Paper to the EASA presentation of Evidence-based training

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Introduction

Evidence-based training (EBT) is a voluntary programme for commercial air transport operators (CAT). Currently it is only available for 'recurrent training and checking'.

Future development into operator conversion course and type rating courses (ATOs) are foreseen in phase 2 of rulemaking task RMT.0599. (Expected start point 1Q2022).

Why we are training and checking our pilots in the same mandatory manoeuvres for all generations of aircraft?

Today's licence proficiency check (LPC) in appendix 9 Regulation (EU) 1178/2011 or the Operator proficiency check (OPC) in ORO.FC.230 Regulation (EU) 9765/2012 and AMC1 ORO.FC.230 paragraph (b), require the same manoeuvres for all generations of aircraft:

- Use of checklist prior to starting engines, starting procedures, radio and navigation (…).
- Before take-off checks.
- Take-off with engine failure between V1 and V2 (takeoff safety speed)
- Rejected take-off at a reasonable speed before reaching V1.
- Normal and abnormal operations of systems. Minimum of 3 for the crew.
- Abnormal and emergency procedures.
    - Minimum of 3 for the crew.
- Adherence to departure and arrival routes and ATC instructions.
- Precision approach
- Non precision approach
- Go- around one engine inoperative
- ….etc.

However, when analysing the operational risks of the different aircraft types, we found that each group of aircrafts types (called aircraft generation) have different operational risks. This is explained in detail in the IATA Data Report for Evidence-based training August 2014 1st Edition.

The table below provides each of the Generations of aircraft and the type ratings associated to each Generation. Due to the availability of data, only western build aircraft were considering in the original data report for Evidence-based training.

AMC1 ORO.FC.232(b)(3) EBT programme assessment and training topics

AIRCRAFT TYPES BY GENERATIONS

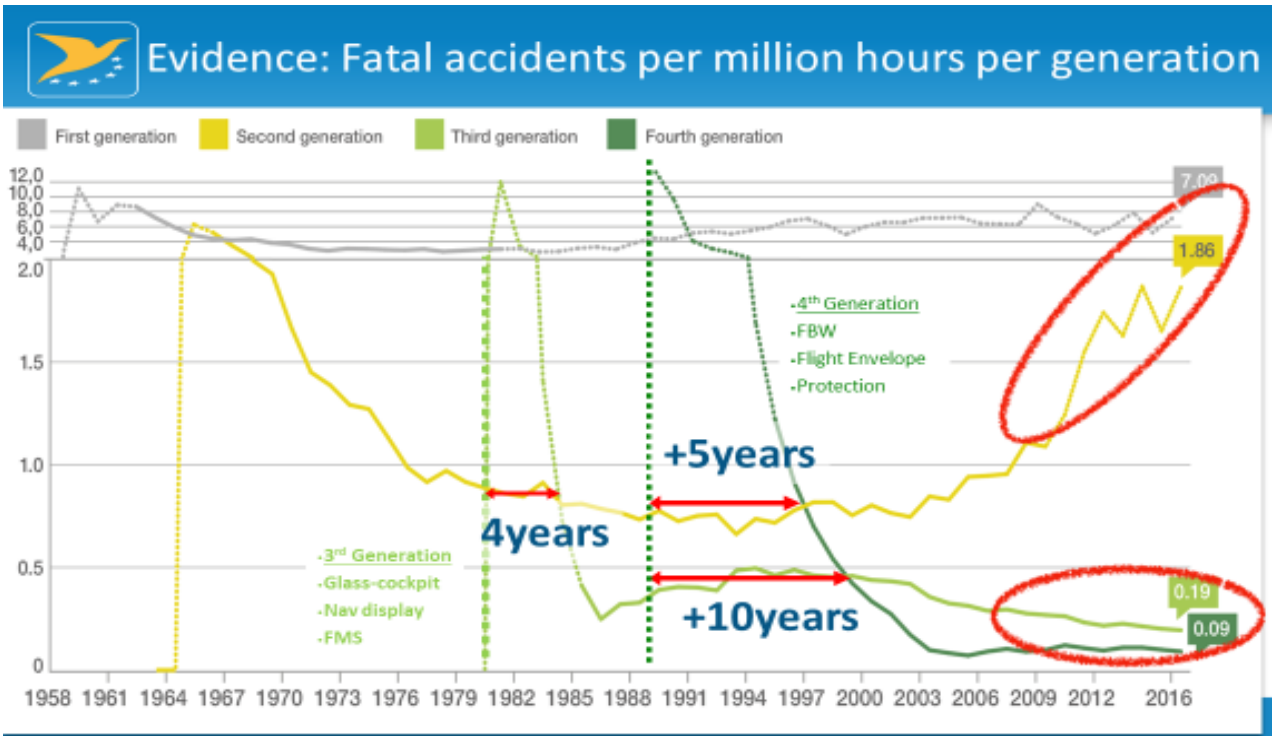
The operator should only develop an EBT programme for aircraft types for which there is a table of assessment and training topics.

