Best Practices on implementing CDO/CCO

Combined ICAO EUR PBN TF and Eurocontrol RAiSG
Paris, France, 11-13 September 2013
Helping to implement PBN within your Airspace
PBN (GNSS) Approach Operations Implementation - Best Practices

MARIE CURIE 8-14, ROOM AUDITORI
BARCELONA (SPAIN)
25-26 APRIL 2013

13th September 2013
Continuous Descent Operation

• Continuous Descent Operation is an operation, enabled by airspace design, procedure design and ATC facilitation, in which an arriving aircraft descends continuously, to the greatest extent possible, by employing minimum engine thrust, ideally in a low drag configuration, prior to the final approach fix [ICAO Doc 9931]
1. ICAO Guidance Material

2. Practical Examples
   - REACT-CR
   - REACT Plus

3. CDOs Inception Phase
1. ICAO Guidance Material

2. Practical Examples
   • REACT-CR
   • REACT Plus

3. CDOs Inception Phase
ICAO: CDO Implementation guidance

- CDO Manual (Doc. 9931) intended to provide guidance and harmonize the development and implementation of CDOs
- To achieve this: collaboration between different involved stakeholders needed (ANPS, A/C operators, Airport operators, aviation regulators)
- Process for effectively implementing CDOs:

![CDO Implementation Road Map Diagram]
1. ICAO Guidance Material

2. Practical Examples
   - REACT-CR
   - REACT Plus

3. CDOs Inception Phase
**Practical Examples**

- **REACT-CR**: Reduction of Emissions using CDAs in TMA in Czech Republic *(finished project)*

  ![REACT-CR](image)

- **REACT-Plus**: Introduction of CDAs and CCDs in Hungary *(on-going project)*

  ![REACT-Plus](image)

*Practical Examples: AIRE 2 and 3 programmes: Today’s partners for Tomorrow’s aviation*
Index

1. ICAO Guidance Material

2. Practical Examples
   • REACT-CR
   • REACT Plus

3. CDOs Inception Phase
• **Project objective:**
  - To get to a pre-operational stage where CDAs can be flown at Prague airport by Czech Airlines (CSA)
    • Introduction of more efficient operational procedures inside an airspace terminal area
    • Awareness regarding the environmental benefits that this and similar activities inside AIRE demonstrate

• **Key concepts:**
  - Continuous Descent Approach
  - Restructuring of TMA Prague
  - Reduction of CO₂ emissions
  - Use of existing technologies

• **Target number of flights:**
  - 350 standard approaches
  - 350 Continuous Descent Approaches
REACT-CR: activities

• Analysis of scenario:
  - Prague: airport, airspace
  - CSA fleet: A319/A320 (& A321)
  - Avionics: Honeywell (using MANAGED guidance)

• Operational definition of the validation plan:
  - Procedure definition: RWY 24
  - Phraseology definition

• Training: CSA crew and ATCO

• Data assessment and evaluation
NEW CDA procedures designed by ANS-CR for RWY 24

Main characteristics:
- Designed as closed STARs → Procedures end at FAF/FAP
- The 4 entry points into Prague TMA are the same as for regular STARs
- Trajectories designed with respect to the minimum length, optimum descent and safety requirements
- All routes flown into CSA’s simulator
- Procedures published as AIP SUP

Selection of destinations
- Night flights
- Low traffic
REACT-CR: CDA examples

Example of a remarkable CDA

CDA discarded due to thrust usage

CDA discarded due to level flights

thrust usage

level segments
REACT-CR: Lessons learnt

• Deceleration segment before FAF, at 4000ft AMSL
  - FAF altitude
  - Deceleration segment

Two reasons for it:
  - FMS SW design: stabilised approach in level segment
    • However “Full managed mode” is close to the most economic (cross checked with OEM)
  - Flight Safety
    • A/P disabling not allowed
    • Speed reduction at FL
    • Speed brakes not allowed during descend

![Diagram showing time to landing and altitudes for OK723 flights](image-url)
CDA STAR design considerations (feedback from pilots)

1. Ideally start at ToD (Top of Descent) or cruise altitude
   - ToD located very far from THR (out of airspace boundaries)
   - Data analysis started at FL160

2. Vertical constraints
   - Issue affecting 1st generation FMSs (codename Legacy)
   - 2nd generation FMSs not affected (codename Pegasus)
   - Related to flight path margins over published minimum altitudes at certain WPTs. If difference < 1000ft: Legacy adds level-off segment
   - Legacy installed at #2 A320 and #2 A321
   - A321 not showing the behaviour
   - STARs tested at simulator with Pegasus FMSs
   - Increase margin over waypoints?

