Review provisions for examiners and instructors of Subpart J & K in Part-FCL: this is a complete review of Part-FCL Subparts K and J, containing the provisions for examiners and instructors. Industry and MS experts requested this task as an urgent correction and alignment of the rules in place. It will also address some of the elements proposed by the Agency's examiner/inspector task force.
- Interface issue between this task and RMT.0196 : CS-FSTD.

### 3.3.8 Preferred Option

Based on the balance between safety, economic and other impacts described above, **Option 3** provides the best outcome to address the issues identified in paragraph 2.1 of this CP and section 2 of the CP for RMT.0599.

# 4 Roadmap for Option 3

## 4.1 Development of an EBT Data Report for Helicopters

Compilation of the Helicopter EBT Data Report will follow the methodology used by IATA in the development of the IATA EBT Data Report to ensure consistency in approach to the data analysis, which will allow commonalities and differences between aeroplane and helicopter operations to be identified. This approach will allow future data comparison with the baseline data established today.
Results to be published within an EBT Data Report for Helicopters will be drawn from multiple sources, some of which are readily available to the public. Some come from information, access to which is restricted to industry specialists, while other results will be inferred from confidential, de-identified data. While the EBT Data Report for Helicopters will not be a meta-analysis in a pure sense, it is derived from an analysis of analyses using a variety of sources and techniques to corroborate and challenge its own findings. It will consist of a large collection of results from primary and secondary studies that are consolidated to determine training needs. Findings of this nature in this multi-sourced report will come from various external studies, in addition to internally designed studies. The criteria defining the usefulness of the various studies in this report are the following:
1. It is relevant from a training perspective (e.g., if incorporating a training change mitigates the risk found in the study).
2. There is evidence that it will assist with the identification of competencies to be developed in training in order to mitigate risks encountered in the evolving operational environment.
3. Data will be analysed with one or more of the following objectives:
a. to substantiate the need for change in the assessment and training programs for commercial transport pilots.
b. to provide evidence from data analyses to support the development of training topics, prioritized according to aircraft generation.
c. to challenge and/or corroborate the Training Criticality Survey and Training Guidance with operational data.
d. to provide feedback to determine the effectiveness of changes implemented through the adoption of competency-based training methodologies.
4. The findings of the study will be corroborative or challenging across the spectrum of the multi-analysis study.
5. Analysis of the findings will be compared with data and findings from reports coming from industry-respected research/studies.
6. Varied data sources and/or varied methodology mitigate inherent biases associated with individual types of source data.

### 4.1.1 Data Sources

Data is to be collected from the following sources:
1. Operators
2. Original Equipment Manufacturers – Aircraft (OEM)
3. Accident Investigating bodies
4. International aviation organizations
5. Civil Aviation Authorities

In line with the data sources utilised in the IATA EBT Data Report, the table below lists the data sources proposed for consideration in the Helicopter EBT Data Report and categorises each source in terms of analysis methodology.

| Data Sources |
| --- |
| Helicopter LOSA Reports |
| EBT Helicopter Accident and Incident Study |
| Helicopter Operator Pilot Survey on Training Effectiveness |
| Training Criticality Study (TCS) |
| Helicopter Flight Data Analysis |
| UK CAA Helicopter Safety Reports |
| SINTEF Helicopter Safety Study |
| EASA Safety Risk Porfolio - Offshore Helicopter Operations |
| EHSAT Helicopter Safety Reports |
| EHEST Training and Briefing Materials |
| Jarvis: 'Rotary Wing Monitoring – Phase 1 – Final Report' |
| TAWS – 'Saves' |

The specific methodology associated with each data source category is described in Chapter 3 of the IATA EBT Data Report and, unless specified otherwise, will apply to the analysis in the Helicopter Data Report.

#### 4.1.1.1 Data Source - Category 1 (existing data/analysis/paper)

The first data category contains data from sources that are highlighted in blue in the data source table above. Evidence from these sources will be formulated in the form of statements recorded in an Evidence Table (ET). The Evidence Table is a tool in the analysis, the specific evidence statements within being linked to different parameters.

#### 4.1.1.2 Data Source – Category 2 (Data derived for EBT development)

The second data category will consist of the data from the EBT Helicopter Accident and Incident Study. The results from these analyses provide several means of ranking according to a defined training need. The processes involved are algorithmic and result in distributions that do not translate easily into evidence statements, and therefore are not incorporated in the derived Evidence Table.

#### 4.1.1.3 Data Source – Category 3 (TCS)

The third data source category will consist of the results from the Training Criticality Study (TCS). This study will be administered to all helicopter operators and results analysed (i) separately (as representative of the helicopter operator community) and (ii) comparatively against the data collated from the parallel studies conducted within the commercial airline community.

#### 4.1.1.4 Evidence Table

Specific evidence taken from the particular studies of data source category 2 will be consolidated into single declarative statements and entered into a database with links to the following:

1. Flight phases
2. Competencies
3. Objectives of the study
4. Training Topics
5. Context of the evidence if relevant
6. Factors analyzed in the Accident-Incident Study
7. Sources
8. Keywords associated with the conclusions of the report
9. Applicability to helicopter generations, if determined

The methodology associated with the Evidence Table is referred to in the IATA EBT Data Report in Chapter 3.

### 4.1.2 Types of data

The following two types of data are used to provide systemic feedback for training criticality analysis in this report:

**Training data**, including the elements and structure of operator conversion courses, recurrent training, line flights under supervision in addition to measurements of system performance. This type of data provides information relating to the effectiveness of the training system, the instructor and trainees, and for the purposes of this report is known as the internal training 'feedback' loop.

**Operational & Safety data** – Operators are required to collect data from operations, and this is sometimes used to analyze and determine risk mitigations through training. This is combined with subsequent measurement of the effectiveness of remedies. LOSA, pilot reports and flight data analysis (FDA) are prime examples. (The external training 'feedback' loop)

## 4.2 Sources of Data for Analysis in a Helicopter EBT Data Report

### 4.2.1 LOSA Reports

Monitored campaigns include: North Sea LOSA (CHC and Babcock), Helicopters New Zealand LOSA and South East Asia LOSA for offshore operations and the existing LOSA Collaborative work relating to HEMS operations.

**Background.**

LOSA data is collected using the Threat and Error Management (TEM) framework developed by the LOSA Collaborative and seeks to highlight a number of defined areas of pilot performance. Until recently, LOSA data had not been collated and analysed from commercial helicopter operations, however, a number of campaigns are underway to establish a 'baseline' for offshore helicopter operations. This will allow for analysis of performance trends (i) within a helicopter operator's operations, (ii) comparatively between helicopter operators and (iii) between individual and collated helicopter operators compared to commercial airline operations.

**Strengths and weaknesses.**

Pilot performance can be influenced by the presence of an observer in the cockpit. This can be interpreted as a weakness if strict protocols around observer conduct are not adhered to.
However, the strength of LOSA data comes from direct observation and provides a unique insight into flightdeck operations. Analysis of LOSA data can be broad-ranging or targeted. Another strength to the helicopter LOSA data is that it has been developed using the same core competencies as in EBT.
considerations for helicopter report
Whilst the helicopter LOSA database is limited in size, a recent change in observational technique has been introduced which potentially enhances the value of the output in terms of supporting EBT. The traditional TEM coding is now extended to link to the presence (or absence) of the core competencies (as defined in paragraph 3.5.2 in this CP). This potentially enhances the output of the data for consideration in the wider analysis.

### 4.2.2 EBT Accident & Incident Study

**Background.**

Accident analysis remains a bedrock of safety analysis. The analysis for this study will be drawn largely for the EASA accident and serious incident database and will include data from 2001 to present. Accidents selected for review were filtered using the ECCAIRS Taxonomy (the format in which the data has been collected by EASA). The methodology for analysis will be the same as the fixed wing report (IATA data report for EBT 2014). A mapping of the factors used for in the analysis will also be made to enable direct comparison with the results. At this time, the number of events available for analysis are:

- 94 accidents / serious incidents involving offshore helicopters worldwide
- 85 accidents / serious incidents involving SAR, HEMS and Firefighting operations in EASA Member States
- 308 accidents / serious incidents involving CAT operations helicopters worldwide
- 14 accidents / serious incidents involving SAR helicopters worldwide
- 33 accidents / serious incidents involving Firefighting helicopters worldwide
- 112 accidents / serious incidents involving HEMS helicopters worldwide

In addition, a number of accident reports prior to 2001 will be considered as well. The list is provided in Appendix 4.
The data may be supplemented by mandatory occurrence reports, when identified to be as thorough as full investigation reports, and when already in the EASA database. Since the data available for analysis in MORs is typically incomplete, use of MOR sourced data in the final analysis is likely to be very limited.

**Strengths and weaknesses**

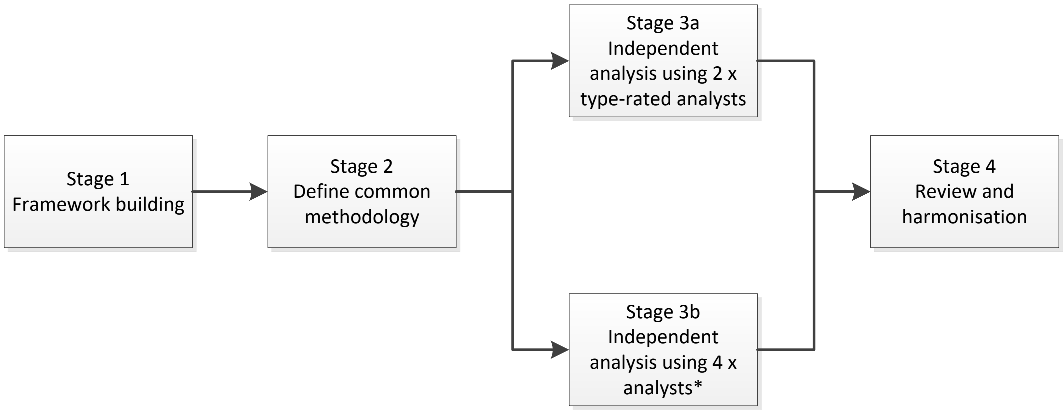
The strength of accident and incident data is its relevance to training. The weakness is in the limited sample size for helicopter accidents compared to the number of commercial aeroplane accidents available for the IATA Data Report. Additionally, it should be noted that the EASA accident database historically extends only as far as 2001 and some significant accidents involving helicopter types in use today, may not be included in the initial study. Therefore, identification of relevant accidents pre-2001 will potentially enhance the quality of the accident study.

considerations for helicopter report

The factors used for analysis in the IATA Accident and Incident Study were considered for their applicability in the Helicopter Accident Study. Following careful consideration it was determined that the majority of the factors were applicable without amendment, whereas a small number required expansion of the associated definition to give clarity for their use in relation to helicopter operations. A full list of the factors to be used in the Helicopter Accident Study and their definitions is available at Appendix 1.