Generation 4 — Jet	From 1988. EFIS cockpit — FMS equipped FADEC Fly-by-wire control systems Advanced flight envelope protection Integrated auto flight control system — navigation performance, and terrain avoidance systems Generation fatal accident average rate: 0,1/million flights	A318/A319/A320/A321 (including neo), A330, A340-200/300, A340-500/600, B777, A380, B787, A350, Bombardier C Series (A220), Embraer E170/E175/E190/E195
Generation 3 — Jet	From 1969 EFIS cockpit — FMS equipped FADEC Integrated auto flight control system — navigation performance, and terrain avoidance systems Basic flight envelope protection — stick shaker/pusher Generation fatal accident average rate: 0,2/million flights	A310/A300-600, B737-300/400/500, B737-600/700/800 (NG), B737 MAX, B757, B767, B747-400, B747-8, B717, BAE 146, MD11, MD80, MD90, F70, F100, Bombardier CRJ Series, Embraer ERJ 135/145
Generation 3— Turboprop	From 1992 EFIS cockpit — FMS equipped EEC/ECU or higher engine control Integrated auto flight control system — navigation performance and terrain avoidance systems Basic flight envelope protection — stick shaker/pusher	ATR 42-600, ATR 72-600, Bombardier Dash 8-400, BAE ATP, Saab 2000
Generation 2 — Jet	From 1964. Integrated auto-flight system. EEC/ECU or higher engine control Analogue/CRT instrument display Basic flight envelope protection — stick shaker/pusher Generation fatal accident average rate: 0,7/million flights	A300 (except A300-600), BAC111, B727, B737-100/200, B747-100/200/300, DC9, DC10, F28, L1011
Generation 2— Turboprop	From 1964 Analogue/CRT instrument display EEC/ECU Basic flight envelope protection — stick shaker/pusher Integrated auto flight control system.	ATR 42, ATR 72 (all series except -600), BAE J-41, Fokker F27/50, Bombardier Dash 7 and Dash 8-100/200/300 Series, Convair 580-600 Series, Shorts 330 and 360, Saab 340, Embraer 120
Generation 1 — Jet	From 1952 First commercial jets. Manual engine control Analogue instrument display Not integrated auto flight control system Basic flight envelope protection — stick shaker/pusher, attitude warning Generation fatal accident average rate: 3.0/million flights	DC8, B707

See also ICAO Doc 9995 ‘Manual of evidence-based training’ Appendix 1.

For each generation, there are differences in operational risks. For example, the operational risk of an engine failure in an Airbus 350 is different to a Convair 580-600, while a total loss of the airspeed indication may be more critical in an A320 (direct law) than in a Saab 340.

ICAO Doc.9995 and ED Decision 2021/002/R (see AMC1 ORO.FC.232 (b)(1)) proposed a different training programme for each generation of aircraft, depending on the operational risks associated to each generation. This is reflected in the Appendixes II - VII to ICAO Doc.9995 and the EASA AMC2 to AMC7 ORO.FC.232 available in the ED Decision 2021/002/R.



Looking at the aircraft generation-specific accident rates over the past 60 years there are a few elements we want to highlight:

1. When the third generation of aircraft was launched, it took less than 5 years for the accident rate to drop below that of the previous generation (Gen 2)
2. When the fourth generation of aircraft launched in the late ’80s, it took over a decade for the accident rates to decrease below the previous generation (Gen 3)

   Answer: training was not adapted to the new generation. Slowly the industry adapted, for example, CRM started to be introduced, and more emphasis is playing to non-technical skills.
3. Now we find in the past 10 years that the accident rate has flatlined - it’s not getting any lower, and;
4. Looking at the generation 2 accident rate in recent years; it's increasing - why is this? Answer: additional complexity in the operating environment in aircraft that were not built for it.

Preparing our pilots for the unexpected- Resilience

The existing national and international regulations for airline pilot training requirements are largely based on the evidence from early generation jets, seemingly in the belief that simply repeating pilot exposure to “worst case” events in training was sufficient. Over time, recent events occurred that were merely added to the requirements resulting in progressively overloaded training programmes and created an inventory or “tick box” approach to training.

In today’s aviation system it is impossible to foresee all plausible accident scenarios. System’s complexity and high reliability mean that the next accident may be something completely unexpected (see regulator paradox for more info).

Event: differences in generations.

In the early days of the aviation industry when the generation 1 or 2 aircraft (e.g. DC-3, Super constelation…etc) started to fly the aircraft systems were not complex, and normally, the aircraft had a less number of systems - perhaps only hydraulics, power plant, electrics and fuel. Also, the environment where we flew those aircraft would be more benign (VFR, or weather that allow non-precision approaches such NDB, with probably no icing…etc.) and the operations were rather simple (no RVSM, ETOPS, AWO, LVOs etc.).

