Evidence Based Training – Challenges, Opportunities and the Way Forward

Moderator
Viktor Robeck
Head, Training and Qualification, SFO, IATA

Panelists
Henry Defalque
Technical Officer, Licensing and Operations, Flight Ops, ICAO
Yann Renier
Management Captain, Air France
Pat Dever
Fleet Captain: A330, B747, B777, Delta Air Lines
Evidence-Based Training

Viktor Robeck
Head, Training & Qualification, Safety and Flight Operations, IATA
Background

- EBT is an initiative to improve safety in flying operations
- To further reduce airline accident rate, a review of recurrent and type-rating training was necessary
- So far – event-based training, … including lessons learned from past accidents/incidents into training sessions, leading to a systematic form of training, checking off tick boxes
Data Research Process

- Flight ops and training data from the past 20 years has been reviewed (i.e., LOSA programs, air safety reports, flight data analysis)

- Examination of threats, errors, undesired aircraft states and their relationship to unwanted consequences.

- These findings were compared with current training practices with the outcome, that the current training schema does not factor in the differences of the four aircraft generations in use today.

- One size training does NOT fit all aircraft types
### Aircraft Generations

<table>
<thead>
<tr>
<th>Aircraft by Generation</th>
<th>Gen 4 Jet</th>
<th>Gen 3 Jet</th>
<th>Gen 3 Turboprop</th>
<th>Gen 2 Jet</th>
<th>Gen 2 Turboprop</th>
<th>Gen 1 Jet</th>
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<tbody>
<tr>
<td></td>
<td>A318/A319/A320/A321, A330, A340-200/300, A340-500/600, B777, A380, B787, A350, Bombardier C Series, Embraer E170/E175/E190/E195</td>
<td>A310/A300-600, B737-300/400/500, B737-600/700/800 (NG), B757, B767, B747-400, B747-8, B717, BAE 146, MD11, MD80, MD90, F70, F100, Bombardier CRJ Series, Embraer ERJ 135/145</td>
<td>ATR 42-600, ATR 72-600, Bombardier Dash 8 Q Series</td>
<td>A300 (except A300-600), BAC111, B727, B737-100/200, B747-100/200/300, DC9, DC10, F28, L1011</td>
<td>ATR 42, ATR 72 (all series except -600), Embraer EMB-120</td>
<td>DC8, B707</td>
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Publications

EBT was developed with industry over 6 years, under ITQI, and jointly agreed by ICAO, IATA, and IFALPA. **ICAO doc 9995** was published in May 2013.

augmented by IATA ITQI doc “EBT Implementation Guide”
EBT Source Data

- LOSA reports
- Flight Data Analysis studies
- Accident/Incident analyses
- Studies-AQP/ATQP Airline results
- Studies-Skill Decay & Retention
- Flight deck Automation studies
- STEADES
- Airbus Special FDA Reports
- Pilot Survey
Evidence from Data

- Data from over **3 million** flights over multiple aircraft types over multiple airlines over several regions
- Use of standardized event set
- Analyzed for event frequency rate and clusters (drill down)
- **LOSA data:**
  - Over **9,000 observed** flights
  - **50+** airlines
  - 90 page report from LOSA Archive
  - Subsidiary follow up report
LOSA:

- 4% of all approaches were unstable
- 97% of unstable approaches are continued to landing
  - 10% result in abnormal landings
- Only 3% of unstable approaches lead to a Go-Around
- When a GA occurs – it almost always poorly performed
  - Usually a surprise to the crew
  - Very rarely occurs at (the briefed) missed approach height
8 Core Competencies

- Communication
- Aircraft Flight Path Management – Manual Control
- Aircraft Flight Path Management – Automation
- Leadership and Teamwork
- Problem Solving and Decision Making
- Application of Procedures
- Work Load Management
- Situational Awareness
Competencies & Related Knowledge, Skills and Attitudes

- Competency
- Competency Description
- Performance Criteria – observable behavior

