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Investigation into ‘irrational’ airline strategies

Exploring ground operations as crucial control element in airline networks

SESAR Engage /// Thematic Challenge 4 Workshop – Madrid

12 November 2019

Problem Statement

- To maintain safety, the European air traffic flow management (ATFM) function can impose ground delay on some flights
- For ATFM, all flights are **equal** and are given delays in accordance with the **first planned first served** principle
- But for airspace users, all flights are **unique**

UDPP
to provide appropriate measures ?

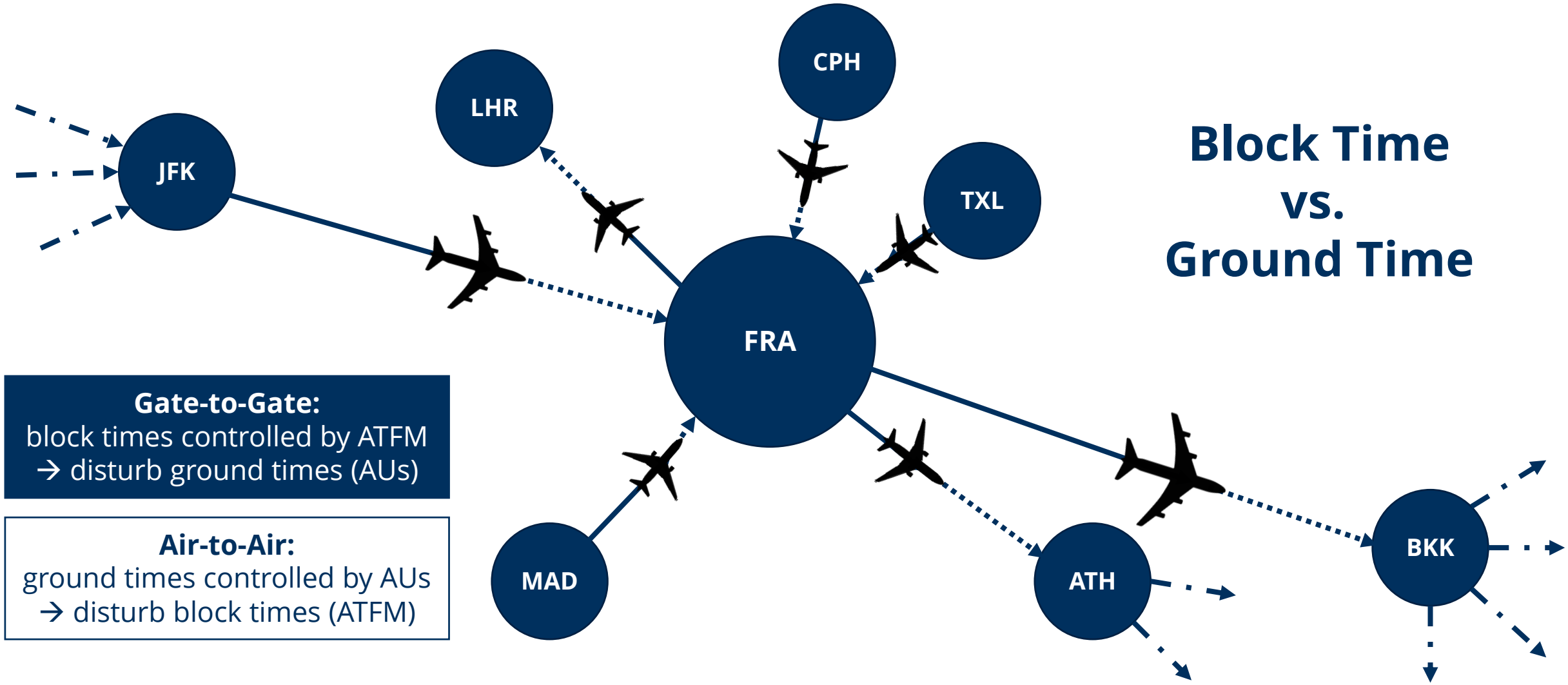
We believe:

Airline Behavior is rational
→ might only seem irrational viewed from outside ('black box')

Kirby & Pilon (2017) – ATM Seminar

Network Operations

Airlines' Value of Flight: The Origin-Destination-Perspective (Connections)



Block Time vs. Ground Time

Gate-to-Gate:
block times controlled by ATFM
→ disturb ground times (AUs)

