Types of scenarios to be addressed with ABM

CASSIOPEIA +

Complex Adaptive Systems for Optimisation of Performance in ATM

DCI-4HD2D

UNIVERSITY OF WESTMINSTER

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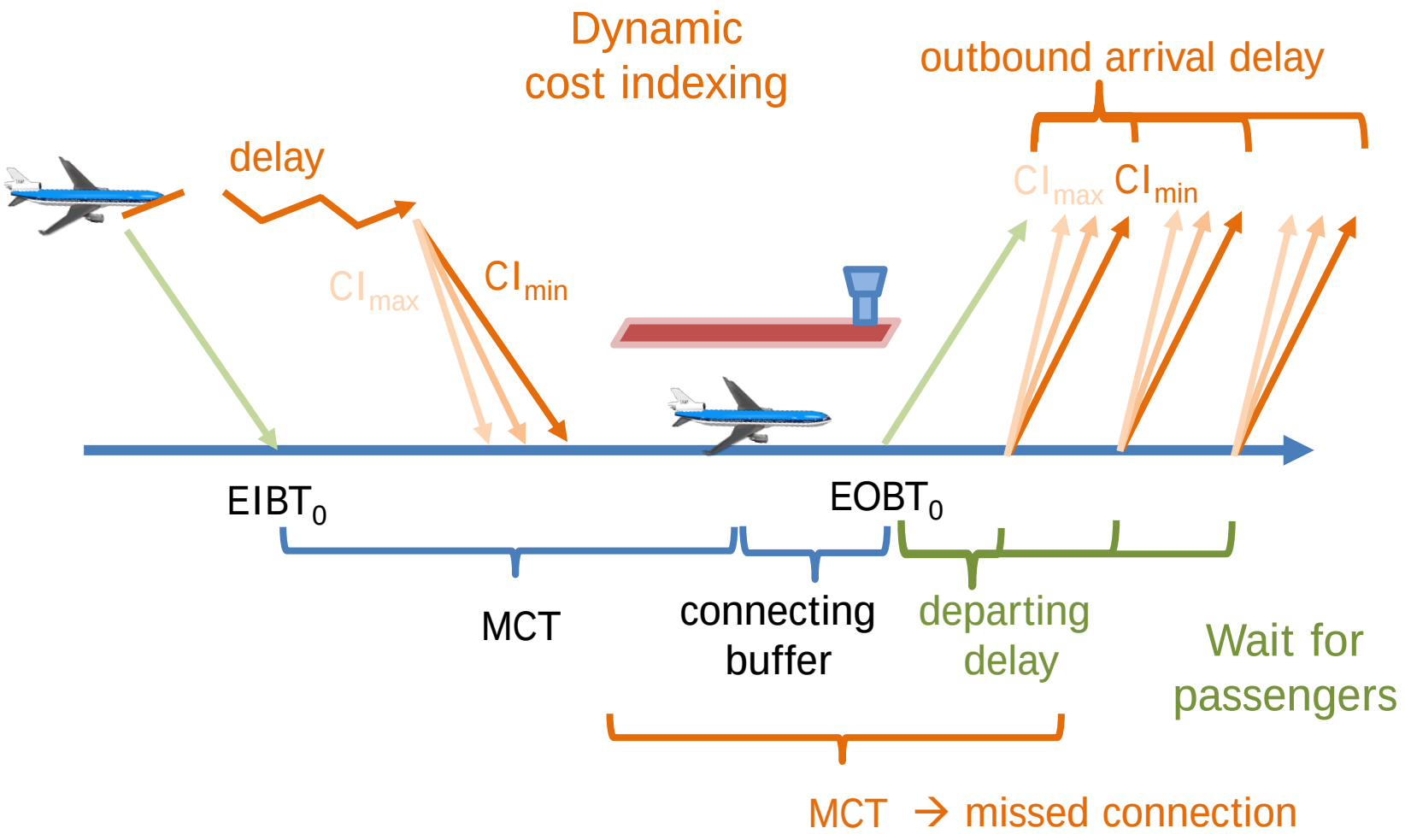
Hub operations: Delay recovery based on cost optimisation