The following principles will be applied for analysis of accidents and serious incidents:

General principle:




Stage 1: EASA builds the framework for the analysis and sources the appropriate accident reports for further analysis. Analysis includes the identification of factors, presence of core competencies and a rating for improved training effect.

The analyst may select as many factors and technical skills as detected.

When many non-technical skills are involved, the 2 most relevant ones will be selected. If necessary, the analyst may select only one more and highlight why.

The Improved Training Effect is considered as the potential effect of FSTD training in accident or incident prevention or mitigation of the severity of the event, using a 5-point scale as follows:

- U– Unknown effect
- N – No effect
- L - Low effect
- M – Medium effect
- H – High effect

Stage 2: a set of 5 pre-defined accidents are analysed by all analysis team members together in order to ensure that a common methodology is applied and inter-rater reliability is achieved to ensure consistency of results across the process. Any necessary revision of the factor categories and definitions will take place following this stage.

Full guidance will be provided to analysts prior to stage 3, to ensure inter-rater reliability.

Stage 3 has two possible pathways depending on availability of type-rated analysts.

Stage 3a - For accident / serious incident reports where 2 appropriately type-rated analysts are available, the report shall be analysed independently by both analysts. Analysts will be current or formerly type rated pilots. Analysts will be experienced on the particular variant/model, and when not possible on the helicopter type (with same endorsement on the licence).This is the preferred method.
Stage 3b: For accident /serious incident reports where 2 appropriately type-rated analysts are not available, the report will be analysed independently by 4 analysts, with at least one type-rated analyst. The opinion of the type rated pilot will be prioritised against the other 3.

Where no type-rated analysts are available, the analysis record shall be marked and considered accordingly.

Analysts in Stage 2, 3a and 3b should have access to relevant manuals for the subject helicopter type. The version of the manuals is not required to be the version in force at the time of the occurrence. Independent analysts may use the competencies of subject matter experts (SMEs), for example for language issues, or if they are not familiar with the role, or if not qualified as CRM trainers for example, in which case they remain the owner of their assessment.

- At Stage 3a or 3b, at least 1 analyst will have instructor or examiner experience.
- At Stage 3a or 3b, at least 1 analyst will have human factor experience (eg. CRM trainer, MCCI or a person trained in the assessment of CRM skills).

**Stage 4:** This stage comprises a review between of the outputs of Stages 3a or 3b, as followed, with the principle aim of resolving any observed variation in factor and competency analysis. This stage will be managed by a team representing regulators from Member States (preferably with helicopter operations experience and, where possible, type-rating experience) and will overseen by EASA. A second principle aim of this stage is to assure that where variance in scoring factors and competencies is observed in Stage 3b, appropriate recognition/weighting is given to the analysis completed by a type-rated analyst.

It is recognised that not all accident or serious incident reports are written in English. This may present a language issue potentially limiting the analysis.

- For offshore accidents and serious incidents, an accident investigation report will be available in English language 76% of the time. Even when the report is written in another language, there is a chance that an English version of the executive summary will be available in the report.
- For other kinds of operations, the chances are that much more than 10 % of the investigation reports will not be available in English. However, offshore operations and SAR are the priority.
- If sufficient language skills are not available during stage 3a or 3b, then the analyst will not analyse the factors and competencies for this particular occurrence.
- Occurrences that will have been analysed by only one analyst because of language issues will also be reviewed during stage 4.

The summary of the analyses presented in the Helicopter EBT Data Report will indicate how many occurrences will have been analysed by all analysts, by a reduced number of analysts, or not at all because of language issues, for both offshore and non-offshore operations.

It has been realised that not all accident reports contain detailed information about the history of the flight, from an EBT perspective. The analysis assessment will be scored according to the following scale of 1 to 3. Priority will be given to the analysis of occurrences scoring higher on this scale:

1: Sufficient data available resulting in full objective analysis
2: Data available allows only partial or subjective analysis
3: Insufficient data available resulting in limited to no meaningful analysis

Various options have been considered in relation to publication of the accident and serious incident analysis in the Helicopter EBT Data Report. It has been decided that the results will be published in such a way that individual analysis of a particular report is not identified.

### 4.2.3 Training Criticality Survey (TCS)

A key element of the EBT methodology is a Training Criticality Survey (TCS) which seeks to identify potential threats and errors relating to individual phases of flight and score the associated risks in terms of a prioritised training benefit. A similar survey distribution is sought for the Helicopter TCS, namely to an industry-wide community of pilots experienced in both operations and training.

**Background.**

A TCS will be devised reflecting a similar series of questions utilised in the IATA EBT Data Report. The survey will consist of a series of 3-part questions concerning the same set of (40) performance influencing factors used in the accident analysis, which are sub-categorised by phase of flight.
The final question in survey will give the respondents the opportunity to mention any other training criticality issues that had not been covered by the previous questions.
The objective is to have the survey hosted and administered by EASA.
The output of the survey will be an analysis based on likelihood of occurrence, severity of occurrence and the potential training benefit to be gained in relation to each of the 40 factors considered.

**Strengths and Weaknesses:**

Surveys are based on samples of populations and are subject to sampling error, which reflects the effects of chance and uncertainty in the sampling process. Expert opinion is extremely useful as a data source. Surveying pilots with experience of line flying and training is intended to offer a balance of opinion to optimise the validity of the benefits and criticality of training focus.

The anonymity of survey responses allows respondents to express themselves without identification and accountability, which should reduce levels of perjorative or unhelpful responses.

A major limiting factor for any survey is the number of responses received.

Considerations for the Helicopter Report.

The IATA aeroplane Data Report for EBT highlights the weaknesses of the TCS resulting from (i) a number of questions going unanswered by each respondent and (ii) the deviation in risk assessment values (likelihood vs severity) for a given factor when it was associated with a specific phase of flight, to the exclusion of the assessment of the same factor, if it were to occur in other flight phases. Therefore, the construction of the

TCS for the Helicopter Report will be optimised to offset the possibility of these weaknesses being repeated.

### 4.2.4 Operator Pilot Survey on Training Effectiveness

**Background.**

A survey has been created which reflects a similar survey utilised in the IATA EBT Data Report. The survey consists of a series of questions to helicopter pilots relating to the effectiveness of the training they have received in relation to the helicopter type they are currently flying. The survey has been hosted by EASA and made available through a web link, allowing respondents to do so anonymously.

The survey probes are designed to fill gaps in the developing helicopter EBT dataset, as well as to crosscheck data derived from other sources. The survey questions are a mix of multiple choice, free text and quantitative distribution allocation.

**Strengths and weaknesses.**

Surveys are based on samples of populations and are subject to sampling error, which reflects the effects of chance and uncertainty in the sampling process. Expert opinion is extremely useful as a data source. Surveying line pilots offers a balance of opinion to the results of the Training Criticality Survey, which is aimed at training subject matter experts in the helicopter community.

The anonymity of survey responses allows respondents to express themselves without identification and accountability, which should give rise to an improved level of pejorative responses.

A major limiting factor for any survey is the number of responses received. The survey is limited in length to ensure a higher return rate; the brevity in scope balanced with the need to focus on specific areas of enquiry which would otherwise not be accessible using other methodologies.

The list of questions included in the Operator Pilot Survey is available at Appendix 2.

### 4.2.5 EBT Flight Data Analysis

Whilst the potential value of FDM data is understood in terms of providing evidence to support the proposed Data Report, it is recognised that helicopter operators, whilst conducting their own FDM programmes, have little to offer in terms of comparable data.

Several industry initiatives focused on pooling FDM data for industry-level analysis are underway and their outputs will be considered as they become available, however, the underlying message is that FDM is currently unlikely to provide a significant data source in support of the analysis planned to shape helicopter EBT.

### 4.2.6 UK CAA Helicopter Safety Review: CAP 1145

**Background.**

The data source independently supports EASA work towards developing pilot competencies for training and assessment of offshore pilots as part of an evidence based training programme.

Following a number of helicopter accidents in the UK offshore sector, the UK CAA initiated an Offshore Helicopter Safety Review in September 2013 to examine thoroughly the risks and hazards of operating in the North Sea and consider how these can be managed more effectively. The CAP 1145 Safety Review of offshore public transport helicopter operations in support of the exploitation of oil and gas considered a total of 25 reportable UK offshore helicopter accidents during the period 1992 to 2013 noting an accident rate of 1.35 accidents per 100,000 flight hours or 0.66 per 100,000 flight sectors.

**Considerations for the Helicopter Report.**

The analysis indicated that over 70% of the operational causes of accidents related to pilot performance issues such as flight crew perception and decision making and identified the importance of aircrew training as a key factor in the prevention of accidents. In common with commercial airline operations, the review found that loss of control associated with the sophistication and automation of modern aircraft and helicopters was an issue requiring particular attention. The report also identified dependency on automation, loss of manual flying skills and poor pilot/flight path/systems monitoring as casual factors in offshore accidents.

Most stakeholders interviewed as part of the Safety Review felt that Part-FCL and Part Ops training/checking requirements were heavily biased to runway-based one engine inoperative flight and that this did not adequately prepare a pilot for the environment in which the type(s) were being operated, namely to/from offshore locations. Likewise the annual licence proficiency check and 6-monthly operator proficiency check perpetuated this historical focus. Whilst the operator conversion course is the method to prepare a pilot for line operations, the end product should reflect the offshore operating environment. To that end, a number of stakeholders suggested the possibility of an offshore rating or the possibility of mirroring the flexibility offered to aeroplanes establishing an Alternative Training and Qualification Programme (ATQP), both options being currently unsupported by helicopter regulation.