So if we represent an event as a roll of dices, where each component of an event is a dice (e.g. 1 dice is the system, another dice is the environment, and another dice is the operation) - you roll the dice and see what combination of system, environmental and operational issues you have. As the dice in generation 1 and 2 have only a few sides because there are fewer systems, the environment is VFR or close to VFR, and the operation is rather simple, then the events are repetitive and foreseeable, we have previous evidence to back it up, and therefore we know what to train and what is coming.

Obviously in the early times we had to throw the dices much more frequently than today, however is also true that those dices where rather simple.

Let's now look at a generation 3 aircraft. Now we have a safer systems. However this systems are also more complex and many more (auto fly, inertial and navigation…, plus the traditional systems), with more complex environments (all weather, LVOs, fly over the inter-tropical convergence zone,…), and more complex operations (busy airports, airport hub operations, ETOPS, RVSM…etc). So the dice are now more complex - there are more possible combinations. However, we can still see repetition and have previous evidence, so potential events remain known to us.

Again for generation 3 is obviously less likely to throw the dices, however this dice has now more possibilities.

Now moving onto generation 4 aircraft, let's roll those dice! Many more faces to each - an Airbus A350 has over 4,000 ECAM drills, and we fly in all combinations of weather and multiple, complex operations. So now the events that are possible are unique and unforeseeable, we don't have any evidence, and therefore we don't know what's coming next. This is what is known as the "Black Swan Events".

In today's aviation system and for the future to come, the aviation system is probably in a "regulator paradox" where it is nearly impossible to foresee all plausible accident scenarios. System's complexity and high reliability mean that the next accident may be something completely unexpected

Regulator paradox

The regulator's paradox was originally a non-aviation engeneering concept. Engeneer books such as Safety I and Safety II the past and future of safety management, by Erik Hollnagel provides extensive details of this concept

To ilustrate our presentation this document provides a short explanation from different books or papers:

Regulator paradox from the book General Principles of Systems Design Paperback – September 1, 1988 by Gerald M. Weinberg: ***The task of a regulator is to eliminate variation, but this variation is the ultimate source of information about the quality of its work. Therefore, the better job a regulator does, the less information it gets about how to improve.***

Regulators need necessarily be able to perceive errors. Out of this condition, a paradox does arise, stated in the following terms by B. PORTER: "If the regulator were totally successful, the error would exhibit no variety, the regulator would accordingly receive no information about the external disturbances acting upon the plant, and successful regulation would thus be impossible" (1976, p.228)

In all that, there's a caveat. It is of the essence of Black Swan (or even a Black Cygnet) that it's unpredicted and unpredictable. Ironically, the more successful we are at reducing uncertainty, the less often we'll encounter rare events. The rarer the event, the less we know about it—and therefore, the less we're aware of the range of its potential consequences. The less we know about the consequences, the less likely we are to know about how to manage them—certainly the less *specifically* we know how to manage them. In short, the more rare the event, the

less information and experience we'll have to help us to deal with it. One implication of this is that our Black Cygnets, in addition to adding time, having a chance of screwing up other things in ways that we don't expect.

Why EASA introduced EBT for recurrent training

"An analysis of fatal aircraft accidents worldwide for the period 2001–2011 shows that in more than 50 % of these accidents the action of the flight crew was the primary causal factor (CAA UK, 2013). This analysis shows that flight crew handling skills were a factor in 14 % of the accidents whereas flight crew non-technical skills were a factor in more than twice as many (32 %). It is generally accepted that further improvements in flight safety require a comprehensive review of pilot training (IATA, 2013), and the accident statistics show that the emphasis of this training should be placed on developing the non-technical as well as technical pilot skills.

Traditional recurrent training requirements for pilots operating with airlines are, to a large extent, not relevant to the operation of modern multi-crew transport category aeroplanes (IATA, 2011) and have not kept up with the development of the operating environment. The present requirements are largely based on the evidence of accidents involving early-generation jet aircraft (IATA, 2013) and do not reflect the risks of the present operating environment.

Operators and industry bodies have recognised that the traditional training processes do not guarantee that the trained pilots are competent, or they do not adequately address 'human factors' issues (IATA, 2013)." Source EASA Concept paper for Evidence-based training.

Additionally, EASA considered the following:

- There is a need to address the operational and training challenges of today's technologies that are in the latest aircraft types (e.g. A350, B787…etc.).
- Improve efficiency and effectiveness.
- There is a need for a data-driven training system. This data must be meaningful to the operator but also the regulator and the rest of the industry where lesson learning and conclusions could be extracted -meaningful data! EBT helps to this purpose by proposing a standardised methodology to collect training data (9 competencies, graded 1 to 5 through the VENN methodology and for those that collect this data (instructors) a standardised training).
- This data collection must ensure just culture and data protection.

EASA Regulatory roadmap for EBT

The first step for those wishing to implement EBT is:

1- Assessment according to EBT principles: this is the first step for the operator. No regulatory amendment is required in the country. The operator and its competent authority continue to comply with the traditional training and checking requirements. However, the operator starts to assess the 9 competencies from 1 to 5 at the end of each simulator. This is done in the top of traditional assessment. In this step, it is advisable that the instructors receive a short training.