Air-to-Air:
ground times controlled by AUs
→ disturb block times (ATFM)

Network Operations
Performance Review

Research heavily focused on ATFM although ground operations cause larger share of average delay

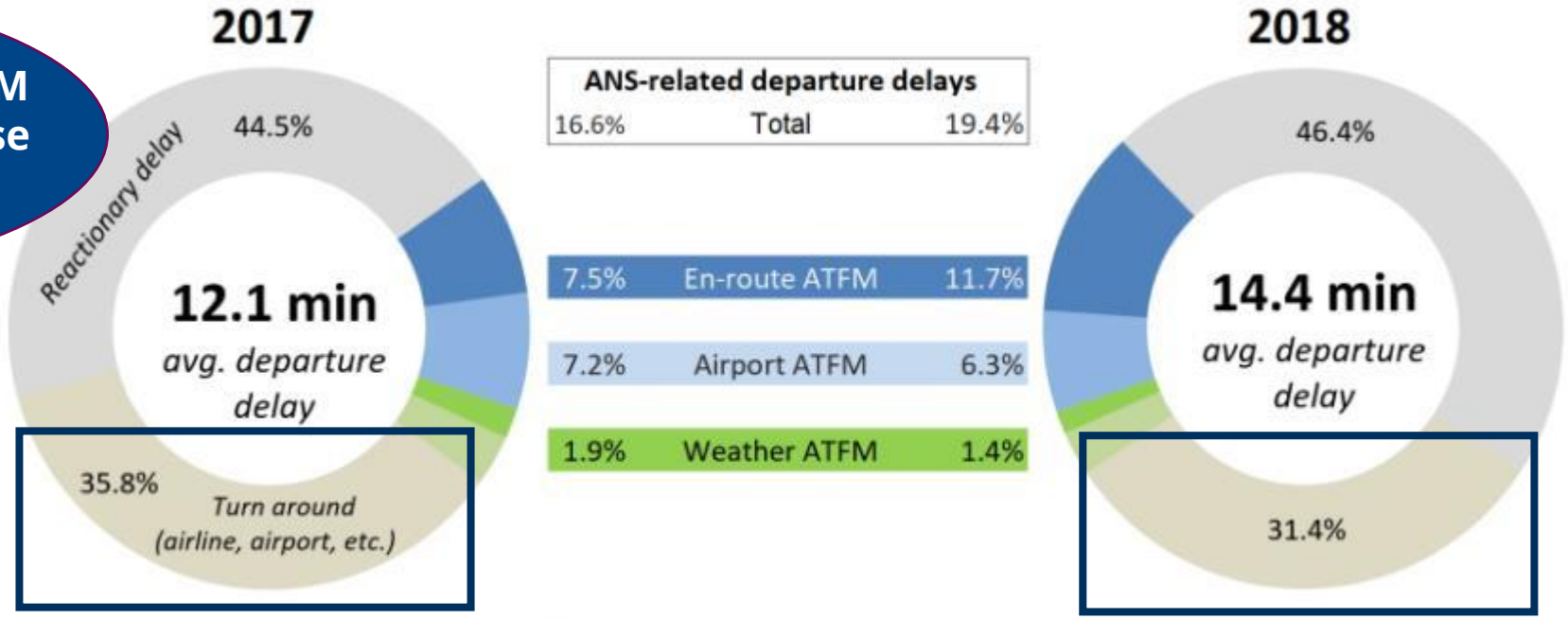


Figure 1-15: ANS contribution towards departure total departure delays

Source: Eurocontrol PRR (2018)