A core tenet of ATQP philosophy is to allow operators to draw upon the output of their Flight Data Monitoring (FDM) programme, addressing issues raised during line operations and addressing them in a focused training and checking regime. A second tenet of ATQP philosophy which was recognised as valuable is the identification of training and checking needs which are correlated to individual competencies required of the crew, enabling the assessment of specified performance standards.

**Strengths and weaknesses.**

The report covers an industry-wide review of the safety of offshore helicopter operations within the UK sector and offers a regulator's perspective, identifying crew performance as a contributory factor in the majority of Flight Operations-related accidents. Whilst the analysis of crew performance does not specifically call out a need for Evidence Based Training (EBT) as defined in ICAO Doc 9995, it does recognise the concept of shaping training programmes based on the use of operational data, such as accident reports and Flight Data Monitoring (FDM) programs. The use of LOSA is less well-known in the UK and its use as a perspective data source is not specifically identified in CAP 1145. The accident analysis contained within CAP1145 provides useful and complementary safety data, which should be considered amongst other existing data sources.

### 4.2.7 SINTEF Helicopter Safety Study 3 (HSS-3)

**Background.**

The overall objective of the Helicopter Safety Study 3 (HSS-3) is to contribute to improved safety in helicopter transport of personnel to, and from, fixed and floating oil- and gas installations on the Norwegian Continental Shelf (NCS). The project was a follow-up of the previous HSS-1 and HSS-2 studies. HSS-1 and HSS-2 cover the periods 1966–1990 and 1990–1998 respectively. HSS-3 covers the period 1999–2019. The main report describes a method for risk quantification, development for the periods 1999–2009 and trends 2010–2019, plus statistical/historical data and the estimation of risk levels.

In addition, the study includes an analysis of passengers' risk perception regarding offshore helicopter transport, and a proposal on how safety can be monitored by a set of lagging and leading indicators.

The study includes a survey of the technical, operational and organizational changes which took place in the period 1999–2009, and the expected trends for 2010–2019 that could influence the safety of passengers and pilots. The project was extended to reflect the latest developments in 2009. This included the accidents and serious incidents in 2009, the challenges following changes in the internal framework conditions in the two largest Norwegian helicopter operators and the new common European regulations for helicopter operations and the possible consequences on the possibility to maintain and establish national additional requirements.

The study employs a systematic use of risk influencing factors (RIF). Changes in the risk picture have been quantified by the use of expert judgments and a model that shows the overall impact of the risk influencing factors. The study incorporates development within safety thinking from a linear approach to consider safety as a dynamic interaction in continuous change using resilience engineering principles.

The report concludes with a number of recommendations on measures to improve or, as a minimum, maintain safety at the current level.

**Strengths and weaknesses.**

The study builds on and is an extension of two previous studies. It is based on data analysis and expert opinion, and employs a scientific method to arrive at its conclusions.

The study has an almost purely Norwegian perspective. This is in regard to the background data, experts, cultural influences etc. Some international incident and accident data has been reviewed.

It does not contain much specific discussion on training, but emphasises training as one of the most important controls that determine the overall risk level.

**Considerations for the Helicopter Report.**

The study concluded that increased pilot skill by additional requirements regarding competence, experience and simulator training on NCS operations was one of eight main contributing factors in the 16 % reduction of risk level in the period 1999-2009 compared to the previous 10 year period.

To achieve further risk reduction in the period 2010-2019 the study recommends focusing on the following aspects of training:

- Improve education, training and interaction between the pilots, plus the requirements for use of simulators to allow pilots to train realistically (MCC) challenging operations such as approaches to offshore platforms/ships in non-optimal conditions (incl. DVE, darkness, movement).
- Extend and adapt the training of pilots to include realistic, actual critical situations
- Improve simulator standards and use to better recreate realistically actual accidents and abnormal situations.
- Number of hours and content of the training should be expanded in relation to the authorities' minimum requirements, so that the training also includes special situations, repetitions and addressing individuals' training needs. (resulted in 16 hrs. crew time annually as the norm currently).
- There should be an optimal balance between IT-based ground training and experience transfer in classrooms.
- The quality and content of the training should be followed up, not just the number of hours.
- The importance of proximity and thus easy access to simulators to make it feasible to do more hours in the simulator.dssssss
- Train the pilots to give plain and clear information on the PA.

The study addresses the use of FDM data as a basis for developing realistic training scenarios and the development of simulators to allow the scenarios to be recreated realistically.

The increased need for training required to meet the challenge caused by recruitment of new pilots was an issue then and may be relevant in the hopefully not too distant future, when closing the generation gap caused by the staff reduction in the recent years.

### 4.2.8 EASA SAFETY RISK PORTFOLIO – OFFSHORE HELICOPTER OPERATIONS

**Background.**
This paper is the first sector safety risk portfolio created by EASA. The portfolio reports on the analysis of offshore helicopter data available to the Agency and identifies Key Risk Areas and Safety Issues. The primary source of data for the report was the EASA accident and incident database involving EU offshore helicopters between 2011 and 2015.

The key risk areas identified are:

- System/component failures
- Loss of control in-flight
- Controlled flight into terrain
- Fire
- Collision with obstacles during take-off and landing and ground collisions
- Abnormal runway contact

Analysis also identified the following Safety Issues to be addressed through multiple safety actions, which include crew training:

- Aircraft ditching and evacuation events
- Diagnosis of system failures
- Gearbox and transmission system reliability
- Detection, recognition and recovery of deviation from normal operations
- Control of the helicopter flight path

- Obstacle clearance
- Automatic Flight Control System reliability
- Flight crew perception and awareness
- CRM and communication
- Knowledge and competency of individuals
- Management of stress
- Use of rules and procedures

**Considerations for the Helicopter Report.**

The accident and incident analysis seeks to identify causal and contributory factors, however, these are categorised in terms of the ADREP terminology and broad references to human factor influences, without making specific reference to the ICAO core competencies. Whilst the analysis methodology and terminologies in this study differ from the methodologies and terminologies applied in the IATA Data Report, the identification of key risk areas and safety issues provides useful crosschecking to other data sources. There also appears to be considerable alignment with the key safety issues outlined in this paper and the core competencies which EBT programmes seek to develop in crews.

### 4.2.9 EHSAT Helicopter Safety Report

**Background.**

Under EHEST the analysis team is called the European Helicopter Safety Analysis Team (EHSAT). This working group of EHEST performs the first step in the ESSI process: the review of occurrences under the human factor scope. The analysis was performed taking the official AAIB reports to analyse helicopter accidents and derive recommendations for interventions. It is estimated that the current nine EHSAT regional analysis teams cover more than 90% of the civil European helicopter fleet. The EHEST analysis consolidates analyses of European wide helicopter accident data. The accident dataset consists of 311 helicopter accidents analysed by the regional EHSAT teams up to 31 March 2010.

The top 3 identified areas for the Standard Problem Statements are:

- Pilot judgment & actions
- Safety Culture/Management
- Ground duties

The use of the HFACS taxonomy by the EHSAT provided a complementary perspective on human factors, which is very relevant for the EBT purpose. In 78% of the accidents, at least one HFACS factor was identified. In most accidents unsafe acts or preconditions for unsafe acts were identified. In fewer accidents reports issues related to supervision or organisational influences were captured. The possibility of identifying those factors is very much dependent on the depth of the accident investigation performed and the accident data available.

For both the Standard Problem Statements and HFACS taxonomies, different patterns were observed for Commercial Air Transport, Aerial Work and General Aviation.

Most Intervention Recommendations (IRs) were identified in the areas of Operations & Safety Management/Culture, Training/Instructional, and Regulatory/Standards/ Guidelines, but in all of them the Human Factor, NOTECH or behaviours where, in some manner assessed.

**Strengths and weaknesses.**

The use of two taxonomies, the SPS and the more recognized HFACS, was an asset in this study. Analysing the accidents under the HF prism revealed very interesting data and lights up where the operating organizations, regulatory authorities and crews were having problems and therefore recommendations can be proposed.

Another strength in this study was the fact that the analysis was carried out by regional teams who used the AAIB reports in their mother language so accuracy was expected to be high. In the same way, but in the opposite meaning the lack of harmonization within the teams could made the results inconsistent.

It is recognised that the study was not designed specifically to address the high level restructuring of training programmes as focused on in the EBT philosophy.

**Considerations for the Helicopter Report.**

As previously said, even the study wasn't designed specifically to address EBT, the taxonomy, methodology and results of this analysis are totally aligned with the objective of this CP. Changes in the way we train crews must be put in place in order to achieved a reduction of accident rates. It was proved in this analysis that human factor elements like decision making or situational awareness as well as TECH and NO TECH skills were relevant factors in the event outcome.

Of the IR (Intervention Recommendations) derived from the study, we can observe that the two most relevant are:

- "Ops & Safety Management / Culture
- Training and Instructional

In both cases, elements of EBT training model were assessed. Especially important are the IR's about "Training and Instructional" (more than 450 IR were released) which are totally aligned and in line with the EBT scope and objective:

### 4.2.10 EHEST material

**Background.**

Launched on November 2006, the European Helicopter Safety Team (EHEST) brings together manufacturers, operators, pilot associations, research organisations, regulators, accident investigators and a few military operators from across Europe. EHEST is the helicopter branch of the ESSI, and also the European component of the International Helicopter Safety Team (IHST).

The basic principle is to improve aviation safety by complementing regulatory action by voluntarily encouraging and committing to cost-effective safety enhancements. Analysis of occurrence data, coordination with other safety initiatives and implementation of cost-effective action plans are carried out to achieve specific safety goals. In addition, the EHEST initiative implements actions of the European Plan for Aviation Safety (EPAS) 2016-2020, EPAS 2017-2021 and EPAS 2018-2022.

The European Helicopter Safety Implementation Team (EHSIT) was launched in February 2009. The team uses the accident analyses and the intervention recommendations produced by the EHSAT to develop safety enhancement strategies and action plans. In 2009 the EHSIT defined a process to aggregate, consolidate, and prioritise the intervention recommendations identified in this report and also defined safety strategies and action plans.