2- Mixed implementation of EBT: for this steep a small modification is needed in the regulatory framework of the country to allow a slight modification of the training requirements. However traditional checking is maintained, and therefore maintain the traditional safety net of the licence proficiency check and the operator proficiency check. In this step, the operator in top of assessment according to EBT principles, the training and checking programme is modified as follows:

   a. Instead of the traditional order of train and check, in EBT mixed the evaluation (checking) is done first and training is done after (scenario-based training).
   b. EBT Training of the instructors is mandatory. However, the training is flexible and there is no formal requirement of the instructor training syllabi.
   c. An instructor concordance programme (inter ratter reliability) is advisable.
   d. The traditional training programme is substituted by the programme per generation covered in ICAO Doc.9995 Appendix II to VII or EASA ORO.FC.232 Regulation (EU) 2020/2036 and AMC 2 to AMC7

ORO.FC.232 ED Decision 2021/002/R. This programme requires to perform (expose the crew) to some TRAINING TOPICS at a specific frequency (A, B, C equivalent to 6 months, 1 year, 3 years).

Note: this step is mentioned in the ICAO Doc.9995, however, is not described. For a detailed explanation of EBT mixed, please follow the EASA documentation:

- EASA EBT checklist: Oversight guidance for transition to EBT Mixed Implementation
- EASA Executive Decision 2015/027/R 'Implementation of evidence-based training (EBT) within the European regulatory framework'. It includes:
    - Annex I to ED decision 2015/027/R: GM1 ORO.FC.230 (a); (b); (f). Recurrent training and checking to Part-ORO – Issue 2, Amendment 4 (); and
    - Explanatory Note to the ED Decision 2015/027/R
- Additionally: - Terms of reference (ToR) RMT.0696 'Implementation of Evidence-Based Training within the European regulatory framework'.

3- Baseline EBT: This steep is fully described in the ICAO Doc.9995 and EASA regulation: Reg.(EU) 2020/2036, Reg.(EU) 2020/2193 and ED Decision 2021/002/R. On top of the requirements for EBT mixed the operator replaces the licence proficiency check (LPC) and the operator proficiency check (OPC) with the competency assessment of the EBT system. Some of the additional requirements for EBT baseline are:
    a. EBT training to the instructor is mandatory, and the assessment of such training shall be recorded. The training and assessment syllabi is mandatory and described in the regulation.
    b. Instructor concordance assurance (inter-ratter reliability) is mandatory. Concordance means the degree of agreement among raters. It is a score of how much homogeneity, or consensus, there is in the ratings given by various instructors.
    c. Training Feedback loop is required.
    d. Equivalency of Malfunctions (malfunction clustering) is required.
    e. Full compliance of the training topics and frequency described in Appendix II to Part ORO for your generation of aircraft. Furthermore, a contextualisation of the example scenario elements chosen to develop the training programme is required.

4- Enhance EBT: this element is described in ICAO Doc.9995. In EASA is currently not allowed. The rulemaking task RMT.0599 will commence in late 2022 for this purpose.

5- EBT Operator conversion Course and Initial EBT Type rating: this element is described in ICAO Doc.9995. In EASA is currently not allowed. The rulemaking task RMT.0599 will commence in late 2022 for this purpose. The intent of this regulatory effort is to provide the operator with a single philosophy of training (EBT operator conversion course and when combined EBT type rating course as well, EBT recurrent training, EBT recurrent assessment (LPC+OPC), including Low visibility approval…etc).

6- Introduction of the new aircraft types into EBT: this is currently happening for helicopters where EASA and the industry are developing a helicopter data report for Evidence-based training, the concept paper will be available in a few months (1Q2022), and the full document of the helicopters data report will be published in 1Q2022. This will allow a helicopter EBT mixed implementation. (see new amendments of the Helicopter EBT mixed regulation in the ED Decision 2021/002/R – GM1 ORO.FC.230). This steep will allow a single philosophy of training across the industry and therefore a possible data exchange across the industry. This step also allows another part of the industry such as non-commercial aircraft or aircraft types not included in EBT (see the table with generations above) a standardised methodology to join EBT.

EASA Regulatory Roadmap for EBT by regulations that should be amend

Extracted from EASA ToR and EBT concept paper

Following the steps described above, the suggested sequence of possible actions to be taken in the European regulatory system for the adoption of EBT is as follows:

First step (EASA COMPLETED THIS STEP IN 2020):

— amend Appendix 9 to Annex I (Part-FCL) to Regulation (EU) No 1178/2011, and 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.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 any other applicable regulation.

Second step: starting 2022.

— amend ORO.FC.220 — Operator conversion and checking of Subpart FC — Flight Crew of Annex III (Part-ORO) to Regulation (EU) No 965/2012[1] 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 965/2012[2];

— amend ORO.FC.A.201 — In-flight relief of flight crew members of Subpart FC — Flight Crew of Annex III (Part-ORO) to Regulation (EU) No 965/2012; and

— amend any other applicable regulation.

