A-CDM Benefits & Network Impact Study

A-CDM Information Exchange – Preliminary Findings

Denis HUET
Simon PICKUP
22nd September 2015
Agenda

- Study Objectives
- Airport Factsheets
- Local Benefits
- Network Assessment Approach
- Network Assessment Findings
- Next Steps
Study Objectives

- Update March 2010 A-CDM Network Impact Assessment
  - 16 CDM Airports. More to come.
  - SESAR focus on APOC developments
  - New EU Performance Scheme

- Produce a consolidated list of verified local A-CDM benefits
  - Absolutely no benchmarking between airports.

- Understand operational enablers that lead to the realisation of A-CDM benefits

- Provide opportunity for airports to voice their achievements and challenges

Communicate findings to the community
Structure of Study

2 main phases of the study:

1. Review of local benefits at CDM airports
   - On-site visits to 16 fully implemented CDM airports
   - Acquire information on tangible and quantifiable benefits
   - Understand operational context

2. Analysis of A-CDM on the network
   - Refine assumptions from previous study
   - Challenge previous conclusions based on improved model inputs
   - Analyse any other impacts on the network
Airport Engagement – Local Benefits

- A-CDM Airports have actively engaged in the project across 3 phases:

  - Phase 1 – Information Gathering
    - On site operational review (including ATC)
    - Data acquisition where possible

  - Phase 2 – Factsheet Generation
    - 4 sheet operational summary
    - Supporting operational analysis report

  - Phase 3 – Factsheet Review
    - Factsheet content critically reviewed in a second on site meeting
    - Quantitative data analysis presented back to the airport in support of benefit claims
Factsheet Development

- Factsheets intend to describe in 4 pages:
  - Operational Overview
  - CDM Process Fundamentals
  - Qualitative & Quantitative Benefits

- Aimed to be as balanced as possible, reflecting the positives and negatives of each A-CDM implementation.

- Some airports have supported detailed analysis to validate benefits reported in the factsheets.
  - Statistical analysis as part of bespoke analysis report for those airports.
Local A-CDM Benefits
Local Benefit Realisation – First Lesson Learnt

Information Sharing + Procedural Adherence = Benefit Mechanisms

Benefit Mechanisms + Operational Characteristics = Realised Benefits
A-CDM Benefit Mechanisms

Technical Enablers
- Local Radar Integration
- FUM / EFD Integration
- Taxi-In Time Accuracy

Information Sharing
- ICAO / IATA Flight Matching

Procedural Enablers
- TOBT Accuracy
- TOBT Stability
- MTTT Accuracy
- TSAT Adherence

Arrival Predictability SUPPORTS Off-Block Predictability ENABLES Take-Off Predictability

- De-Icing Timestamp Accuracy
- Estimated De-icing Time Accuracy
- Taxi-Out Time Accuracy
Arrival Predictability

Benefits observed from improved in-block estimates
Arrival Predictability Benefits

- Reduction in the number of late stand changes
  - Oslo recorded 750 fewer ‘late’ stand changes the year after implementation.
  - Passenger experience has improved
  - Off-block punctuality is protected

- Improved estimated landing time accuracy supports stand planning functions.
  - Madrid has integrated ELDT updates into stand planning software:
    - Automatic stand contention detection
    - Optimisation of stand capacity during peak hours

- Situational awareness of arrival flow improves
  - Fewer ‘surprises’. Diversions / anomalies are detected sooner
  - AO / GH provided better information earlier to facilitate tail swaps / cancellations

- Supports off-block predictability
Arrival Predictability Benefits – Operational Enablers
Off-Block Predictability
Operational impacts of the TSAT Procedure
Target Start-up Approval Time (TSAT) Overview

- TSAT procedure is the mechanism for **transparent** and **flexible** pre-departure planning

- TSAT Procedure supports:
  - Elimination of NM generated departure regulations
  - Ground asset allocation by known start-up time
  - Accountability for start-up and push delay
  - On-stand delay absorption (‘green delay’)
  - Optimisation of the runway departure sequence
Benefits of TSAT Procedure

Taxi-time / Apron Movements

Start-up / Push Delay

Recovery Time

ATC Planning Workload

Peak Departure Rate

Operational Resilience
Faster Recovery from Adverse Conditions

- Phantom start-up delay reduced
  - ATC handling ‘real’ flights only!