To address the top intervention recommendation categories identified by the EHSAT, the EHSIT has launched three Specialist Teams on Operations and SMS, Training, and Regulation. These EHSIT Specialist Teams are in the process of developing detailed action plans and delivering safety promotion material and tools of benefit for the industry, in particular for small operators and General Aviation. EHSIT results will be communicated to the helicopter community via the Communications Sub-Group. Also the EHSAT will continue analysing accidents in order to monitor possible changes in accident scenarios over time. The team will also be involved in the measuring of results and effectiveness of safety improvements.

Following there is the list of EHEST material analysed in consideration for applicability to EBT:

*(1) HE1 Training Leaflet – Safety considerations*

This leaflet was the first in a series of safety related leaflets and publications aiming at improving safety by sharing good practises.

Data from the EHSAT review confirm that a continuing significant number of helicopter accidents is due to pilot disorientation in the Degraded Visual Environment, Vortex Ring State, Loss of Tail Rotor Effectiveness and Static & Dynamic Rollover. Therefore, the aim of this leaflet is to improve the safety of helicopter operations by providing pilots with the relevant information for each of these topics in order to allow a basic understanding of the causes, the prevention and the recovery actions thereby enabling pilots to make better, more informed decisions. This Leaflet covers the following subjects:

- Degraded Visual Environment (DVE)
- Vortex Ring State
- Loss of Tail Rotor Effectiveness (LTE)
- Static & Dynamic Rollover
- Pre-flight planning Checklist

This leaflet assesses the crew technical skills supported by the EBT model.

*(2) HE2 Helicopter Airmanship leaflet*

Airmanship is defined by EASA Part FCL as: "The consistent use of good judgement and well-developed knowledge, skills and attitudes to accomplish flight objectives." The EHEST review of helicopter accidents 2000 to 2005 revealed 140 general aviation helicopter accidents in Europe identifying the following (causal and contributing) factors:

- Pilot decision making and risk assessment
- Mission Planning
- Pilot misjudged own limitations/capabilities, overconfidence
- Pilot inexperienced
- Inadequate consideration of weather/wind
- Failed to follow procedures
- Pilot control/ handling deficiencies

- Failed to recognise cues to terminate current course of action or manoeuvre
- Inadvertent entry into IMC, vision restricted by meteorological conditions
- Wilful disregard for rules and SOPs

The majority of these factors are related to airmanship.
In this case Knowledge, Skills and Attitudes are covered. In line with EBT concepts.

*(3)* *HE3 Helicopter Off Airfield Landing Site Operations*

The helicopters ability to approach, manoeuvre, land and take-off from an off airfield Landing Site or unprepared Landing Site is one of the most important aspects of helicopters operations.
The various landing sites such as hotels, golf courses, sporting venues, etc can vary in their dimensions, approaches, hazards, elevation, and location, the same basic principles should be employed. This is particulary important in HEMS and AOC operations.

Landing sites that are remote from an airfield offer various challenges to the pilot and consequently have resulted in a significant number of accidents. Unlike at an airfield there is generally, little or no assistance in the assessment of wind, guidance on appropriate approach directions or information on other traffic. Hazards not normally experienced at an airfield such as wires, obstructions, uneven landing ground, trees, Foreign Object Damage, livestock and pedestrians are quite likely to be found and require a heightened degree of situational awareness by the pilot who needs to expect the unexpected!

HE3 covers the following aspects:

- Planning and Preparation
- Landing Site Identification
- Landing Site Recce
- Types of Approach
- Manoeuvring in the LS
- Departure
- Pilot Errors

This leaflet assesses equally Knowledge, Skills and Attitudes as proposed in EBT model.

*(4)* *HE4 Training Leaflet – Single Pilot Decision Making*

Research into the human factors related to aircraft accidents and incidents has highlighted Decision Making as a crucial element. Pilots intend to fly safely, but they sometimes make errors. It has been observed that the majority of fatal crashes are attributable to decision errors rather than to perceptual or execution errors.

While we cannot eliminate human error, a thorough understanding of human factors principles can lead to appropriate strategies, means and practical tools to prevent most errors, better detect and manage them, and mitigate their adverse impact on aviation safety.

This leaflet focusses on:

- Human Factors Affecting Decision Making,
- Decision Making,
- Decision Error Factors,

- Decision Making Models.

Some NOTECH skills (which are linked to EBT competencies) are covered in this leaflet.

*(5)* *HE5 Training Leaflet – Risk management in training*

The document was developed in partnership with major stakeholders and provides tools and methods to improve risk management in training. Training for autorotation is used as a practical example to illustrate the process.

*(6)* *HE 6 – Advantages of simulators in Helicopter Flight Training*

The purpose of this leaflet is to highlight the various helicopter flight simulation training devices available and to also review the additional training and safety benefits related to recent technological and regulatory developments.

Although this material do not cover specifically EBT, highlights the importance of simulator training, which is the keystone of the EBT.

*(7)* *HE 7 – Techniques for Helicopter Operations in Hilly and Mountainous Terrain*

This leaflet outlines the techniques for helicopter operations in hilly and mountainous terrain. The leaflet aims to help pilots and instructors understand basic principles, threats, errors and possible undesirable aircraft states when flying in mountainous terrain. Developed in partnership with major stakeholders, the leaflet also provides guidance to manage the risks associated with these operations with the objective to improve pilot technical skills.

*(8)* *HE8 – The Principles of Threat and Error Management (TEM) for Helicopter Pilots, Instructors and Training Organisations*

Data analysis  confirms that a continuing significant number of helicopter accidents occur due to poor decision making and human performance made both prior and during flight. The aim of this leaflet is to introduce and illustrate the concept of TEM to flight crews and training organisations.

By training the crews in the TEM model we are increasing the overall knowledge and awareness and promoting the NO TECH skills.

*(9)* *EHEST Helicopter Instructor Guide*

One of the important ingredients for flight safety is a properly resourced training sector. Some of those resources can be quite fundamental. For example, an important contribution to training is for flight instructors to have available to them a basic guide to flying training. In response to this need, EHEST contacted the Australian Civil Aviation Safety Authority (CASA) which has developed a flying instructors' manual incorporating extensive feedback from the helicopter training community. CASA has kindly made this manual available to EHEST for dissemination. Some changes have been incorporated to reflect European terminology and syllabus contents. The EHEST Helicopter Flight Instructor Manual was upgraded into the Helicopter Flight Instructor Guide that was published in November 2020.

Althought EBT model is not addressed because the scope of this guide was *ab initio* training, the training methods and guidelines address EBT concepts.

*(10) HE9 Automation and Flight Path Management*

This document identifies current best practice on automation and flight path management, which is an important part of the EBT methodology. Over the years helicopter manufacturers have used more automation to assist crews and reduce manual flying workload. The rapid advances in technology have given rise to significant capabilities. Automation has contributed substantially to the sustained improvement of flight safety. Automation increases the timeliness and precision of routine procedures reducing the opportunity for errors and the associated risks to the safety of the flight. The helicopter community has however experienced incidents and accidents where automation and complex flight displays have been significant factors. This leaflet reviews the basics of automation and provides a list of principles for optimal use of automation and flight path management.

For EBT purposes, this leaflet gives an important overview of Flight Path Management, one of the key aspects in the EBT model.

*(11) HE10 – Teaching and Testing in Flight Simulation Training Devices (FSTD)*

This leaflet provides guidance to helicopter instructors and examiners on how to conduct aircrew training and testing in FSTDs, and provides basic principles on how to get the best use of this invaluable training asset. The benefits of FSTDs are covered in the previously published leaflet HE6 “Advantages of Simulators (FSTDs) in Helicopter Flight Training”.

The leaflet HE10 addresses additional aspects, such as FSTDs and training credits definitions, types of training and testing permitted on FSTDs, teaching, examining and testing techniques and competences, the different types of examiner certificates, basic principles and good practices, and differences between helicopter and FSTD.

*(12) HE11 – Training and Testing of Emergency and Abnormal Procedures in Helicopters*

This leaflet provide guidance and safety tips for pilots, instructors and examiners on the subject of training and testing of emergency and abnormal procedures. Subjects include theoretical knowledge training, Human Factors, Threat and Error Management (TEM), Crew Resource Management (CRM) and Aeronautical Decision Making (ADM), Risk Management, flight training, scenario-based testing, hazards involved in simulating systems failures and malfunctions during flight, autorotation and Simulated Engine Off Landing (SEOL), modern technology helicopters (Glass Cockpit / automation), and upset / unusual attitude training.

This leaflet supports EBT by the review of knowledge, skills and attitudes as well as human factors (TME, CRM, ADM…)

**Strengths and weaknesses.**

This compilation of leaflets was created without reference  to EBT, nevertheless Human Factor aspects were taken into consideration and was an important elementwhen creating the content. The materials created derived from the results from the EHSAT report and were intended to address the “holes” and problems seen.  All leaflets reviewed have a solid base in EBT philosophy and the multidisciplinary team who createde them have demonstrated the expertise and knowledge required to properly cover such issues.

**Considerations for the Helicopter Report.**

After the review of the EHSIT material we can perceive that a lack in training, with the actual model, is present. While Skill aspects are generally well covered, aspects like ADM, TEM or CRM must be “more” present in the training of crews. Nevertheless this cannot be a separate effort and a pairing of disciplines must be accomplish so we can achieve “competencies” with the KSA concept proposed in EBT.

The majority of EHSIT leaflets contain information relevant to the development of a helicopter specific Data Report aligned with Option 3 offered in this CP.

### 4.2.11 STEADES Training Query

This was considered as a data souce for analysis, however, as helicopter operators do not consistently contribute to the STEADES database and therefore it is not considered to be a source of data applicable to this analysis.

### 4.2.12 ASCEND Database Query

This was considered as a data source for analysis, however, as helicopter operators do not actively and consistently contribute to the the ASCEND database and the data within it is inconsistent in terms of identifying accident and incident contributory factors, it is not considered to be a source of data applicable to this study.