**Situation Awareness**

- Is aware of what the aircraft and its systems are doing
- Is aware of where the aircraft is and what its environment is
- Keeps track of time and fuel
- Is aware of the condition of people involved in the operation including passengers
- Recognizes what is likely to happen, plans and stays ahead of the situation
- Develops “what if” scenarios and plans for contingencies
- Identifies threats to the safety of the aircraft and people, and takes appropriate action
## 8 Core Competencies

<table>
<thead>
<tr>
<th>Competency</th>
<th>Competency Description</th>
<th>Behavioral indicator</th>
</tr>
</thead>
</table>
| **Application of Procedures** | Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge. | Identifies the source of operating instructions  
Follows SOP’s unless a higher degree of safety dictates an appropriate deviation  
Identifies and follows all operating instructions in a timely manner  
Correctly operates aircraft systems and associated equipment  
Complies with applicable regulations.  
Applies relevant procedural knowledge. |
| **Communication** | Demonstrates effective oral, non-verbal and written communications, in normal and non-normal situations. | Ensures the recipient is ready and able to receive the information  
Selects appropriately what, when, how and with whom to communicate  
Conveys messages clearly, accurately and concisely  
Confirms that the recipient correctly understands important information  
Asks relevant and effective questions  
Adheres to standard radiotelephone phraseology and procedures  
Accurately reads and interprets required company and flight documentation  
Accurately reads, interprets, constructs and responds to datalink messages in English  
Completes accurate reports as required by operating procedures  
Correctly interprets non-verbal communication  
Uses eye contact, body movement and gestures that are consistent with and support verbal messages. |
| **Aircraft Flight Path Management, automation** | Controls the aircraft flight path through automation, including appropriate use of flight management system(s) and guidance. | Controls the aircraft using automation with accuracy and smoothness as appropriate to the situation  
Detects deviations from the desired aircraft trajectory and takes appropriate action  
Contains the aircraft within the normal flight envelope  
Maintains the desired flight path to achieve optimum operational performance  
Selects appropriate level and mode of automation in a timely manner considering phase of flight and workload  
Effectively monitors automation, including engagement and automatic mode transitions. |
| **Aircraft Flight Path Management, manual control** | Controls the aircraft flight path through manual flight, including appropriate use of flight management system(s) and flight guidance systems. | Controls the aircraft manually with accuracy and smoothness as appropriate to the situation  
Detects deviations from the desired aircraft trajectory and takes appropriate action  
Contains the aircraft within the normal flight envelope  
Controls the flight path to achieve optimum operational performance  
Maintains the desired flight path during manual flight whilst managing other tasks and distractions  
Selects appropriate level and mode of flight guidance systems in a timely manner considering phase of flight and workload  
Effectively monitors flight guidance systems including engagement and automatic mode transitions. |
Thank you

www.iata.org/itqi
Evidence-based Training

Henry Defalque
Technical Officer, ICAO
ICAO EBT programme

- History
- Completed
- Caveats
- Roll-out
- Results
- Future Work
  - Short term
  - Long term
History

- ITQI initiated with ICAO finalization

Completed in 2013/2014

- PANS-TRG new Chapter and definitions
- Manual on Evidence-based Training (Doc 9995)
- IATA EBT Data Report

Caveats

- EBT is optional as an AMC
- Only applies to airline recurrent training in an FSTD
- Example of Core Competencies
Future work – short term

- Review competency definitions in PANS-TRG
- Guidance on how to use competencies in training programme development: ATCO Training Manual
- Guidance for the qualifications of inspectors

Future work – long term

- Competency-based type rating programme
  - Why? Prescriptive type-rating= train a candidate minimally to pass a check. CBT = AMC; ICAO formally approached to lead.
  - How: receive mandate based on a project plan+ need help.
Thank you
Captain Yann RENIER
Compliance and Regulatory Affairs, Air France
Air France, Core Competencies and Alternative Training