- Optimum departure mix facilitated

- 60 departures realised 20 minutes sooner

- Significant benefits for delays, cancellations and night programme usage

**Average Duration to achieve departing ATM’s after a period of adverse conditions at LHR**

PRE-CDM = 120 mins

POST-CDM = 100 mins
Departure Rates

- A-CDM airports have shown to operate at a higher departure rates
- Achieved with no increase in runway buffer
Departure Delay Causes

- GH Constraints
- ATC Workload
- En-route / Airport Restrictions
- Late Inbounds
- Local ATC Constraints
Delay Improvement

- CDM Airports tend to show ‘tightening’ of start-procedure
- Leads to reduction in off-block delay at medium levels of congestion
- Benefits tend to disappear at higher levels of congestion
  - TSAT Delay takes hold
Start-up / Push Delay Examples

Push Delay - EFHK

Start-up Delay - EGLL

A-CDM Benefit & Network Impact Study – Preliminary Results
ATFM Delay – Destination Airport Restrictions

Average Airport Restriction ATFM Delay by CDM Flight Proportions

- Number Regulations
- AV Delay - CDM
- AV Delay - NON CDM

Percentage of Flights from A-CDM Airports

Average ATFM Delay per Regulation

Number of Regulations

3 mins
ATFM Delay – Enroute Restrictions

Average Enroute ATFM Delay by CDM Flight Proportions

Percentage of Flights from A-CDM Airports

- NUMBER REGULATIONS
- AV DELAY - CDM
- AV DELAY - NON CDM

Number of Regulations

Average ATFM Delay per Regulation

2 mins
ATFM Delay Probability by CDM Proportions

Probability of receiving ATFM Delay > 30 mins

Probability of receiving ATFM Delay > 40 mins

30 minute delay probability

40 minute delay probability
DPI Integration – T-DPI-t Impact (Preliminary Observations)

- Some airports show immediate and significant reduction in ATFM delay on DPI connection
- Effect is very pronounced for airports generating TOBT based on inbound landing time estimations
- Similar improvements also observed where TOBT accuracy and stability improves
- Strong evidence for the effectiveness of early delay publication via T-DPI-t
Provisional Fuel & Emissions Savings – 10* CDM Airports

Based on 1,300,000 departures...

15,000 tonnes of Fuel Burn

47,500 Tonnes of CO₂
12,500 kg of SO₂

1,600,000 Minutes of Taxi

11.7 million in Fuel

*5 airports verified
Taxi Time Benefit ‘Hurdles’

- TSAT Adherence
- TSAT Quality
- Acceptable levels of delay
- Re-sequencing flexibility
- Runway demand + type mix
- Remote de-icing capacity
- Work in progress
- Stand Capacity

TANGIBLE SAVINGS
Winter Operations Resilience

- De-icing pads readily form capacity bottlenecks for the airfield.

- Holdover restrictions also constrain departing runway options.