## 4.3 Scientific Research Papers

### 4.3.1 Jarvis: ‘Rotary Wing Monitoring – Phase 1 – Final Report’

**Background.**

During the early 1990s, OEMs developed large multi-engine IFR capable helicopters such as the ‘Super Puma Mark 2’ with levels of automation that were broadly equivalent to those fitted to transport fixed-wing aircraft. Many operators of these helicopters encouraged and sometimes mandated the maximum use possible of the automated systems, in the pursuit of enhanced levels of operational safety; however as a number of incidents and accidents have suggested (a recent example being the Sumburgh Super Puma Mark 2 crash close to Sumburgh Airport in August 2013), the ability of pilots to monitor the state and performance of automated systems and also to revert to competent manual handling following failure of these systems has been brought into question.

The trade association ‘HeliOffshore’ sponsored Jarvis Bagshaw Limited to carry out helicopter-specific research into how well helicopter pilots monitor automated systems, both with respect to upper-mode changes and the control inputs made by the autopilot to achieve the desired flight paths. The Airbus H225 simulator at Aberdeen was used as the platform for the research, and the monitoring performance of the pilots was measured during relatively straightforward IFR exercises (such as joining a holding pattern), using eye-tracking spectacles to record where they looked and for how long. This was ‘Phase 1’ of the sponsored research, with 'Phase 2' expected to start mid-2017. Phase 2 will look at pilot performance during abnormal situations, using the Bristow S92 simulator at Aberdeen.

The main findings of the report were:

- Helicopter pilots do not demonstrate the classic 'T' pattern instrument scan; very little attention is paid to the attitude indicator, with the pilot paying most attention to the peripheral 'performance' instruments. This is most likely the result of IFR helicopters being fitted with 'Attitude Modes', where even without any upper-modes engaged the helicopter will generally maintain a trimmed attitude and power setting without any control inputs from the pilot.This in turn infers that when flying 'coupled' to the autopilot, they are not confirming that the attitudes selected by the automatics is consistent with the required flightpath, and so would be slow to recognise some modes of failure. Of even more concern, it infers that pilots would not perform well when forced to fly manually with degraded stabilisation. The parallel research into large transport jet pilots showed very different results, with a much higher level of basic 'T' scan performance being demonstrated.

- Helicopter pilots tend to concentrate on one performance parameter for a long period of time during their scan (in some cases for periods in excess of one minute), inferring that a significant change in another performance parameter would go un-noticed.

- When compared to large transport jet pilots, helicopter pilots demonstrate poor monitoring of automation mode annunciators. By way of example, four out of the 26 helicopter scenarios included one pilot not looking at any mode annunciators at all, in some cases even when they had made the selection themselves (note that each scenario used a different crew, with no crew being used twice.) This contrasts with zero such events during the 150+ scenarios run with large transport jet pilots. This suggests a high risk of wrong or unsuccessful modes selections going un-noticed for long periods of time.

In summary, it appears that when compared to fixed-wing pilots, helicopter pilots are neglecting to implement some very fundamental countermeasures which are required under the principles of Threat and Error Management.

**Strength and Weaknessess.**

The process used is identical to parallel research that Jarvis Bagshaw Limited completed for fixed-wing transport jet aircraft. This helps to further demonstrate the strong similarity of needs and challenges between the type of aircraft and role for which EBT was originally envisioned, and multi-pilot, multi-engine IFR offshore-role helicopters.

The third main strength is that the report demonstrates a clear area of weakness in the way a majority of helicopter pilots monitor automated systems when compared to fixed-wing transport jet pilots, and clearly suggests that typical helicopter pilot competence to recover manual control of a helicopter following a loss of artificial stabilisation is in doubt. This in turn adds significant evidence to define the requirements for Baseline EBT schedules, based on credible research.

Perhaps the main weakness of the report is that this first phase was completed on a helicopter type/generation that has elements of 'envelope-protection' and high levels of redundancy following single and in some cases multiple failures of elements within the stabilisation systems, thereby possibly reducing the need for pilots to be quite so competent with respect to flying the helicopter manually. It also does not examine pilot monitoring performance during simulated abnormal or emergency situations. However Phase 2 of the research will use an aircraft type that has no significant envelope protection, and will examine monitoring performance during simulated abnormal situations.

## 4.4 Industry Reports

### 4.4.1 TAWS - 'Saves' – Honeywell paper:

**Background.**

This paper studies 6 approach and landing incidents involving the potential for a controlled Flight into Terrain (CFIT) event. The term 'saves' is defined as accidents avoided. The potential for a fatal accident outcome in each case, crews were alerted by the Terrain Awareness Warning System (TAWS).

**Strengths and weaknesses.**

Whilst the data sample in this paper is very limited, some of the conclusions drawn are applicable to helicopters. In the offshore environment, HTAWS (where installed) should be operative and selected 'ON'. Pilots should be trained to always comply with HTAWS cautions and warnings.

In terms of weaknesses, helicopters tend to fly at low altitudes where current TAWS modes may be inhibited or subject to false triggering. Obstacles in both onshore (e.g. windfarms) and offshore (e.g. fixed oil platforms, mobile rigs and ships) environments may not be encoded in the database. Training principles must be applied that focus on flightpath management without reliance solely on HTAWS to provide obstacle/terrain awareness.

considerations for helicopter report
Development work currently led by the UK CAA in partnership with industry stakeholders seeks to enhance the current HTAWS capability by adding a Mode 7 protection introducing a low speed/low power envelope to warn against low energy states with developing rate of descent. The research paper should be reviewed following publication for applicability to this study.

# 5 Applicability of a developed Helicopter EBT programme

The applicability of a developed Helicopter EBT programme will be defined following analysis of the data analysed in the Helicopter EBT Data Report. In part, the applicability will be dependent on the source, quality and scope of the data included in the analysis. The concept of an EBT programme is to take account of the differences between aircraft generations by tailoring the training programme to a particular aircraft generation.

## 5.1 Helicopter Generations

The table below is indicative of the aircraft generations that are considered for a Helicopter EBT programme and assigns helicopter types to each of the defined generations. This list is open to amendment as a result of the findings from the data analysis and any input/feedback from stakeholders.

The classification is meant for training purposes only. The main discriminants from one generation to the next have been determined as the following, because they require the approach to training to be adapted.

- The 4 axis AFCS
- Envelope protection (including CFIT)
- Fly-by-wire, when the control laws vary depending on mode selection, phase of flight or other parameters.

The main discriminants are marked in bold in the table below.

It should be noted that Generations 1a and 1b are included for completeness, however, it is not intended to develop an EBT programme for helicopters in these generations, since they are outside the scope of this CP.

A number of the terms used in the generation table below are defined as:

*Envelope protection* – functional AFCS capability that provides protection against operation outside of a safe flight envelope (including CFIT) without pilot intervention

*Full authority AFCS* – AFCS with attitude retention capability and upper modes such that the helicopter can be coupled in all 4 axes simultaneously

*Basic AFCS* – AFCS with SAS or augmented stabilisation capability with no or limited upper modes such that the helicopter can be coupled in a maximum of 3 axes simultaneously.

*Table of applicable helicopter types by generation*

| Generation | Qualifying Description | Types included in category |
|---|---|---|
| Generation 4 | Twin turbine, FADEC, digital cockpit display, FMS, full authority AFCS, envelope protection, **fly-by-wire** | AW609, B525, |
| Generation 3b | All of Generation 3a characteristics, plus **envelope protection** | H175, EC 225 |
| Generation 3a | Twin turbine, FADEC, digital instrument display, navigation display, **full authority AFCS (4 axis)**, FMS | AS332L2, AW139, AW169, AW189, S76 C/D models, S92A, A109SP, Bell 429*, EC155*, H135*, H145*, MD902*, AW109E/S* |
| Generation 2 | Twin turbine, non-FADEC controlled, analogue instrument display, basic AFCS (up to 3 axis) | Agusta 109A/C/K2, AS332L/L1, AS 365N, AS 355, BK117, Bell 212/412, Bell 222, Bell 230/430, BO105, Mil Mi17, S61 all models, S76A/B, S64, EC 135, EC145 , KA32, PZL W3/MI2 |
| Generation 1b | Single piston or turbine engine, digital instrument display | B206 all models, B407, R22, R44, R66, S300, AS350 series, SA315/316/319, A119, Bell 204/205/214, EC130, EC120, Hughes 369D |
| Generation 1a | Single piston or turbine engine, analogue instrument display<br>Early helicopter generation (full analog and mechanical) | |

* May be generation 2 or 3a depending on the cockpit equipment and installed options

### 5.1.1 Alignment of EBT Competencies

EBT is a competency based programme and the applicable core competencies outlined in RMT.0696 ED decision 2015/027/R are listed below. It is preferable to align the approach to competency definition and application in this CP with the core competencies defined for use in the wider EBT programme development. These competencies[2] are:

- Application of Procedures
- Communication
- Flight Path Management – Automation
- Flight Path Management – Manual Control
- Knowledge
- Leadership and Teamwork
- Problem-solving and Decision-making
- Situation Awareness
- Workload Management

All references to EBT competencies in this CP will relate to the competencies list above and the associated observable performance indicators outlined at Appendix 3.

In development of this CP, consideration is given to the inclusion of an additional competency 'Monitoring' as it is felt it may be a critical factor in a number of recent helicopter accidents. However, a counter argument is made that asserts that the performance indicators associated with 'monitoring' are present in the form of existing indicators in the core competencies ooutlined above. In the conduct of the Accident Analysis, consideration is given to referencing a 'monitoring' competency and its continued inclusion in the list of core competencies for helicopter operations will be determined in the final Helicopter EBT Data Report. For the purpose of the Helicopter Accident Analysis, the observable performance indicators associated with the 'monitoring' competency are:

- Mentally flies the aircraft, monitors systems and PF to maintain Situation Awareness
- Detects flightpath deviation and system changes through efficient scanning 'inside and outside'
- Communicates/challenges effectively using standard calls/actions
- Prioritises monitoring during critical flight phases and changes to automation modes
- Manages PM tasks effectively to stay in the monitoring loop
- Monitors the PF consistently and make timely/appropriate interventions

### 5.1.2 Definition of factors

The helicopter factors were initially derived from the aeroplane EBT factors. The definitions were then modified to include helicopter-specific risks. The list of factors was further adapted to helicopter operations following the analysis of a cross-section of accident investigation reports.