- Implementation
- ATQP
- Way forward
Threat and Error Management (TEM)

Anticipate or Recognize / Mitigate

Threat (T)

Detect / Correct

Error (E)

Recognize / Recover

Undesired Aircraft State (U)

Incident Accident

Grew Factors

(R) Response (O) Outcome

(R) Response (O) Outcome

Policies / Procedures
Monitor / Cross-Check
CRM Skills
Checklists
Deviation Callouts
Aircraft Hardware
Airmanship
Luck
Old system:

New Competency grading system:
Grading Scale / Level of Requirements

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<tr>
<th>Situation</th>
<th>Unacceptable</th>
<th>Acceptable</th>
<th>Standard</th>
<th>Standard +</th>
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<tbody>
<tr>
<td>Major UAS</td>
<td>Flight Safety is engaged</td>
<td>Ignored or abused threat, Ignored or abused error, Intentional error, Minor UAS</td>
<td>Threat anticipated or recognized and mitigated, Error detected and corrected</td>
<td>TEM outstanding performance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Competencies</th>
<th>Unacceptable</th>
<th>Acceptable</th>
<th>Standard</th>
<th>Standard +</th>
</tr>
</thead>
<tbody>
<tr>
<td>One UNACCEPTABLE, Too many ACCEPTABLE</td>
<td>One or more significant ACCEPTABLE</td>
<td>Occasional ACCEPTABLE or STANDARD + are not significant</td>
<td>Performance observed always STANDARD or STANDARD +</td>
<td></td>
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</tbody>
</table>

| Adjournment, treatment before return to flight | Must take into consideration recommendations to improve the performance | Performance expected and to be maintained | Performance can serve as an example |
Calibrate
To train and standardize the instructors via:

- Ground course by LOSA collaborative for TEM,
- Training symposiums,
- Fleets STD courses (video…)

To inform the pilots via:

- Training department and fleets communications,
- Instructors during recurrent training briefing,
- Paper and e-letter Focused on each competency,
- OM part A and D…
Air France, Core competencies and Alternative training

► Implementation
► ATQP
► Way forward
Traditional recurrent training/checking

- **Annual cycle**
  - TRNG / LPC+OPC

- **6 months**
  - TRNG / OPC

- **1 year**
  - TRNG / LPC+OPC

**LPC:** Licence proficiency check  
**OPC:** Operator proficiency check
LPC OPC Commonalities

✓ Rejected take-off
✓ Take-off with engine failure between V1 and V2
✓ With one-engine-inoperative:
  ▪ Precision instrument approach to minima
  ▪ Non-precision approach to minima
  ▪ Missed approach on instruments from minima
  ▪ Landing
✓ LVO
With ATQP

Annual cycle

6 months

1 year

TRNG / LPC+OPC

LOE / TRNG

TRNG / LPC+OPC
LOE Session

✔ Based on operational evidences
✔ More focus on normal operations
✔ More realistic exercises
✔ Several scenarios
✔ Surprise effect introduction
LOE Flight Phases and Events

DEP EVENTS

- Flight Computer INOP
- Disembarking PAX
- Weather at destination below minima
- APU shut down during engine start
TRNG session

- Operator’s SBT, MV exercises
- Pilot’s competencies enhancement with Instructor tool box
- Specific pilot training request
- Final grading at the end of TRNG session

SBT : Scenario Based Training
MV: Manoeuvres
LOE/TRNG Sessions Consequences

- Less routine checks
- Training quality improvements
- Safety improvements
- Pilots and Instructors like it
Training quality improvement

« TRICKY » EXERCICE

During the take off roll in high speed situation, the Pilot Flying looses its PFD