In parallel:

— amend ORO.FC.220 — Operator conversion training and checking of Subpart FC — Flight Crew of Annex III (Part-ORO) to Regulation (EU) No 965/2012 when the operator's conversion is combined with a new type/class rating training, as required by Regulation (EU) No 1178/2011;

— 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.

Third step: perform the application of helicopters data report for evidence-based training. Non-commercial complex motor power aircraft may also be considered.

Layers of data of Evidence-based training (EBT)

EBT has 3 layers of data:

The first layer of data is the so call Regulator's data: where data from multiple sources is review by a group of aviation world-leading experts. They produce a report (Data report for evidence-based training) to allow the regulator (ICAO and EASA) to create a training curriculum/programme that could mitigate the operational risks

[1] ORO.FC.215 — Initial operator's crew resource management (CRM) training will be assessed in order to ensure a coherent training and checking for both parts.

[2] This would take into account also ORO.FC.105— Designation as pilot-in-command/commander, including route/area and aerodrome knowledge for commercial operations.

raised in the data report. Obviously not all the operational risks can be mitigated through training, this fact is taken into account in the development of EBT via the training criticality survey, which is part of the development of the EBT training programmes by generation of aircraft (see appendix II to VII ICAO Doc.9995 or EASA ED Decision 2021/002/R AMC2 to AMC7 ORO.FC.232).

AMC1 ORO.FC.232(b)(1) EBT programme assessment and training topics

EBT DATA REPORT

(a) The data report is a large-scale comprehensive study of operational data. It identifies the areas of pilot training for improvement, providing the prioritisation of germane and relevant training topics to guide in the construction of suitable EBT programmes. The data report uses other studies, a variety of data sources and/or varied methodology to mitigate the inherent bias associated with individual types of data sources.

(b) The data report should:

(1) be endorsed or developed by the competent authority, EASA or ICAO;

(2) be reviewed by a team of experts in pilot training, representing airline operators, pilot associations, regulators, and original equipment manufacturers (OEM);

(3) use data or information (training data, operational data and safety data) from the following sources:

(i) accident investigation bodies;

(ii) competent authorities;

(iii) OEM — aircraft;

(iv) EASA safety information;

(v) operators; and

(vi) studies or reports (aviation or scientific);

(4) analyse the data with the following objectives:

(i) to substantiate the need for change in the assessment and training programmes for commercial transport pilots;

(ii) to provide evidence from data analyses to support the derivation of training topics, prioritised according to aircraft generation;

(iii) to challenge and/or corroborate the other sources of data (e.g. Training Criticality Survey and Training Guidance) with operational data;

(iv) to provide feedback regarding the effectiveness of changes implemented through the adoption of competency-based training methodologies; and

(v) to validate or ascertain practices, findings or conclusions made previously by the industry;

(5) include the studies and define the use of such studies in the data report following the criteria below:

(i) The study is relevant from a training perspective (e.g. if incorporating a training change mitigates the risk found in the study).

(ii) 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.

(iii) The findings of the study will be corroborative or challenging across the spectrum of the analysis made in the data report.

(iv) The study allows the analysis and comparison of the data or findings in the data report and it is coming from industry-respected research or studies;

(6) include an evidence table for the purpose of:

(i) integrating the evidence of the analyses in points (4) and (5);

(ii) identifying meaningful patterns;

(iii) enabling the grouping of evidence to support the key findings; and

(iv) facilitating the prioritisation of results; and

(7) include a prioritisation of the training topics for the purpose of translating data into useful events and scenarios to assess and develop pilot performance (assessment and training topics). The prioritisation shall:

(i) systematically rank threats, errors and competencies along with the factors leading to accidents and serious incidents from multiple data sources to formulate a table of assessment and training topics;

(ii) be performed for each of the generations of aircraft. This allows highlighting the differences and commonalities between generations; and

(iii) ensure sufficient flexibility in the process to allow enhancement of the training programmes according to the type of operation, culture and type of aircraft.

The second layer is the 'Operator's layer': here the operator creates an operator's training programme. This programme starts with the generic training programme by generation of aircraft provided by the regulator (previous steep). With this programme the operator distributes the training topics over a period of 3 years and ads on other requirements such as specific approvals, extra operational requirements, or extra training requirements (e.g. training and checking to operates in either pilot's seat). When this is established and the 'assessment and training topics' are correctly distributed in the correct 'frequency' (see example of one page of a generic programme below) the operator needs to choose the corresponding example scenario element, for this purpose the operator will use its own training needs and training feedback to determine the competencies that would like to assess or training choosing the most appropriated 'example scenario element' by observing the *'competency map'* of each 'example scenario element'. Then this example scenario will be contextualised with the operational data of the operator (e.g. the engine failure of the example scenario element of 'take-off low speed' will be performed in Palma de Mallorca (PMI), Spain, as this operator frequently flies into PMI.