The factors will be used for multiple data sources and not only the accident/incident data analysis.

[2] Competency and behaviour indicators in accordance with AMC1 ORO.FC.231(b).

Factor 11 'operations / type specific risks' may be used for any helicopter-specific risk that has not been covered in the other factors. Once the data analysis has been completed, the potential for sub-categorisation of factor 11 will be assessed. If particular helicopter-specific risks are not covered in the other factors and are covered only with factor 11, then the implications for training will be taken into account.

## 5.2 Development of an ICAO Doc 9995 Appendix 2-5 equivalent (a Baseline EBT programme) for helicopters

The analysis published in the Helicopter EBT Data Report above will be used to shape the content of a Baseline EBT programme for helicopters. It is intended to replicate the format of the baseline programmes outlined in ICAO Doc 9995 Appendix 2 to 5 – namely a Baseline programme will be outlined for each generation of aircraft, each programme comprising the following elements for assessment in manoeuvres, evaluation and scenario-based training phases:

- Assessment and Training topics
- Frequency (of assessment)
- Flight phase for activation
- Description of type of topic (threat, error or focus)
- Desired outcomes
- Example scenario elements, including manoeuvre-clustering and approach clustering options
- Competency mapping

More explanations can be found in ICAO doc 9995.

# 6 Development of Regulatory Roadmap

Following the publication of a Helicopter EBT Data Report, the suggested sequence of possible actions to be taken in the European regulatory system for the adoption of EBT in the helicopter community is as follows:

(a) Development of an EBT Data Report for helicopters;
(b) Development of an equivalent to ICAO Doc 9995 Appendices specifically for helicopters (to be published by EASA); and
(c) Development/amendment of existing regulation to provide a pathway for helicopter operators to transition to EBT.

— amend Appendix 9 to Annex I (Part-FCL) to Regulation (EU) No 1178/2011,

— amend ORO.FC.230 and ORO.FC.145 of Subpart FC — Flight Crew of Annex III (Part-ORO) to Regulation (EU) No 965/2012, as regards EBT for recurrent training and checking;

— amend Annex V (Part-SPA — Specific Approvals) to Regulation (EU) No 965/2012, and especially Subpart E — LOW VISIBILITY OPERATIONS (LVO) (SPA.LVO.120 — Flight crew training and qualifications);

— amend ORO.FC.235 — Pilot qualification to operate in either pilot's seat of Subpart FC — Flight Crew of Annex III (Part-ORO) to Regulation (EU) No 965/2012;

— amend ORO.FC.220 — Operator conversion and checking of Subpart FC — Flight Crew of Annex III (Part-ORO) to Regulation (EU) No 965/201227 when the operator's conversion is not combined with a new type/class rating training, as required by Regulation (EU) No 1178/2011;

— amend ORO.FC.205 — Command course of Subpart FC — Flight Crew of Annex III (Part-ORO) to Regulation (EU) No 965/201228;

— amend ORO.FC.240 — Operation on more than one type or variant of Subpart FC — Flight Crew of Annex III (Part-ORO) to Regulation (EU) No 965/2012; and

— amend FCL.725 — Requirements for the issue of class and type ratings of Subpart H — CLASS AND TYPE RATINGS of Annex I (Part-FCL) to Regulation (EU) No 1178/2011 (application of EBT for issuing a type rating);

— amend Subpart J — INSTRUCTORS and Subpart K — EXAMINERS of Annex I (Part-FCL) to Regulation (EU) No 178/2011 (personnel providing training and checking for EBT);

— amend Annex III (Part-ORO) to Regulation (EU) No 965/2012 and Annex VI (Part ARA) to Regulation (EU) No 1178/2011; and

— any other applicable regulation.

# 7 Conclusion

Based on the balance between safety and costs, **Option 3 — Create a specific Helicopter EBT training programme supported by a specific Helicopter Data Report and develop a regulatory framework to allow Helicopter EBT implementation** is recommended.

This Option has the potential to deliver significant improvements in safety without any major commercial or operational impact on those organisations that choose not to implement EBT. If chosen, this option will lead to changes in rules for initial and recurrent helicopter pilot training, and training for helicopter instructors and inspectors, and achieve alignment with the EBT initiative for commercial aeroplane operators.

At the same time, this option obviates the need for the development of a regulatory framework to allow helicopter ATQP programme approval and offers the possibility of transition directly to helicopter EBT programme approval.

Project members involved in the development of this CP and contributing the Helicopter EBT element of RMT.0599 are listed at Appendix 4.

# 8 References


— IATA/ICAO/IFALPA, EBT Implementation Guide, First Edition, July 2013.
— IATA, Data Report for Evidence-based Training, First Edition, August 2014.
— ICAO Document 9995, Manual of Evidence-based Training, Montreal, 2013.

— Civil Aviation Authority (CAA) United Kingdom (UK), CAP 1145, Safety Review of Offshore Public Transport Helicopter Operations in support of the exploitation of oil and gas , Crawley, 2014.
— EASA, Safety Risk Portfolio – Offshore Helicopter Operations, Cologne, 2015.
— SINTEF, Helicopter Safety Study 3, Stavanger, 2010.
— EHSAT, Helicopter Safety Report, 2015.

# 9 APPENDIX 1

The table below provides a full list of factors to be analysed in the Helicopter Accident Study with their associated definitions.

| | CATEGORY | PROPOSED HELICOPTER EBT DEF$^{N}$ |
|---|---|---|
| 1 | Ground Equipment | Ground equipment (vehicles or towed equipment) parked or moving on ramp or helipad/helideck, including aircraft towing or any movement of ground equipment |
| 2 | Ground Manoeuvring | Threats arising from rotor engagement up to the take-off holding point, and from landing to shutdown, including hover taxying, that influence crew or affect aircraft while manoeuvring |
| 3 | Runway/Taxi/Hover taxi conditions | Contamination or surface quality of the runway, taxiway, or helipad/helideck/FATO including FOD |
| 4 | Adverse Weather/Ice | e.g. precipitation, thunderstorm, rain, snow, ice, meteorological turbulence, plus operations in high/low temperature (or high pressure altitude) conditions and including low cloud ceilings. Salt contamination. |
| 5 | Windshear/Turbulence | Windshear without warning or mechanical turbulence associated with topography or structure |
| 6 | Crosswind/Tailwind | Excessive crosswind, including tail wind, that affects control of the helicopter |
| 7 | Air Traffic Control | Impaired communication with ATC; omission of required call, instruction or read-back; incorrect read-back of instruction; poor quality transmission, including limited or intermittent reception |
| 8 | Navigation | Loss of GPS satellite signal; loss of RAIM when required; ANP less than RNP; loss of ground-based NAV source; aircraft lost or unsure of position; routing towards any waypoint or destination other than that intended |
| 9 | Loss of Communications | Pilot radio mis-selection; radio failure; inability to contact ATC, ground station or other aircraft |
| 10 | Traffic | TCAS RA or TA/ACAS, or visual observation of conflict, or traffic compression requiring evasive manoeuvring |
| 11 | Operation/Type Specific | Any type-specific, role-related or mission-specific issue affecting crew or helicopter performance (Whenever this factor is used, the specific issue that is being graded has to be described). |
| 12 | Cabin | Cabin problem, including passenger illness or disruption; issues related to cabin-loaded freight |
| 13 | Compliance | Consequences of non-compliance with operating instructions, e.g. SOP |
| 14 | Deficiency in Manuals | Deficiency within Manuals. Technical or layout, conflict or omission etc |

| | | |
|---|---|---|
| 15 | Deficiency in Operational Data | Incomplete, complex, or including errors, e.g. NOTAMS or weather |
| 16 | Deficiency in Charts | Incomplete, inappropriate, poorly designed approach charts |
| 17 | Deficiency in Check Lists | Incomplete, inappropriate, poorly designed checklists |
| 18 | Deficiency in Data Bases | If the aircraft has a database are there design issues, coding errors or update errors |
| 19 | Deficiency in Procedure | Design fault with, or lack of, any operational procedure, e.g. engine start or any company or manufacturer procedure |
| 20 | Fatigue | Issues affecting helicopter crew performance related to fatigue, whether recognised by the crew or not |
| 21 | Runway Incursion / Wrong Deck Landing | Conflict with other aircraft whilst approaching, entering, holding or exiting runway or helipad/helideck; approaching to, or landing on, helipad/helideck that is not intended destination |
| 22 | Poor Visibility | Any situation where a degraded visual environment (DVE) presents a threat in relation to crew performance, including ‘whiteout’/’brownout’ on landing |
| 23 | Upset | Upset is defined as:<br>• Unintentional exceedance of the parameters normally experienced in line operations, or a control failure or disturbance that alters the normal response of the helicopter to pilot input, such that the pilot must adopt an alternate control strategy to regain and sustain controlled flight.<br>• Intentional manoeuvre leading to the same result. |
| 24 | Wake Vortex / Rotor Downwash | Wake vortex or rotor down-wash events affecting helicopter or crew performance |
| 25 | Terrain / Obstacle Proximity or Collision | Any automated (HTAWS) or verbal alert, warning or caution of unsafe proximity to, or collision with, terrain or obstacle (including wires) |
| 26 | Birds | Bird strike, resulting in damage or affecting performance of the flight, or avoidance manoeuvre related to bird activity |
| 27 | Engine Malfunction | Any engine failure or malfunction, which causes loss of power or uncommanded change in rotor speed and impacts flight performance |
| 28 | Minimum Equipment List (MEL) | An MEL cleared item that impacts performance of the flight and/or crew, e.g. landing gear locked down |
| 29 | Fire | Any fire, smoke or fumes, associated with fuselage, engine or helicopter systems |
| 30 | System Malfunction | Any internal failure(s) apparent or not apparent to the crew |
| 31 | CRM | Standard CRM issues |
| 32 | Physio | Issues relating to the physical working environment that affect crew performance |