ASSOCIATED GRADING
BEFORE / AFTER
Flight Safety Improvements

Green Arrow: FDM events

Red Line: ASR ratio
Air France, Core Competencies and Alternative Training

- Implementation
- ATQP
- Way forward
EU Regulations Changes Needed

Annual cycle

6 months

1 year

LOE / TRNG

LOE / TRNG

LOE / TRNG
ICAO Changes Needed

Annex 1 — Personnel Licensing
😊 No controversial issues but no references to EBT

Annex 6 — Operation of Aircraft
其他玩家 vs 2 Proficiency Check per year (Ch. 9.4.4)

Doc 9995, Manual of Evidence-based Training
其他玩家 Applicability restricted to Annex 6 perimeter (Ch. 2.1.1)
Thank you
CAPTAIN PAT DEVER
Wide Body Fleet Captain, Delta Air Lines
Our Steps to Implement EBT at Delta

- EBT would take the pilot training in the industry to the next level
- International collaboration would ensure valuable and widely applicable outcome
- Delta needed to be involved for the benefit of our training
- Our regulatory environment would allow us to participate and implement EBT
Implementation Precursors

- Development of competency framework and grading system
- Instructor training to assess and train core competencies
- Provision of information to pilots regarding performance criteria and core competencies
- System of measurement for training system performance
Core Pilot Competencies

EBT:
- Flight Path Mgmt – Manual
- Flight Path Mgmt – Auto
- Application of Procedures
- Communication
- Leadership & Teamwork
- Problem Solving & Decision Making
- Situation Awareness
- Workload Management

Delta:
- Flight Path Mgmt – Manual
- Flight Path Mgmt – Auto
- Application of Procedures
- CRM/TEM
CRM Competency

- Workload Management
- Communication
- Planning
- Situational Awareness
- Decision Making
- Professional Management
- Threat & Error Management
Threat & Error Management Model

UNEXPECTED THREATS
TOC
TOC
TOD
TOD
EXPECTED THREATS
EXPECTED THREATS

Gate
WARTS
NATS
Gate

Fly A/C
PF vs. PM

NO TIME
TIME

Plan (B)
Communicate

Fire
Smoke*
Security
Med. Emer.

Time
Plan
Communicate

Everything
Else
Measuring Training System Performance

- Delta has adapted the Kirkpatrick model for measuring training system performance
  1. Level one – Reaction
  2. Level two – Learning
  3. Level three – Line performance
  4. Level four – Organizational benefits
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<th>330</th>
<th>737</th>
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<th>764</th>
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</table>

*CQ FL*
CQ FL 777 56A -F/L: 6.1 VISUAL APP

Stick & Rudder

Procedures

Automation Proficiency

CRM

Go to Comments

Go to Scorecard

DELTA
Discussion
New Aircraft Technology – Human Machine Interface

Moderator
Tom Fodor
Head, Engineering and Maintenance, SFO, IATA

Panelists
Mario Chaves
Head, Flight Operations Efficiency, SFO, IATA

Bob Myers
Chief Engineer, Flight Deck, Boeing

Rakesh Jha
Director Advanced Technology, Crew Interface & Avionics Platform Systems, Honeywell Aerospace

Jean-Michel Roy
Test Pilot, Airbus
New Aircraft Technology – Human Machine Interface

Mario Chaves
Head, Flight Operations Efficiency, SFO, IATA
Session Objective

- Explore the new aircraft technologies to be implemented over the next 20 years
- Consider the impact of new technologies on human factors, their potential effect on safe and efficient ops
- Consider how to maintain human control with increasingly higher levels of automation
- How to ensure that only those technologies which improve system and human performance and make business sense are considered
Future Airspace Environment Influence

- With the implementation of the ICAO Aviation System Block Upgrade (ASBU) the information interchange will increase immensely. System Wide Information Management (SWIM) is intended to provide a common communication platform.