The third layer is the instructor layer: the operator has developed an operator's specific assessment and training programme where on day one there is an evaluation, and on day two there is a scenario-based training. On day one the instructor will assess the pilot/crew and will identify the training needs of the pilot/crew so that on day two a specific training adapted to that particular pilot/crew is provided. See more info about tailored training and additional training in ED Decision 2021/002/R AMC4 ORO.FC.231(d)(1) Evidence-based training.

Operator's building blocks. EBT components

The building block of the Operator's EBT system are: the operator's specific EBT programme, the EBT competencies and the EBT instructors.

1- EBT programme:
   - Take the AMC2 to AMC7 ORO.FC.232 (see EASA Annex III to ED Decision 2021/002/R)
   - Select your aircraft generation (e.g. A320 Generation 4)
   - Take the training topics applicable to Generation 4 and distribute them in your 3-year programme with the correct frequency (e.g. A every 6 months, B every 1 year, C every 3 years)
   - For each training topic, choose the example scenario element depending on the competency/ies you want to train (some training topics do not have all the competencies in the example scenario elements)
   - Contextualised your example scenario element with your operational data.

2- EBT competencies:

   An EBT program aims to identify, develop and evaluate the key competencies required by pilots to operate safely, effectively and efficiently in a commercial air transport environment, by managing the most relevant threats and errors, based on evidence collected in operations and training. ICAO has defined competency as "the combination of knowledge, skills and attitudes (KSAs) required to perform a task to a prescribed standard under a certain condition", yet conventional recurrent training requirements consider only the so-called "technical skills" and knowledge. A pilot's competencies in some areas, such as situation awareness, are not addressed. It is impossible to foresee all plausible accident scenarios, especially in today's aviation system where the system's complexity and high reliability mean that the next accident may be something completely unexpected.

   An EBT program aims to identify, develop and evaluate the key competencies required by pilots to operate safely, effectively and efficiently in a commercial air transport environment, by managing the most relevant threats and errors, based on evidence collected in operations and training. EBT training is a continuous assessment process throughout all phases, observing, recording, analysing and determining crew performance against a defined standard in the context of overall performance.

   EBT addresses this by moving from pure scenario-based training to prioritising the development and assessment of defined competencies, leading to better training outcomes. Mastering a finite number of defined competencies will allow a pilot to manage previously unseen potentially dangerous situations in flight.

   The intention of EASA was to maintain the ICAO competencies + Knowledge following the ICAO amendment in PANS-TRAINING.

The EASA competencies are described below and its observable behaviours can be found in the following link Annex III to ED Decision 2021/002/R in AMC1 ORO.FC.231(b)

3- Instructors: the success of EBT depends on the instructors and is a critical element for the EBT system. Specific training and further requirements compared to traditional training are required in EBT. The requirements for the instructors include:
   - Instructor's initial training: the initial training has 2 main parts. One is a ground course and another is a practical assessment in competencies carry out in the simulator.
   - Instructor's recurrent training: this includes as a minimum another ground training every year and a practical assessment of competencies every 3 years. Facilitation is a key element in the instructor role in EBT and is one of the EBT programme features contained in AMC1 ORO.FC.231(a)(2) Evidence-based training.
   - Instructor concordance: this is a key element of a standardised instructors group. Extensive requirements and explanations are provided in the EASA regulatory package for EBT to address this particular element. Detailed information is provided in Reg.(EU) 2020/2036 (definition and requirements in ORO.FC.231 point (a)(4)) and in Annex III to ED Decision 2021/002/R (AMCs and GM to ORO.FC.231 (a)(4)):

- Definition of Concordance (inter-rater reliability): means the consistency or stability of scores between different EBT instructors which gives a score (or scores) of how much homogeneity, or consensus, there is in the ratings given by instructors (raters).

Advice to stakeholders:

- Follow the official documentation of your regulator (Chinese CAA), ICAO, and EASA.
- The use of private consultants other than IATA are not advisable.
- EBT is a worldwide global initiative that was created and developed by many public organisations. No single organisation or person can claim the original idea or ownership of EBT and its principles.
- EBT is a long journey: 1-2 years of EBT principles and 2-3 of EBT mixed.
- Train the trainers. It will provide a return on investment. Ensure a good instructor training (emphasis on facilitation)
- Ensure a good instructor concordance. This system will allow the operator to have consistent grading and identify at least the following:
    - Which instructors grade to high
    - Which instructor grade to little
- Ensure a good Feedback loop. More information in the Annex III to ED Decision 2021/002/R.

Recommended documentation

Primary documentation

- EASA EBT checklist: https://www.easa.europa.eu/sites/default/files/dfu/EBT-Checklist.pdf

- ED Decision 2015/027/R Implementation of evidence-based training (EBT) within the European regulatory framework https://www.easa.europa.eu/document-library/agency-decisions/ed-decision-2015027r. It includes:

    - Annex I to ED decision 2015/027/R: GM1 ORO.FC.230 (a); (b); (f). Recurrent training and checking to Part-ORO – Issue 2, Amendment 4; and

    - Explanatory Note to the ED Decision 2015/027/R.