Thursday at 9h00 → Economics session (Lecture room B)

Problem statement



Problem statement

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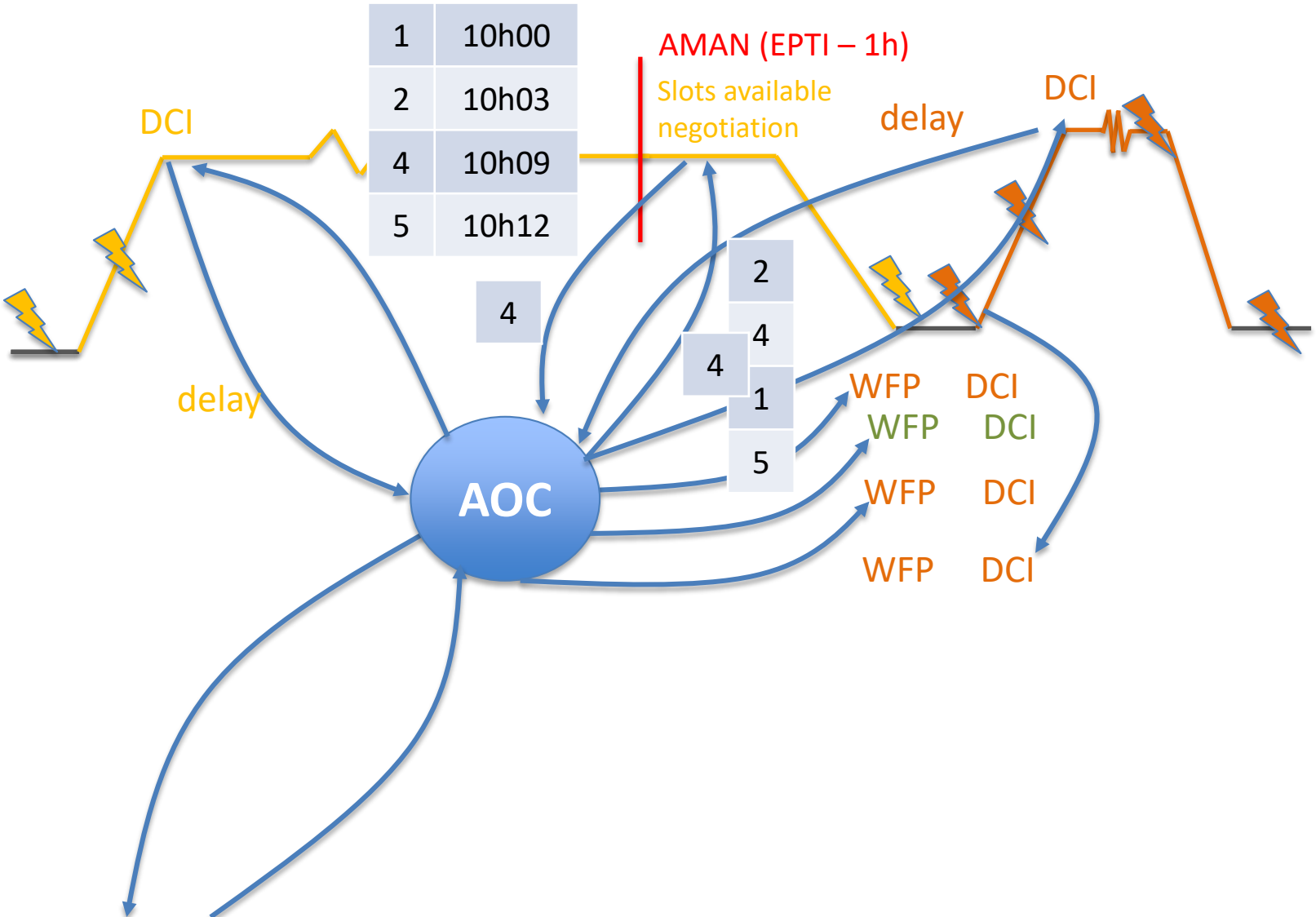
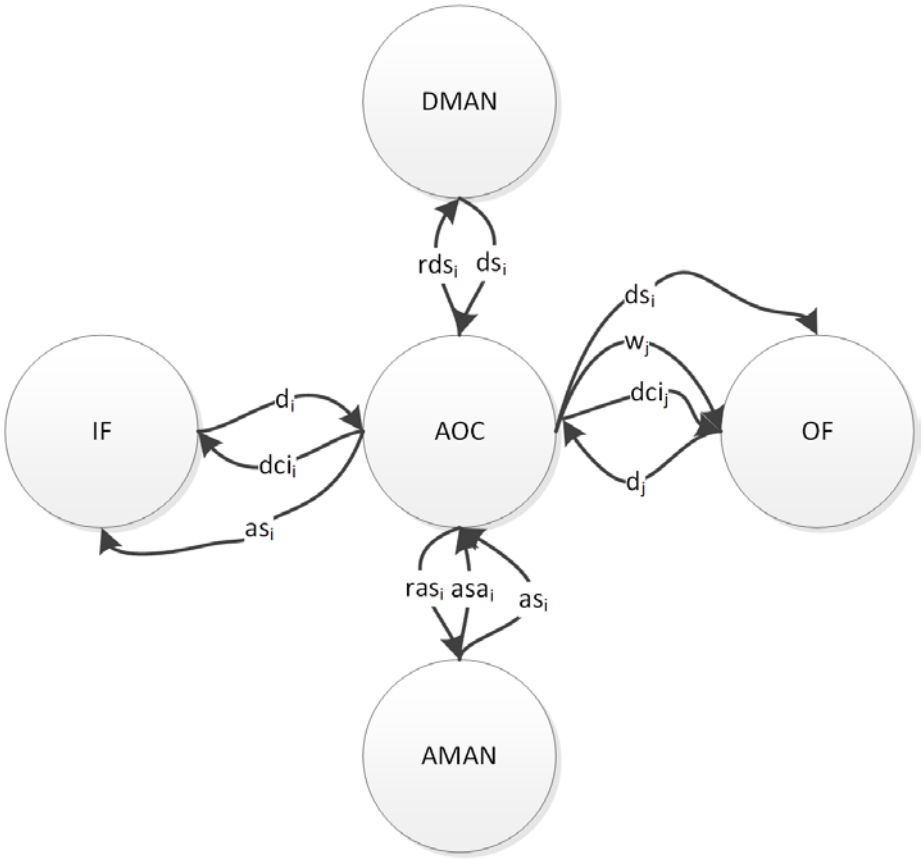