FCFS

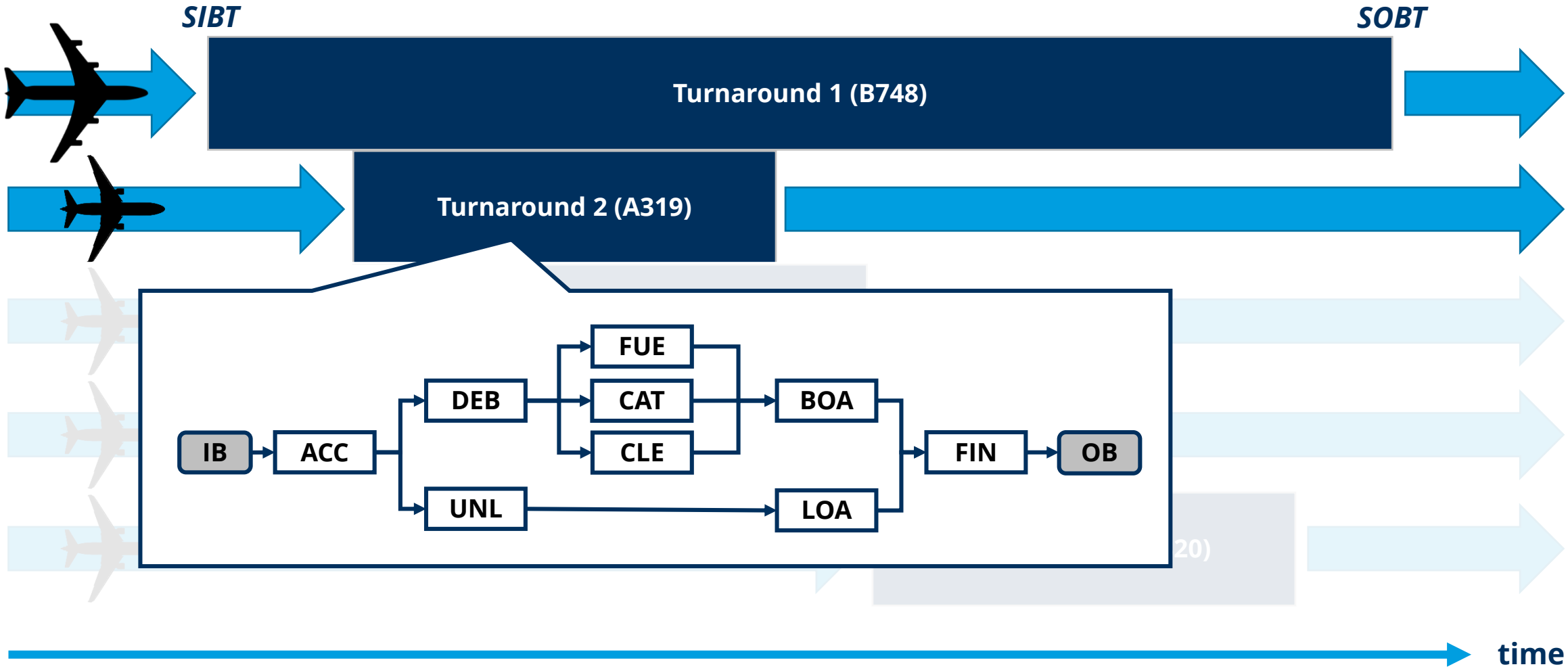
Gate-to-Gate:
block times controlled by ATFM
→ disturb ground times (AUs)

Air-to-Air:
ground times controlled by AUs
→ disturb block times (ATFM)