- Consequently On-Board information will increase to provide better operational support to the Pilots (e.g. Weather, ATC information, Airline OCC and Maintenance information,…)

- Future cockpits need to accommodate this expected increase of information in order to transfer it to the pilots whilst still maintaining their focus on the primary flying tasks.
Air Transport System is Complex

- Aircraft
- Pilot
- ATC
- Airline Operation Center:
  - Providers:
    - Flight Plan
    - Weather
    - Fuel…….
Airline Concerns

- Is the future technology aligned both ANSP/OEM and ANSP/ANSP in order to reduce the on-board investment while enabling the best efficiency from it?
- How much will the Pilot supervising/monitoring role change with the new technology?
- What will be the role of the FMS and EFB?
  - They will be combined?
  - They will co-exist?
Thank you
Bob Myers
Chief Engineer, Flight Deck, Boeing
The Future Flight Deck – Sensible Evolution

Bob Myers
April 14, 2015
The Evolutionary Flight Deck
Managing Sensible Change
A Challenge for the Whole Industry
Flight Deck Change is Constrained
Few ‘clean sheet of paper’ designs

- **Revolutionary** designs incur risk
  - Safety
  - Cost
  - Schedule

- **Industry rewards commonality**
  - Crew training
  - Industry standards
  - Regulation

- **Long product life cycles**
Fleet Turnover is Gradual
Most planes in service 20 years from now are in production today

SOURCE: 2014 Boeing Current Market Outlook
Flight Decks Will Change
The industry drives evolutionary change

- **Personal Electronics**
  - Connectivity
  - Big data

- **Flight Operations**
  - Safety enhancements
  - Efficiency
  - Congestion
  - Infrastructure changes

- **Pilot demographics**
  - More global diversity
  - More technology exposure
  - Less military experience
  - Increased reliance on automation
Implementing Change
Adding stand-alone flight deck capabilities is typical

- **Adding features is necessary**
  - Datalink
  - Satellite navigation
  - ADS-B In
  - Electronic Flight Bags, personal electronics

- **Adding features burdens the crew**
  - More operational knowledge
  - New procedures
  - New responsibilities
  - New habit patterns
  - New error sources to avoid
Implementing Change
Integrating new capabilities reduces the burden

- Build on previous experience
- Adjust don’t add crew procedures
- Information managed and consistent
- Maintain alerting and design philosophies
- Examples:
  - Selectable layers on navigation display
  - Tablet user interface compatible with flight deck
  - New alerts consistent with flight deck design
Implementing Change
The industry needs to work together

- Eliminate antiquated operational capabilities
- **Automation should aid not replace the pilot**
  - Keep the pilot in the loop
  - Allow pilots to use the airplane’s full capabilities
  - Let the pilots choose their task flow
  - Trust but verify pilot performance
- **User interface consistency and compatibility**
- Eliminate or streamline crew responsibilities
Evolve Responsibly
Incorporate supplemental electronics responsibly

- **Should be used for:**
  - Supplemental information
  - Reference information
  - Strategic planning
  - Administrative activity
  - Data storage, most processing

- **Should NOT be used for:**
  - Aviating
  - Navigating
  - Communicating (i.e. ATC, safety services)
  - Operating systems (e.g. control, alerting)

- **Should be integrated sensibly, not just added**
Summary

- Complete overhaul of the flight deck is not imminent

- Evolutionary change is ongoing and necessary

- Change sensibly
  - Maintain or enhance safety
  - Utilize proper human factors engineering
    - Manufacturers
    - Operators
    - Regulators
  - Consider the impact to the flight crew
Rakesh Jha
Director Advanced Technology, Crew Interface & Avionics Platform Systems, Honeywell Aerospace
New Aircraft Technology – Human Machine Interface

Alternative Futures

Rakesh Jha
Honeywell Aerospace
Director, Advanced Technology
Fundamental question

Will the human-machine systems be capable enough to meet the mission demands of safety, efficiency, and economics?

Focus on Human-Machine Systems (HMS) rather than HMI
Forces driving change in future flight decks

- New technology
- NextGen/SESAR
- Demographics and culture
- UAS in shared airspace
- Greater operational demands
- Economics and regulations

- Many interacting factors affect human-machine performance.
- Factors may evolve in unknown ways.