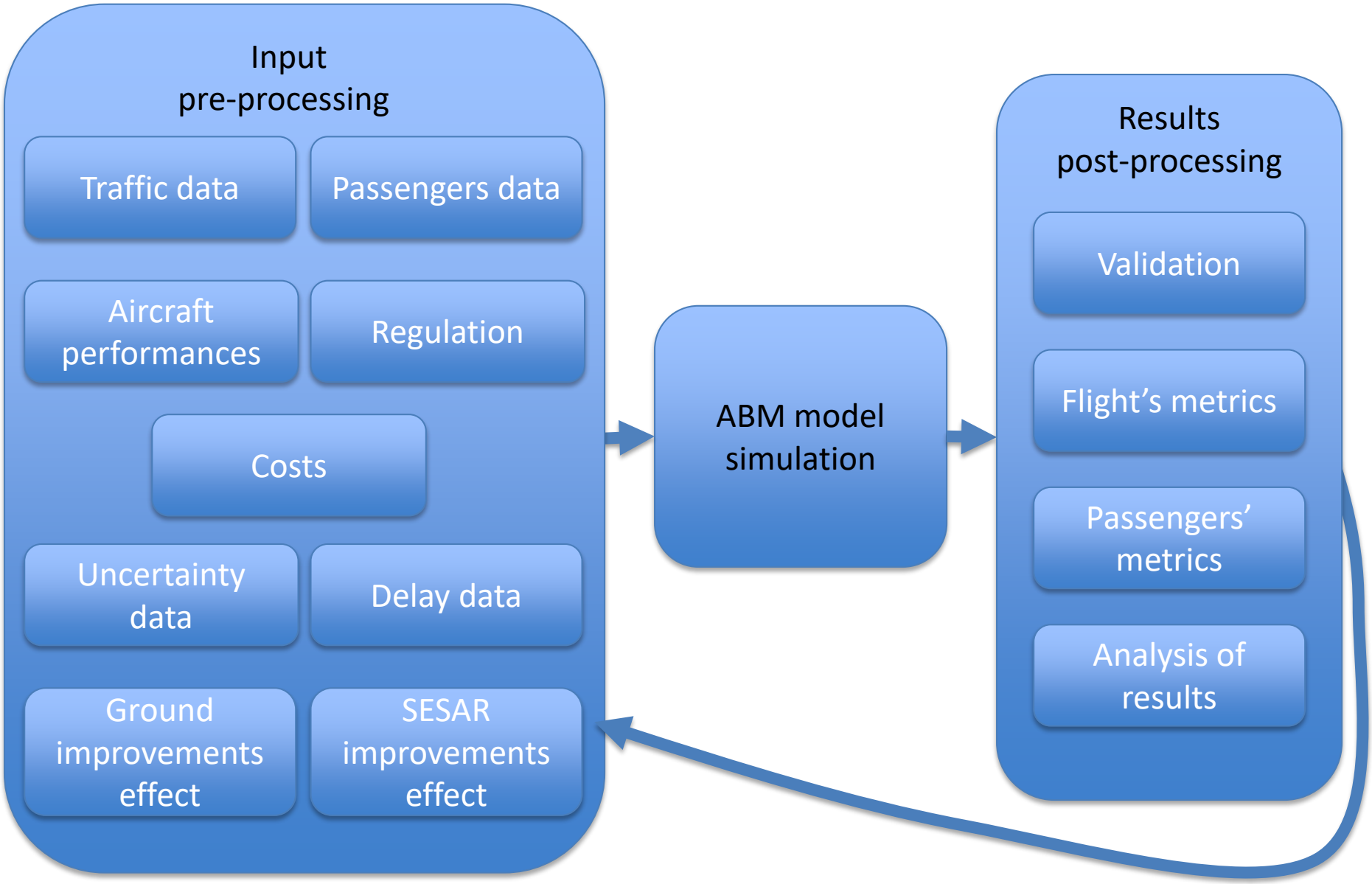
Agents and their interactions



High-level objectives

- Model operations at a hub allowing two strategies
  - Dynamic cost indexing (DCI)
  - Wait-for-passengers (WFP)
- Analyse effect of these strategies considering
  - Delay and uncertainty at different levels
  - DCI for inbound and outbound flights at TOC
  - E-AMAN with slot negotiation capabilities
  - Different temporal frames: current operations, ground improvement and SESAR and ground improvements

High level processes



Data input characteristics

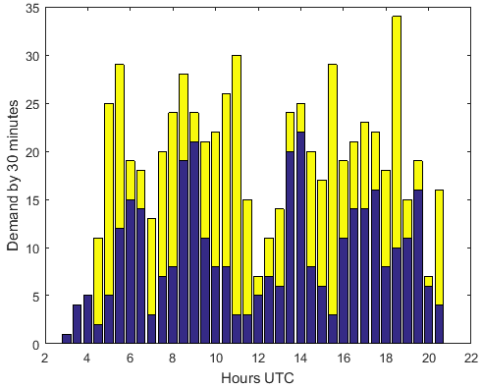
- Traffic data
  - Baseline traffic 2010 (based on busy Friday 2010)
  - Data sources
    - Flight schedules from PRISME
    - Flight trajectory and phases based on so6 data file
    - Nominal speed from BADA (adjusted for short flights)
    - Airbus PEP for effect of CI variations on trajectory
    - CFMU and post-operational taxi times
    - CODA delay data

Data input characteristics

- Traffic data
  - Baseline traffic 2010 (based on busy Friday 2010)
  - Data sources
  - Data estimation
    - Taxi times and arrival buffers
    - MTT and turn around buffers
    - Average cruise wind
    - Flight plan variation due to use of DCI