| | | |
|---|---|---|
| 33 | Workload Distraction Pressure | Workload distraction or time pressure |
| 34 | Dangerous Goods | Issues relating to Dangerous Goods that impact the performance of the flight |
| 35 | Loading, Fuel, Performance | Issues relating to Loading, C of G, Fuelling and Performance that impact the performance of the flight |
| 36 | Mismanaged AFCS | Issues relating to mis-handling of Automatic Flight Control or Stabilisation System, including incorrect or inappropriate mode selection or non-use leading to impaired helicopter performance |
| 37 | Mismanaged Aircraft State | Unstable approach or speed/path/vertical rate not congruent with required state for given flight condition, including Loss of Tail Rotor Effectiveness (LTE), Static or Dynamic Rollover and Vortex Ring State |
| 38 | Mismanaged System | Issues relating to mis-diagnosis of system fault/failure leading to incorrect application or non-adherence to normal, abnormal or emergency procedures |
| 39 | Pilot Incapacity | Any incapacitation which impacts the performance of the non- affected pilot |
| 40 | In-flight replanning | Any re-planning of routing once crew boards helicopter for initial departure, including changes to intermediate stops (offshore) and/or onshore destination |
| 41 | Communication | Demonstrates effective use of language, responsive to feedback; plans are stated and ambiguities resolved |
| 42 | Situation Awareness | Awareness of the aircraft state in its environment projects and anticipates changes |
| 43 | Leadership and Teamwork | Uses appropriate authority to ensure focus on the task and crewmember concerns. Supports others in completing tasks |
| 44 | Workload Management | Prioritises, delegates and receives assistance to maximise focus on the task. Continuously monitors the flight progress |
| 45 | Problem solving / Decision-making | Detects deviations from the desired state, evaluates problems, identifies risk, considers alternatives and selects the best course of action. Continuously reviews progress and adjusts plans |
| 46 | Knowledge | Knowledge and understanding of relevant information, operating instructions, aircraft systems and the operating environment |
| 47 | Application of Procedures | Application of procedures according to published operating instructions |
| 48 | Flight Management, Guidance and Automation | Proficient and appropriate use of flight management, guidance and automation including transitions between modes. Monitoring, mode awareness and vigilance. Flexibility needed to change from mode to another |
| 49 | Manual Aircraft Control | Maintains control of the aircraft in order to assure the successful outcome of a procedure or manoeuvre |
| 50 | Monitoring | Mentally flies the aircraft; monitors systems and other crew, particularly during critical flight phases; detects flightpath deviation and makes required interventions; takes control when necessary |

# 10 APPENDIX 2

The Operator Pilot Training Effectiveness Survey contained the following questions:

1. **In the first 200 hours of flying your current aircraft type, you encountered a situation where you had difficulty in managing flight paths using automation (including FMS):**

- Never
- Once
- A few times
- Frequently

(pick one option)

2. **The real operational use of automated flight path management is learned…**

____ % in training
____ % in the line operation.

(numbers - should add up to 100%)

3. **After the type rating course, you felt comfortable managing the aircraft flight path using automated systems…**

    - On your first aircraft flight
    - After IOE
    - After **50 hours** of operation
    - After **100 hours** of operation
    - After **200 hours** or more of operation

(pick one option)

4. **The training of flight path management using automated systems (including the FMS) on the type you are currently flying:**

- Does not adequately cover the operational needs and definitely must be improved
- Is minimal and there is room for improvement
- Is adequate
- Is excellent - Don't change anything.

(pick one option)

(if the person ticked any of the first 3 choices, there will be a follow-up question → see below)

**Which area(s) in the flight path management training should be improved?** (pick as many as necessary)

- **Manual flying**
- Programming **the FMS**
- Basic knowledge of the **automated** systems
- Automation surprises
- Transitioning between operational modes
- Hands on use in the operational situations
- Other:______________________ (free text)

5. **I feel completely confident in my ability to take over manual control of the aircraft following sudden failures of the AFCS:**

    - **Yes**
    - **No**

6. **During last 5 years, did you have a situation where you believed that there should have been a go-around but the approach was continued to landing?**

- Yes, you suggested it, but the other crew member did not agree
- Yes, but you did not suggest it
- Partly, please explain: ___________________________ (free text)
- No, you did not have this situation

(pick one option)

(follow-up question to everybody if one of the first 3 choices ticked:)

**On that flight, you were:**

- Captain
- First Officer

**You were acting as:**

- Pilot Flying
- Pilot Not Flying (Pilot Monitoring)

**The approach was to:**

- **An onshore landing site**
- **An offshore landing site**

**The landing followed:**

- **A visual approach**
- **An instrument approach**

(pick one option in each follow-up question)

7. **What do you think are the top 3 reasons for continuing an approach to land when a go-around should have been completed?**

- Operational inconvenience (impact on schedule etc.)
- According to the judgment by the pilot, the landing can be performed safely
- Embarrassment related to a go-around
- Making a go-around mandates a report
- There is a big psychological barrier to go-around because they are **such** rare events
- Pilots are not as familiar with unstable approach criteria as they should be.
- Other: ______________________

(can tick up to 3 options)

8. **During training, how often did you get a chance to perform the approach briefing before commencing the arrival procedure?**

- Never
- Practically never
- Sometimes
- Always

(pick one option)

9. **Some research shows that monitoring and cross-checking is the poorest during the CLIMB phase. Why do you think this is the case?**

  - Pilots have too many secondary duties not directly related to flying in this phase
  - SOPs are generally too weak in monitoring and cross-checking.
  - Complacency after Takeoff phase
  - Other: ______________________________

(Pick as many as necessary. In “other” a text field with sufficient space for a list of items)

10. **How important is monitoring / cross-checking?**

  - One of the most important of piloting skills
  - Rather important
  - Not so important
  - One of the least important of piloting skills

(pick one option)

11. **Is detecting and managing Errors part of your recurrent training?**

- Yes, as a specific topic, both in theory and practice
- Covered somehow, but not explicitly
- Marginally covered
- Not talked about at all

(pick one option)

**12. In your opinion, what is the most effective strategy concerning errors in the flight deck?**

- Not to commit errors (error prevention)
- Detect and manage errors effectively

(pick one option)

**13. What kind of intentional deviations from the SOP's have you experienced on the flight deck during the last 2 months?**

- Checklist deviations
- Callout deviations
- Deviation from stable approach criteria
- Other, describe: ___________________________ (free text)

(pick as many as necessary)

(Follow-up question, for each ticked box above:)

**How often would you say you experience this kind of deviation?**

- Virtually every flight
- About every 10 flights
- A few times a year
- Once a year or less

(one to be picked for each ticked deviation type)

**14. When would you deviate from the SOP's?**

- Never
- If the deviation results in no reduction in safety
- Only if the deviation increases safety
- Other: _______________ (free text)

(pick one option)

**15. How long was the briefing before the simulator session, typically, during you latest training?**

- No brief
- Very short, lasting a few minutes
- 10 min to 20 min
- 20 min to 40 min
- 40 min to 1 hour
- Over 1 hour

**16. How long was the debriefing after the simulator session, during you latest training?**

- No debrief
- Very short, lasting a few minutes
- 10 min to 20 min
- 20 min to 40 min
- 40 min to 1 hour
- Over 1 hour

**The debriefing took place in:**

- The simulator
- The briefing room
- other, what:_____________ (free text)

(pick one option)

**17. In the last 6 months, were there operational situations where you did not feel comfortable?**

- Yes
- No

**What kind of training would have helped in those situations?**

__________________________________________________

(free text)

**18. In the last 5 years, have you had experiences in training that were negative? Please describe:**
__________________________ (free text)

**19. In your last training session, did your instructor raise your confidence level in your proficiency?**

- Yes, it increased.
- No, no change.
- No, it decreased.

(pick one option)

**20. When you are the Pilot Not Flying (Pilot Monitoring), it is easy for you, without hesitation, to:**

- Tell the Pilot Flying about a deviation

- Take control from the Pilot Flying
- Propose a checklist if the Pilot Flying delays asking for it
- Propose a go around during an unstable approach
- Verbally demand a go-around if you think it is required

(pick as many as necessary)

21. **In the last 6 months, were there operational situations that occurred for which you had not been trained sufficiently? Please describe:**

___________________________ (free text)

**Could you please let us know the following information about you for statistical reasons:**

Region you are based in:

- Africa
- Central Asia
- Central/South America
- Europe
- Middle-East
- North America
- Pacific
- South Asia
- South East Asia

The aircraft type you are currently flying:_______ (free text)
Time on current type:______ (Years/months)
You are a:

- Captain
- First Officer

(pick one option)

The training you receive is delivered by:

- The airline/operator I'm flying with
- An external training organization

(pick one option)

The Airline/operator you are flying with: _______________________ (free text)

Your Civil Aviation Authority: ____________________ (free text)

# 11 APPENDIX 3

The competencies and associated observable performance indicators[3] used throughout this CP are presented below:

- **Application of knowledge and procedures**
- Communication
- Flight Path Management – Automation
- Flight Path Management – Manual Control
- Knowledge
- Leadership and Teamwork
- Problem-solving and Decision-making
- Situation Awareness
- Workload Management

The monitoring competency is described in paragraph 3.5.2 whereas the other competencies are further described below.

| **Application of knowledge (KNO)** | |
|---|---|
| **Description:** | Demonstrates knowledge and understanding of relevant information, operating instructions, aircraft systems and the operating environment |
| **OB 0.1** | Demonstrates practical and applicable knowledge of limitations and systems and their interaction |
| **OB 0.2** | Demonstrates the required knowledge of published operating instructions |
| **OB 0.3** | Demonstrates knowledge of the physical environment, the air traffic environment and the operational infrastructure (including air traffic routings, weather, airports) |
| **OB 0.4** | Demonstrates appropriate knowledge of applicable legislation. |
| **OB 0.5** | Knows where to source required information |
| **OB 0.6** | Demonstrates a positive interest in acquiring knowledge |
| **OB 0.7** | Is able to apply knowledge effectively |
| **Application of procedures and compliance with regulations (PRO)** | |
| **Description:** | Identifies and applies appropriate procedures in accordance with published operating instructions and applicable regulations |
| **OB 1.1** | Identifies where to find procedures and regulations |
| **OB 1.2** | Applies relevant operating instructions, procedures and techniques in a timely manner |