- EASA EBT baseline regulation:

    - EASA ED Decision 2021/002/R https://www.easa.europa.eu/document-library/agency-decisions/ed-decision-2021002r

- Provisions for Operators: Annex III https://www.easa.europa.eu/sites/default/files/dfu/amc_gm_to_part-oro_-_issue_2_amendment_17.pdf
- Provisions for authorities
    - https://www.easa.europa.eu/sites/default/files/dfu/amc_gm_to_part-aro_-_issue_3_amendment_11_0.pdf
    - https://www.easa.europa.eu/sites/default/files/dfu/amc_gm_to_part-fcl_-_issue_1_amendment_11.pdf

- European Commission Regulation
    - Reg. (EU) 2020/2036 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R2036&from=EN
    - Reg. (EU) 2020/2193 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R2193&from=EN

For info:

- ToR RMT.0696 Implementation of Evidence-Based Training within the European regulatory framework. https://www.easa.europa.eu/document-library/terms-of-reference-and-group-compositions/tor-rmt0696.
- ToR (+ Concept Paper) RMT.0599 Evidence-based and competency-based training. https://www.easa.europa.eu/document-library/terms-of-reference-and-group-compositions/tor-concept-paper-rmt0599.
- EASA Notice of proposed of Amendment 2018-07(B): https://www.easa.europa.eu/sites/default/files/dfu/NPA%202018-07%28B%29.pdf
- ICAO Doc 9995 AN/497 Manual of Evidence-based Training First Edition – 2013.
- IATA Data Report for Evidence-Based Training August 2014 1st edition.
- ICAO PANS Training DOC 9868.
- IATA Evidence-Based Training Implementation Guide July 2013.

ANNEX 1 – SOME PARTS OF THE EBT REGULATION TO ILUSTRATE THE TOPIC

AMC1 ORO.FC.231(b) Evidence-based training

RECOMMENDED EBT COMPETENCIES (EASA COMPETENCY FRAMEWORK)

(a) The operator should include in its EBT programme at least the following competencies:

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
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

GM2 ORO.FC.146(c) Personnel providing training, checking and assessment

EBT INSTRUCTOR — RECURRENT STANDARDISATION

(a) Refresher EBT training

The intent of this training is to provide the framework for existing instructors to develop their competence to conduct EBT. Further guidance can be found in the EASA EBT manual.

(b) Concordance training

This training is one of the elements to ensure concordance within the EBT instructor community. Those EBT instructors who do not demonstrate concordance may require further training. The operator's instructor standardisation and concordance assurance programme provides insight in the areas that an instructor (or instructor population) requires concordance training. As such, concordance training varies in content and scale depending on the need for concordance improvement.

Instructor concordance training may include candidates grading the same controlled content (e.g. a video or paper case) followed by:

(1) a subsequent comparison of intra-group variance; and

(2) alignment of root-cause analyses between instructors.

AMC1 ORO.FC.231(a)(4) Evidence-based training

INSTRUCTOR CONCORDANCE ASSURANCE PROGRAMME (ICAP)

(a) The ICAP should be able to identify areas of weak concordance to drive improvement in the quality and validity of the grading system.

(b) The ICAP should be adapted to the size and complexity of the instructors' group and the complexity of the operator's EBT programme.

(c) Complex operators should include an ICAP-specific data analysis, demonstrating:

(1) instructor-group assessment homogeneity (agreement);

(2) instructor assessment accuracy (alignment).

(d) The operator should verify the concordance of the instructors:

(1) once every cycle;

(2) for a sufficient number of competency-grade combinations.

(e) The operator should establish procedures to address those instructors who do not meet the standards required.

(f) The operator should maintain a list with the EBT instructors qualified to deliver the EBT programme.

GM1 ORO.FC.231(a)(4) Evidence-based training

INSTRUCTOR CONCORDANCE ASSURANCE PROGRAMME (ICAP)

(a) Instructor concordance is a tool for continuous improvement of the EBT programme as data reliability results in a more accurate and effective training.

(b) The operator may have a more frequent, or even a continuous, assessment of concordance as it provides more opportunities to improve.

(c) Concordance standards are normally set by the operator; however, the competent authority may recommend criteria, as licences' revalidation is performed under EBT.

(d) Individual instructor concordance may be verified:

(1) through uniform standardisation material where at least three different levels of performance are included and for all the competencies at a frequency of 72 months;

(2) by reference to the analysis of the data produced by the instructor every 12 months; normalisation may be necessary as there is no homogeneity of all EBT modules and the pilots that the instructor assessed; and

(e) Instructor-group assessment homogeneity (agreement) may be inferred from instructors who have observed the same content.

(f) Instructor assessment accuracy (alignment) may be inferred from comparing instructor assessments with an 'assessment standard' consisting of correctly identified competency(-ies) and correctly identified grade levels. Neither the competency(-ies) nor the grade level(s) may be communicated in advance to the instructors. The assessment standards may be set by consensus of a standards group, in order to guard against individual biases.

(g) When the operator uses a small group of instructors (e.g. 10), the data-driven concordance assurance programme may be directly integrated into the annual refresher training, removing the need for the above guidance.