Data input characteristics

- Traffic data
  - Baseline traffic 2010 (based on busy Friday 2010)
  - Data sources
  - Data estimation



Data input characteristics

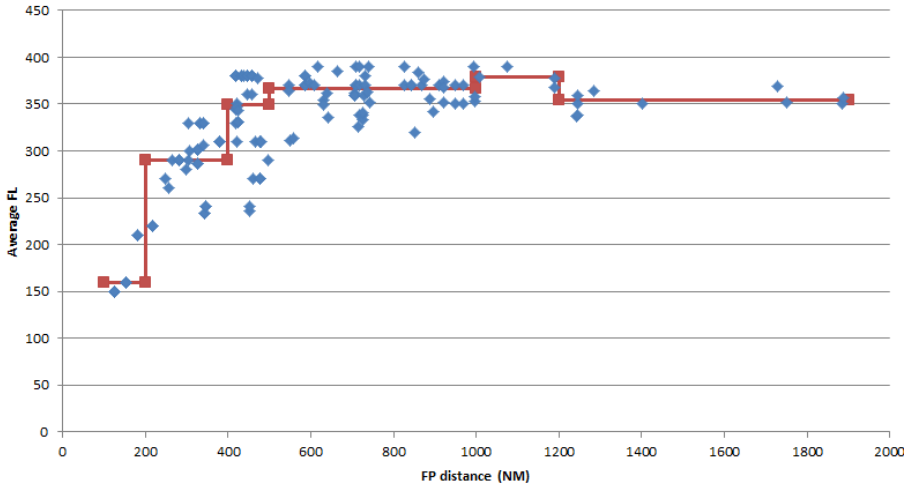
- Traffic data
- Passengers data
  - Passenger itineraries from anonymised airport data
  - Minimum Connecting Time

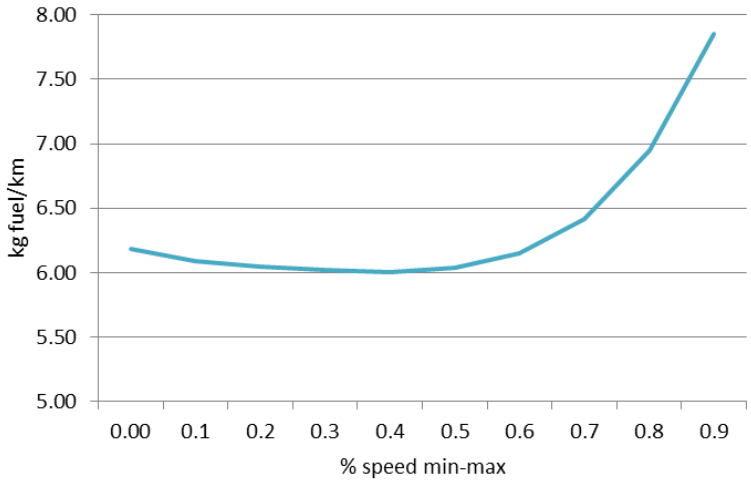
Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
  - BADA

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
  - BADA
  - Data estimation
    - Flight level
    - Reference average cruise weight
    - Reference speed
    - Minimum and maximum speed





Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
  - Data sources
    - Reg. 261
    - Consultation

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
  - Data sources
  - Data estimation
    - Claim uptake

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
  - Cost of delay
  - Cost of fuel