[3] Competency and behaviour indicators in accordance with AMC1 ORO.FC.231(b).

| | |
|---|---|
| **OB 1.3** | Follows SOPs unless a higher degree of safety dictates an appropriate deviation |
| **OB 1.4** | Operates aircraft systems and associated equipment correctly |
| **OB 1.5** | Monitors aircraft systems status |
| **OB 1.6** | Complies with applicable regulations |
| **OB 1.7** | Applies relevant procedural knowledge |
| **Communication (COM)** | |
| **Description:** | Communicates through appropriate means in the operational environment, in both normal and non-normal situations |
| **OB 2.1** | Determines that the recipient is ready and able to receive information |
| **OB 2.2** | Selects appropriately what, when, how and with whom to communicate |
| **OB 2.3** | Conveys messages clearly, accurately and concisely |
| **OB 2.4** | Confirms that the recipient demonstrates understanding of important information |
| **OB 2.5** | Listens actively and demonstrates understanding when receiving information |
| **OB 2.6** | Asks relevant and effective questions |
| **OB 2.7** | Uses appropriate escalation in communication to resolve identified deviations |
| **OB 2.8** | Uses and interprets non-verbal communication in a manner appropriate to the organisational and social culture |
| **OB 2.9** | Adheres to standard radiotelephone phraseology and procedures |
| **OB 2.10** | Accurately reads, interprets, constructs and responds to datalink messages in English |
| **Aeroplane flight path management — automation (FPA)** | |
| **Description:** | Controls the flight path through automation |
| **OB 3.1** | Uses appropriate flight management, guidance systems and automation, as installed and applicable to the conditions |
| **OB 3.2** | Monitors and detects deviations from the intended flight path and takes appropriate action |
| **OB 3.3** | Manages the flight path to achieve optimum operational performance |

| | |
|---|---|
| **OB 3.4** | Maintains the intended flight path during flight using automation whilst managing other tasks and distractions |
| **OB 3.5** | Selects appropriate level and mode of automation in a timely manner considering phase of flight and workload |
| **OB 3.6** | Effectively monitors automation, including engagement and automatic mode transitions |
| **Aeroplane flight path management — manual control (FPM)** | |
| **Description:** | Controls the flight path through manual control |
| **OB 4.1** | Controls the aircraft manually with accuracy and smoothness as appropriate to the situation |
| **OB 4.2** | Monitors and detects deviations from the intended flight path and takes appropriate action |
| **OB 4.3** | Manually controls the aeroplane using the relationship between aeroplane attitude, speed and thrust, and navigation signals or visual information |
| **OB 4.4** | Manages the flight path to achieve optimum operational performance |
| **OB 4.5** | Maintains the intended flight path during manual flight whilst managing other tasks and distractions |
| **OB 4.6** | Uses appropriate flight management and guidance systems, as installed and applicable to the conditions |
| **OB 4.7** | Effectively monitors flight guidance systems including engagement and automatic mode transitions |
| **Leadership & teamwork (LTW)** | |
| **Description:** | Influences others to contribute to a shared purpose. Collaborates to accomplish the goals of the team |
| **OB 5.1** | Encourages team participation and open communication |
| **OB 5.2** | Demonstrates initiative and provides direction when required |
| **OB 5.3** | Engages others in planning |
| **OB 5.4** | Considers inputs from others |
| **OB 5.5** | Gives and receives feedback constructively |
| **OB 5.6** | Addresses and resolves conflicts and disagreements in a constructive manner |
| **OB 5.7** | Exercises decisive leadership when required |
| **OB 5.8** | Accepts responsibility for decisions and actions |

| | |
|---|---|
| **OB 5.9** | Carries out instructions when directed |
| **OB 5.10** | Applies effective intervention strategies to resolve identified deviations |
| **OB 5.11** | Manages cultural and language challenges, as applicable |
| **Problem-solving — decision-making (PSD)** | |
| **Description:** | Identifies precursors, mitigates problems, and makes decisions |
| **OB 6.1** | Identifies, assesses and manages threats and errors in a timely manner |
| **OB 6.2** | Seeks accurate and adequate information from appropriate sources |
| **OB 6.3** | Identifies and verifies what and why things have gone wrong, if appropriate |
| **OB 6.4** | Perseveres in working through problems whilst prioritising safety |
| **OB 6.5** | Identifies and considers appropriate options |
| **OB 6.6** | Applies appropriate and timely decision-making techniques |
| **OB 6.7** | Monitors, reviews and adapts decisions as required |
| **OB 6.8** | Adapts when faced with situations where no guidance or procedure exists |
| **OB 6.9** | Demonstrates resilience when encountering an unexpected event |
| **Situation awareness and management of information (SAW)** | |
| **Description:** | Perceives, comprehends and manages information and anticipates its effect on the operation |
| **OB 7.1** | Monitors and assesses the state of the aeroplane and its systems |
| **OB 7.2** | Monitors and assesses the aeroplane's energy state, and its anticipated flight path |
| **OB 7.3** | Monitors and assesses the general environment as it may affect the operation |
| **OB 7.4** | Validates the accuracy of information and checks for gross errors |
| **OB 7.5** | Maintains awareness of the people involved in or affected by the operation and their capacity to perform as expected |
| **OB 7.6** | Develops effective contingency plans based upon potential risks associated with threats and errors |
| **OB 7.7** | Responds to indications of reduced situation awareness |
| **Workload management (WLM)** | |

| | |
|---|---|
| **Description:** | Maintains available workload capacity by prioritising and distributing tasks using appropriate resources |
| **OB 8.1** | Exercises self-control in all situations |
| **OB 8.2** | Plans, prioritises and schedules appropriate tasks effectively |
| **OB 8.3** | Manages time efficiently when carrying out tasks |
| **OB 8.4** | Offers and gives assistance |
| **OB 8.5** | Delegates tasks |
| **OB 8.6** | Seeks and accepts assistance, when appropriate |
| **OB 8.7** | Monitors, reviews and cross-checks actions conscientiously |
| **OB 8.8** | Verifies that tasks are completed to the expected outcome |
| **OB 8.9** | Manages and recovers from interruptions, distractions, variations and failures effectively while performing tasks |

## 12 Appendix 4 - List of additional accident reports prior to 2001

List of full accident reports, still published on AAIB websites, with occurrence date prior to 2001 that are to be included in the accident analysis.
The following list was established by checking the AAIB websites from the FR, NL, BE, NO, UK and DK AAIBs and filtering the reports that were within the scope of EBT.

NL
https://www.onderzoeksraad.nl/en/onderzoek/1498/entered-water-during-approach-to-platform-sikorsky-s-76b-north-sea
DK Nil
NO offshore
https://www.aibn.no/Aviation/Reports/2001-47-eng?ref=1713
https://www.aibn.no/Aviation/Reports/2000-83?ref=1713
https://www.aibn.no/Aviation/Reports/2000-28-eng?ref=1713
https://www.aibn.no/Aviation/Reports/1998-02-eng?ref=1713

NOEMS
https://www.aibn.no/Aviation/Reports/2005-25?ref=1713
FR Nil
BE Nil

UK :
List of accidents that took place in the 1990s
The group performed an evaluation and included for analisys the following:
https://www.gov.uk/aaib-reports/5-1995-bell-214st-g-bkjd-6-december-1994 – Flight in vicinity of microburst at night close to Helideck deck resulting in loss of airspeed and vortex ring – recovered
https://www.gov.uk/aaib-reports/2-1993-as-332l-super-puma-g-tigh-14-march-1992 – Shuttling in field at night in strong winds resulting in Vortex ring during downwind turn – not recovered.

These other three accident reports were excluded:
https://www.gov.uk/aaib-reports/2-1998-aerospatiale-as332l-super-puma-g-pumh-27-september-1995 - Maintenance
https://www.gov.uk/aaib-reports/2-1997-aerospatiale-as332l-super-puma-g-tigk-19-january-1995 - Lightning Strike to tail rotor blade - ditching successful
https://www.gov.uk/aaib-reports/2-1991-sikorsky-s-61n-g-bewl-25-july-1990 - handling near deck and tail struck anemometer mast/guard rails – pre FDR days so very little data to analyse.

## 13 APPENDIX 5 - Acknowledgement of Project Members

The following persons will participate in the helicopter EBT developmental activity.

| Name | Role | Contribution/Specialisation |
|---|---|---|
| F Arenas Alvariño | EASA Rule Making Officer and project manager | Pilot and Regulatory SME |
| E Bennett | EASA Rule Making Officer | Pilot and Regulatory SME |
| R Canis | EASA Safety Specialist | Accident Analysis SME |
| N Ilieva | EASA Safety Information Specialist | Survey and Data Analysis SME |

| | | |
|---|---|---|
| O Rodríguez Candado | EASA Air Operation Expert | Regulatory SME. |
| T Rolfe | Helicopter Sub-working Group Chair | Pilot training SME |
| B Baldwin | Helicopter Sub-working Group member vice-chair | Pilot training and regulatory SME. UKCAA |
| O Lien | Helicopter Sub-working Group member | Pilot training and regulatory SME. Norway CAA |
| R Saethre | Helicopter Sub-working Group member | Pilot training and regulatory SME. Norway CAA |
| F.J. Bernal Márquez | Helicopter Sub-working Group member | Regulatory SME. AESA Spain |
| D Abad Alarcon | Helicopter Sub-working Group member | Pilot training SME |
| P Bakke | Helicopter Sub-working Group member | Pilot training SME |
| R.Carvell-Shepherd | Helicopter Sub-working Group member | Pilot training SME |
| D Groeneveld | Helicopter Sub-working Group member | Pilot training SME |
| A.Espejo-Saavedra | Accident Data analyst | Pilot training SME and HF specialist |
| J Olavide | Accident Data analyst | Pilot training SME and HF specialist |
| FJ Mendi | Accident Data analyst | Pilot training SME and HF specialist |
| JJ Abad | Accident Data analyst | Pilot training SME and HF specialist |