3. Use of existing waypoints
   - No different speed or altitude constraints shall be required for CDA STARs if they are not required for conventional STARs
• ANS point of view
  - **It is not easy for the ATCOs to control mixed flights** (this affects the implementation plan)
  - Sometimes routes are not ideal:
    - Starts at TMA entry
    - Sometimes shorter to vector from FIR border
    - Up to the pilot to fly it as CDA
    - **Discussions to be held with pilots to solve this**
    - Use of “distance to touchdown” methodology to be studied before implementation
  - **Noise impact or reduction is hard to estimate**
    - Monitoring stations located in the vicinity of the airport, mainly at Final Approach
  - CDAs better for controllers due to minimum altitudes at WPTs
    - It helps the controller to provide vertical separation between departing and arriving aircrafts without much communication
    - **CDAs STARs are better than “radar vectoring + distance to touchdown”**
REACT-CR: Lessons learnt

• Implementation of CDAs is very attractive, but:
  - CDA from ToD difficult to achieve
  - Pilots and ATCOs might be “conservative”: CDAs are not mandatory
  - Considerable differences between aircraft’s avionics: some of them cannot fly CDAs

• Recommendation: DO IT STEP-BY-STEP
  - Prague example
    • Start from FL70 or IAF
    • Learn how to deal with them
    • Go for more complex operations: departures, ToD, CDA startings at different FIRs...

• Recommendation: EVERY MILE COUNTS
  - Fly “CDA-like” whenever possible, even if operation is interrupted later
  - Not necessary to get to touchdown
• Benefits have been estimated at about **65kg of fuel savings per A319 or A320 flight** and about **96kg of fuel savings per A321 flight**
  - In average about 200 and 300 kg of CO2 per arrival

• **Annual extrapolations** of CO2 savings for CSA are potentially about **2,080 tons**
  - Approximately €500,000
Index

1. ICAO Guidance Material

2. Practical Examples
   - REACT-CR
   - REACT Plus

3. CDOs Inception Phase
REACT-Plus: Overview

• Project objective:
  – To get to a pre-operational stage where Continuous Descent Approaches and Continuous Climb Departures can be flown at Budapest airport by Wizz Air
    • Introduction of more efficient operational procedures inside an airspace terminal area
    • Awareness regarding the environmental benefits that this and similar activities inside AIRE demonstrate
    • To reduce fuel consumption and CO2 emissions

• On-board, procedures shall rely on present aircraft capabilities

• Target number of flights:
  - 300 standard operations (200 arrivals + 200 departures)
  - 300 enhanced operations (200 CDAs + 100 CCDs)

• Publication on Hungarocontrol AIP (AIC):
  - Since 1st March 2013, CDAs and CCDs are being tested for traffic to and out of Budapest Airport, with the main objective of reducing CO2 emissions
React-Plus: Merge Strip

- No application of any of the solutions proposed in the ICAO CDO manual
- Hungarocontrol adapted the Point Merge concept and created the Merge Strip.
Index

1. ICAO Guidance Material
2. Practical Examples
3. CDOs Inception Phase
Inception Phase: Capitalising Best Practices

Give support to the Stakeholders on:

<table>
<thead>
<tr>
<th>Objective:</th>
<th>Action:</th>
</tr>
</thead>
</table>
| Development of STARs CDO and SIDs CCO procedures over the selected airports | • Experts Working Sessions  
• Creation of an Integrated Team  
• Procedure design |

<table>
<thead>
<tr>
<th>Objective:</th>
<th>Action:</th>
</tr>
</thead>
</table>
| Safety analysis to put in place the new procedures | • Experts Working Sessions  
• Integrated Team  
• Safety file |

<table>
<thead>
<tr>
<th>Objective:</th>
<th>Action:</th>
</tr>
</thead>
</table>
| Sensibilisation and training of ATC and pilots | • Validation exercise  
• Training Workshop |
Study of the CDA Applicability at Sofia Airport

- **Operational Assessment**
  - CNS/ATM analysis
  - Air Traffic analysis
  - Analysis of practices

- **Training: CONOPS and methods**
  - Definition of Implementation Group
  - Understanding and harmonisation

- **Joint Agreement on preferred implementation**
  - Definition of CDO facilitation method
  - Safety Considerations

- **Cost-Benefit Analysis**
  - CNS/ATM enablers and savings derived from chosen method
  - CDO Implementation benefits and costs
  - Simulations (OPTIONAL)

- **Stakeholders Workshop**
  - Final workshop with BULATSA, CAA and airlines

---

Combined ICAO EUR PBN TF and Eurocontrol RAiSG – 11th-13th September 2013
Combined ICAO EUR PBN TF and Eurocontrol RAiSG
Paris, France, 11-13 September 2013
Inception Phase: Capitalising Best Practices

- The proposed solution will allow Stakeholders:
  - To familiarize with CDO&CCO technical and safety elements
  - To acquire knowledge and experience on its future operational implementation
- A validation plan with airliners in the loop would allow testing the new profiles in a pre-operational environment
- Activity aligned and in compliance with the generic Implementation flowchart defined within the guidelines for implementing Continuous Descent accepted by ICAO