Data input characteristics

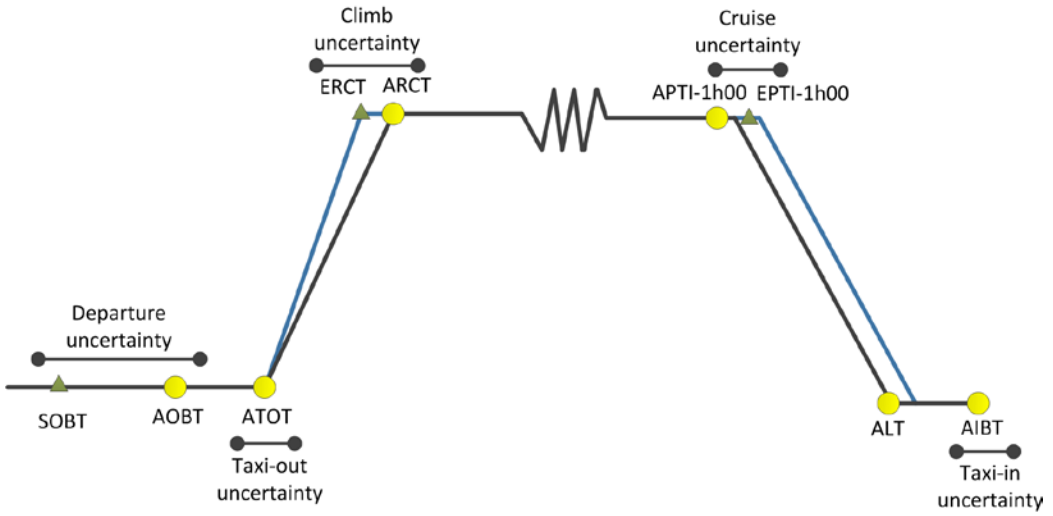
- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
  - AIRAC 1313-1413 DDR2 data (m1,m3)

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
  - AIRAC 1313-1413 DDR2 data (m1,m3)
  - Data estimation
    - Taxi in – out uncertainty
    - Climb uncertainty
    - Cruise uncertainty

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
  - AIRAC 1313-1413 DDR2 data (m1,m3)
  - Data estimation



Data input characteristics

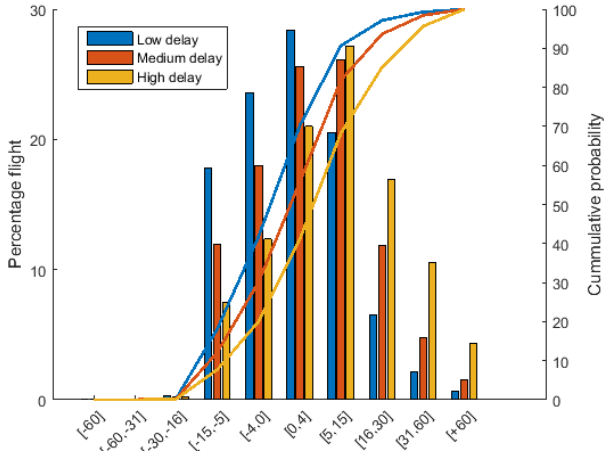
- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
  - Data sources
    - CODA
    - Airport post operational data

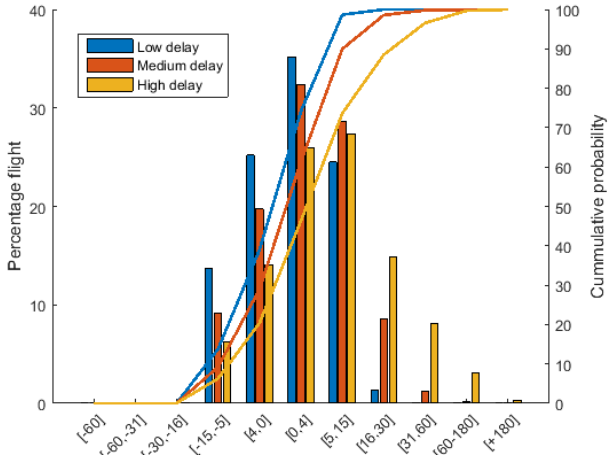
Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
  - Data sources
  - Data estimation
    - Departure delay distributions

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
  - Data sources
  - Data estimation