- Poor situational awareness of upstream demand, de-icing capacity and runway availability leads to:
  - Excessive taxi times
  - Holdover violations
  - Poor asset utilisation

- TSAT mechanism integrates GH, ATC and de-icing coordinator views
  - Increased runway utilisation
  - Fewer holdover violations
Take-Off Predictability

Enabler of Network Benefits
Take Off Predictability

- Take-Off Accuracy is key enabler of network benefits
- It drives improved tactical decision making and ETFMS / CASA flexibility

All CDM airports have shown:
- A significant reduction in the standard deviation of TOT accuracy
- Convergence of average TOT accuracy close to 0.
- Dramatic (80%+) improvements during adverse conditions
AIRAC 1507 Take-Off Accuracy Performance

TOT Accuracy Increasing

Standard Deviation Decreasing

Non DPI airports

DPI airports

A-CDM Benefit & Network Impact Study – Preliminary Results
Take-Off Time Predictability Benefits

- Significant reduction of Flight Activity Monitoring suspensions
- Enabler of Single Engine Taxi Operations - LHR
- Improved ATFM Slot Utilisation
- Reduction in ATFM delays
- Improved sector traffic load accuracy + predictability…
- Enables enroute capacity buffer reductions…
A-CDM Network Impact Study

Understanding the influence of improved take-off predictability on the network
Approach

- Determine how the improvement in take-off predictability effects the probability of sector over-delivery
  - Convert into potential capacity buffer reduction
  - Considers both Advanced ATC Tower and A-CDM airports

- Generate a European trajectory model based on real ETFMS archives
  - Based on previous NEST (NEVAC) study in 2010

- Take-off time accuracy assumptions refined
  - Previous study used MUC Take Off Accuracy results for a CDM airport

- Results generated at the ECAC and ANSP level
NEST Simulation Principle

EDDUAR 08:00 – 09:00

CDM / ADV TWR Airport
Improved Take-off Accuracy

ECAC Wide Overdelivery Counts

A-CDM Benefit & Network Impact Study – Preliminary Results
Over-delivery Probability Reductions – 30 DPI Connected Airports
The aim of the analysis was to see how the ratio of DPI flights on sector entry streams would impact sector over-deliveries.

2 ‘Modes’ of DPI stream saturation considered. ‘Uniform’ and ‘By Stream’

**Sector Stream Fast Time Simulation**

- **By Stream**
  - 1. 0-100%
  - 2. 0-100%
  - 3. 0-100%
  - 4. 0-100%
  - 5. 0-100%

- **Uniform**
  - 1. 10%
  - 2. 10%
  - 3. 10%
  - 4. 10%
  - 5. 10%
  - 6. 20%
  - 7. 20%
  - 8. 20%
  - 9. 20%
  - 10. 20%
  - 11. 30%
  - 12. ...
Simulation Results – Saturation Modes

“The response of an individual sector to improved take-off predictability is highly dependant on sector location and the ratio of flights from DPI connected airports feeding each stream”
Combined Mode Simulation Results

CDM TOT Standard Deviation = 3 mins

CDM TOT Standard Deviation = 5 mins

60% CDM Flights

A-CDM Benefit & Network Impact Study – Preliminary Results
Sector Over-delivery Probability by DPI Flight Saturation

- Stream dependant improvements. Over-delivery probability could increase.
- Reliable (but small) Improvements
- Strong Stream Independent Improvements
- Benefit plateau
Link to 2010 Results (ECAC Wide)

# CDM Airports

16  30  75

2010 Study
2015 High (SD3)
2015 Low (SD5)
A-CDM Network Study Conclusions

- There is a clear impact of A-CDM / ADV TWR adoption on reducing sector over-delivery probabilities.

- After 60% of CDM flights in the sector, improvements are most dramatic.

- Between 0 and 60% CDM flights, sectors could become more susceptible to clustering.

- Tangible network improvements are starting to be realised at 16 A-CDM airports
  - Faster improvements expected between 16 and 30 A-CDM airports than previously predicted.

- Benefits plateau at ~ 50 A-CDM airports between 3.5 and 5.5% - lower than previously estimated.
Next Steps

- Study to be completed in January 2016
- More airports to provide benefit feedback over the coming weeks
- Final report will comprise:
  - Local description of ACDM implementation, including qualitative and quantitative benefits.
  - Impact on network activities
  - Per airport A-CDM Factsheets
Questions ?