(h) Operators with a complex group of instructors (e.g. a big rotation of instructors, subcontracted instructors, big number of instructors, many different fleets, etc.) may need to implement a more extensive concordance assessment system.

SPT.012 ORO.FC.231(a)(4) — safety promotion task 012 — safety material for EBT — CONCORDANCE

RELEVANT METRICS MUST BE USED TO SUPPORT THIS PROGRAMME;

(a) Concordance must be analysed independently per competency, and, if possible, segregated between different levels of competency assessment. This serves to identify whether concordance varies between competencies or between levels of assessment, providing guidance that is more accurate in order to improve concordance. Assessing concordance between instructors should make use of statistical methods, gauging both individual instructor metrics as well as group instructor metrics.

(b) Different statistics may be appropriate for different types of measurement. Some options are: joint-probability of agreement, Cohen's kappa, Scott's pi and the related Fleiss' kappa, inter-rater correlation, concordance correlation coefficient, and intra-class correlation.

(c) Individual assessments should assess to what extent an individual aligns with predefined standards for the reference material (e.g. correlation analysis) and to what extent the individual's ability to assess is improving or deteriorating over time (e.g. compared to previous concordance assessments). Group statistics may make use of group agreement (e.g. variance assessment) and group alignment (e.g. group averages compared to standards for the reference material). A high variance implies that a large number of instructors is not rating according to the standards set, and warrants investigation. Individual instructors that exhibit a large deviation from standards, consistent positive/negative bias or poor improvement/deterioration of their concordance with standards, must be considered for focused instructor training before re-engaged in EBT assessments. However, the investigation may determine that although an individual instructor exhibits a large deviation, the reason is not that this instructor is not standardised. The reason could be that the instructor is delivering a different programme (e.g. always delivering a harder-than-usual EBT programme in preparation of command upgrades) or that the instructor is fundamentally conduct training to a specific group of pilots (e.g. those that require remedial training).

(d) Finally, when subcontracted instructors are used, the standardisation provided to them should be particularly considered. This group of instructors may not acquire the required concordance initially. In order to maintain the data integrity for instructor concordance, the operator should maintain data traceability for each group of instructors (airline and subcontracted) as the root cause for the good or bad performance of each group may be different as the background and environment of each group is different. Same principles may be necessary to be applied in other groups (e.g. mature instructors vs young instructors).

CONTINUOUS IMPROVEMENT OF CONCORDANCE

(e) Metrics of instructor concordance must drive specific interventions in instructor training, the assessment framework used and/or the reference material developed. Instructor concordance must be submitted to a process of continuous improvement in order to safeguard against standards drift and concordance degradation. For this reason, these requirements do not specify statistical thresholds of minimum variance of concordance; however, improvement in concordance metrics should indicate whether the operator's concordance programme is effective. Over time, as concordance improves, so will the reliability of EBT data.

CONCORDANCE ASSURANCE AND EBT INSTRUCTOR RECURRENT STANDARDISATION (SEE GM2 ORO.FC.145(a)(3) point (c))

(f) Instructor concordance may be verified by controlling the content to be assessed (reference material) such as flight recordings, scripted videos and/or case studies.

(g) Within each 3-year period, reference material should address every competency at a minimum of two levels per competency, such that concordance is assessed across the wide range of competency assessment that instructor must be proficient in. Reference materials may not be presented to the same instructor within 3 years in order to maintain true assessment of an instructor's ability to assess accurately. Operators should strive to include a broad diversity of flight phases, situations and behaviours when developing reference material, and preferably integrate their own operations and SOPs.

(h) Reference material should be assessed using the same assessment framework used for actual EBT training delivery, and preferably assess not only the competency observation, but also the ability to assess root causes and identify subsequent training needs. Reference material should be supplemented with 'correct' ratings (i.e. answer sheet), such that instructor assessment can be compared against agreed-upon standards. The answer sheet should be composed by a core group of EBT instructors; preferably, rotating members to prevent standards drift and/or lasting bias.

(i) Instructor concordance may not be inferred from actual assessment data collected from EBT sessions when these sessions are not equivalent in terms of difficulty, competency distributions, etc. because this may not guarantee equal reference material between instructors.

INSTRUCTOR CONCORDANCE

(j) The development of strong instructor concordance (inter-rater reliability) is critical for the validity of the EBT data collection. In a norm-referenced system, the operator must safeguard concordance between instructors. Minimum concordance standards are normally set by the operator; however, the competent authority may recommend certain criteria, especially when the revalidation of licences is performed under EBT.

(k) Distribution of grades across the instructor community for the modules conducted should be recorded. This recording may be accessible to the instructors, normally a posteriori. Some airlines underweight the grading performed by an instructor with poor concordance to have accurate competency data. Underweight may only be needed in rare cases during mixed EBT; however, it should not happen during EBT baseline.

(l) However, this standard needs to be easy for the instructors allowing them to focus on the observation of the students and to provide training to them rather than crosschecking complicated criteria.