Data input characteristics

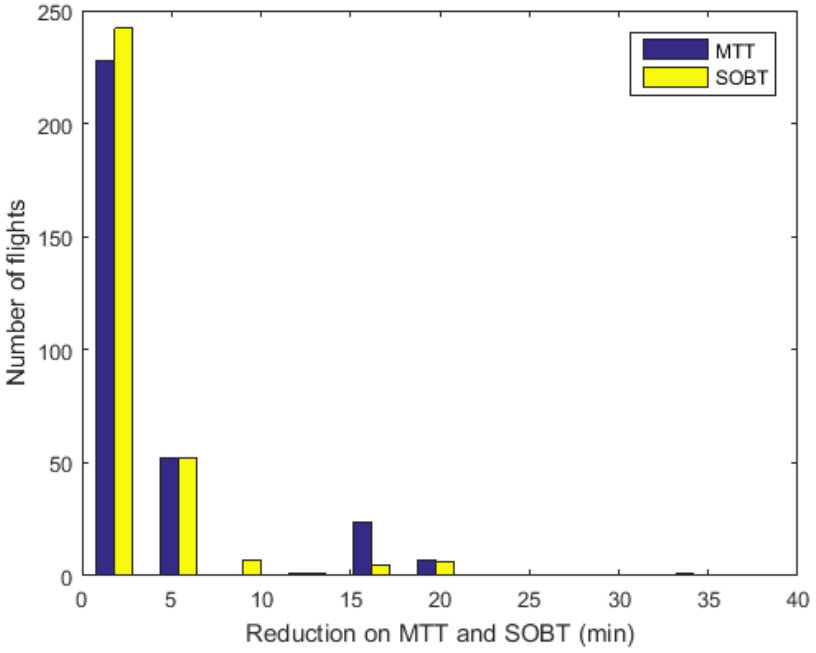
- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
- Ground improvements
  - Literature review

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
- Ground improvements
  - Literature review
  - Data estimation
    - MTT reduction
    - SOBT modification

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
- Ground improvements
  - Literature review
  - Data estimation

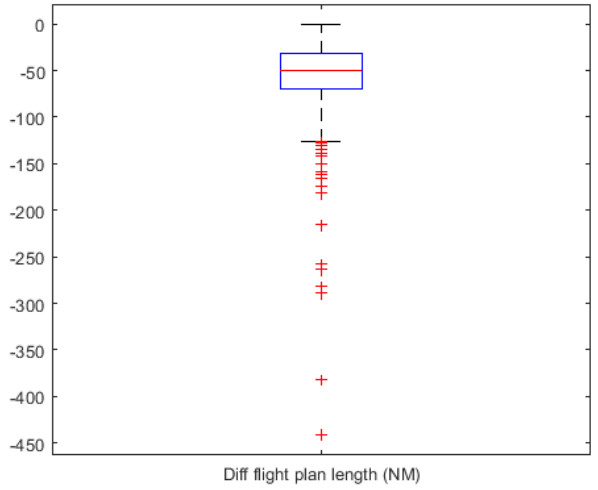


Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
- SESAR improvements
  - Literature review
  - Data estimation
    - GCD routes
    - SIBT and SOBT modified

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
- SESAR improvements
  - Literature review
  - Data estimation



Reduction FP length

Data input characteristics

- Traffic data
- Passengers data
- Aircraft performances
- Regulation
- Costs
- Uncertainty
- Delay
- SESAR improvements

Scenario design

- Variables considered for the cases of study
  - Air traffic
    - 2010
    - Ground
    - SESAR and ground
  - Fuel cost
    - Nominal
    - High
  - Optimisation strategy
    - Baseline
    - Cost optimised
    - Cost optimised with high claim uptake
  - System delay
    - Low
    - Medium
    - High

Scenarios considered

Scenario variable	Option 1	Option 2	Option 3
Flight database (FD)	2010	Ground improvements	SESAR and ground improvements
Fuel cost (FC)	Nominal	High	-
Strategy applied (SA)	1	2	3
Delay (ID)	Low	Medium	High

54 scenarios to test

Problem size

- One hub
- 676 flights (336 inbound, 340 outbound)
- 61,446 passengers' itineraries
  - 11,570 connecting (18.9%)
  - 73,016 passengers' legs
- Complexity
  - For each outbound there are in average 12 inbound feeding it
  - For each inbound there are in average 13 outbound being feed
  - With 10 possible CI → ~10^{18} possible options