Complex environment with significant uncertainty
Scenario planning – alternative futures

Spectrum of crew roles: as do-all pilots or as overseeing managers
Human-machine interaction philosophies

### Pilot as Pilot
1. Involved in all functions
2. Final authority
3. Automation as aid
4. Issues – workload, skills

### Pilot as Manager
1. Mission-level functions
2. Shared authority
3. Automation as key doer
4. Issues – engagement, resilience

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R. A. Coppenbarger, R. W. Mead, D. N. Sweet, 7th AIAA ATIO Conference, 2007, Belfast, Northern Ireland

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**Analyze spectrum with test cases, develop HMS guidelines**
The certain and the likely futures

- **Certain**
  - More information in the flight deck
  - More complex operations

- **Likely**
  - **Connected**
    ✷ Superior situation awareness.
    ✷ Integrated with service providers.
  - **Intelligent**
    ✷ Human-machine collaboration
  - **Natural to interact with**
    ✷ Multimodal and transparent

Some advances will occur under most scenarios
Navigating the decision space

- Look for signposts, e.g.,
  - High pilot costs or low availability
  - Elevated accident rates due to human error
  - Public distrust of fully automated systems
  - Law requires pilots to retain final authority

- Develop strategic options
  - Core enablers serving any scenario
  - Users-in-the-loop iterative prototyping
  - Maintain flexibility

- Monitor and adjust dynamically

How we could make strategic decisions
In conclusion

As flight decks change, humans will remain vital to aviation safety and operational effectiveness.

Human-machine interaction will become human-machine collaboration
Jean-Michel Roy
Airbus
New Aircraft Technology

HMI

Captain Jean-Michel ROY
Airbus Test Pilot
Human to remain at the Heart of the System

Safety – Efficiency – Comfort
Basic Crew Tasks

• Fly
• Navigate
• Communicate
• Manage systems
FLY

• Protected aircraft to become the standard.

• More robust automation adapted to new operational environment while keeping good pilot **basic flying skills**
FLY: Robust and adapted Automation

- More **robust** automation
  - Autopilot available even in degraded conditions:
    - Limited sources (air data……)
    - Limited Hydraulic power
- More automation **adapted** to new operational environment:
  - TCAS avoidance
  - Emergency descent …..
- **Automatic configuration** setting according to speed/performance requirements:
  - Flaps
  - Landing gear
FLY: Keeping pilot basic flying skills

• Moving toward **flying the trajectory and the energy**:
  • Flight Path Vector (Bird)
  • Total Energy (Chevrons)
• Easy to understand and to remember
• Head Down Display as well as Head Up Display
• Predicting a return to “visual” flight:
  • Wide use of Synthetic Vision System
• Specificity of Long Haul operation
NAVIGATE

- Extensive use of **data link**
  - ATC (clearances, D-ATIS) connections to Aircraft (FMS….)
  - Pilot validation to confirm
- Continuous world: Gate to Gate
- Very accurate aircraft position
- High quality global **data bases**: Airport, Terminal, En route, Terrain
COMMUNICATE

• **Key** function to support major step change
  • Real time
  • Quality at low cost
  • Voice
  • Data
  • Video

• Continuous Aircraft monitoring from ground:
  • Position
  • Condition
MANAGE SYSTEMS

• **Automatic** display management
• **Very simple:**
  • Green / Amber / Red
• **Interactive** system displays with graphical guidance for procedures
  • both normal and non-normal

The right information
- at the right place
- at the right time
MANAGE MISSION

- Historical border between EFB and Avionics (FMS…) to be redesigned:
  - Performance computations
  - Navigation data base
  - Weather Data
MANAGE MISSION

• Thanks to enhanced communication system, **collaborative approach** with Airline back office on ground (dispatcher.....) to support pilots in:
  • Situation analysis
  • Decision making
  • Action implementation
  • Reporting (logbook....)
Well trained Human to remain at the Heart of Advanced System
Discussion