UDPP

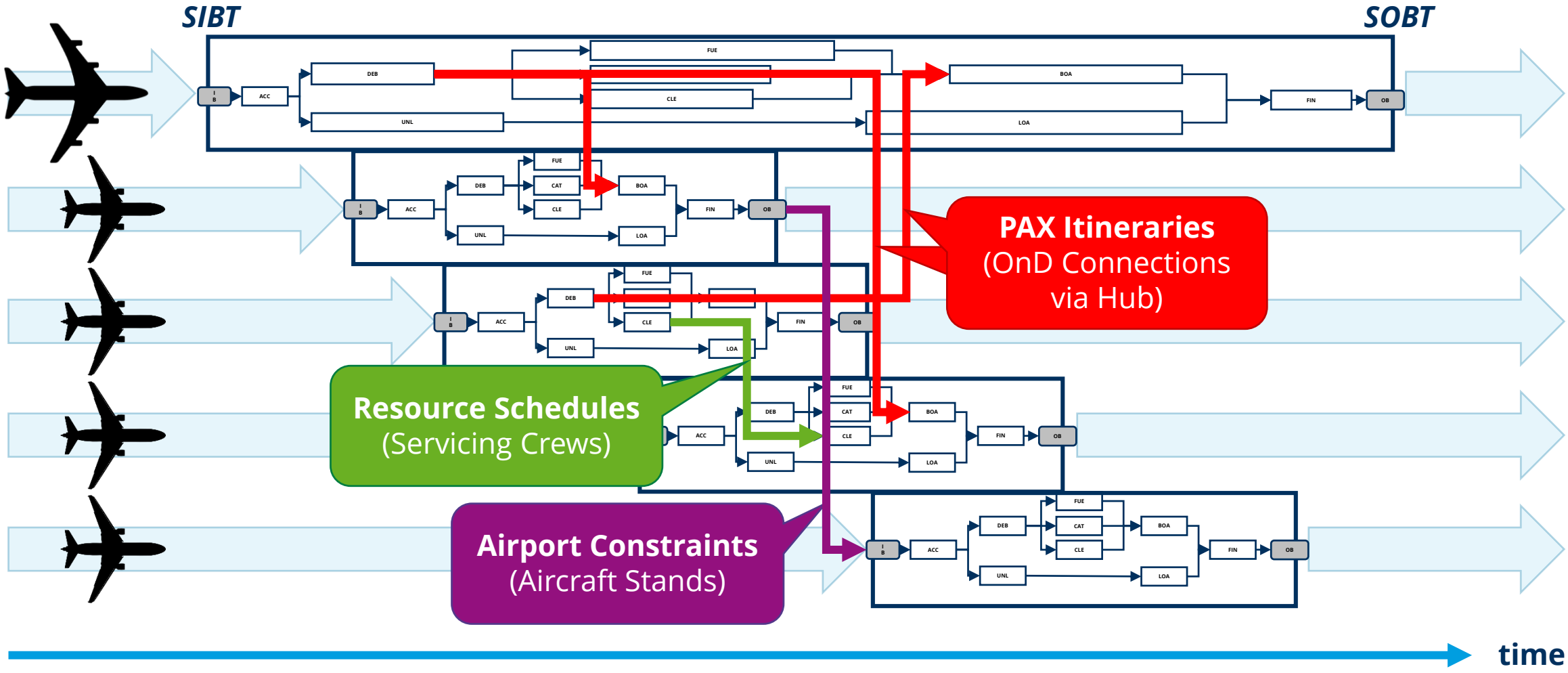
Air-to-Air Perspective on Network Operations

Focus on Business Trajectories (Aircraft Rotations) Instead of Single Flights



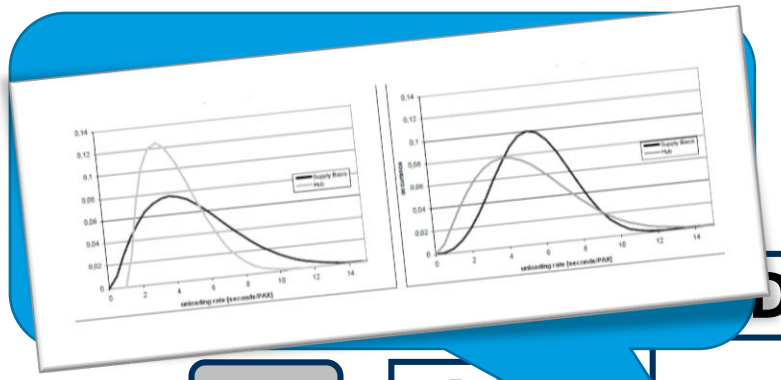
Air-to-Air Perspective on Network Operations

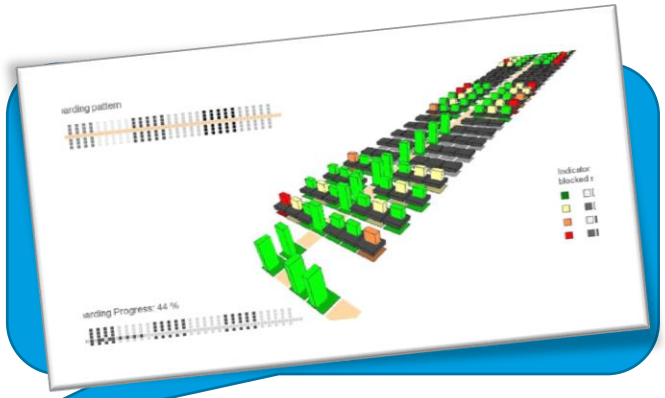
Integration of Passenger, Crew, Resource and Maintenance Dependencies



IFL Research Focus on Airport Operations

Stochastic and Microscopic Process Modelling



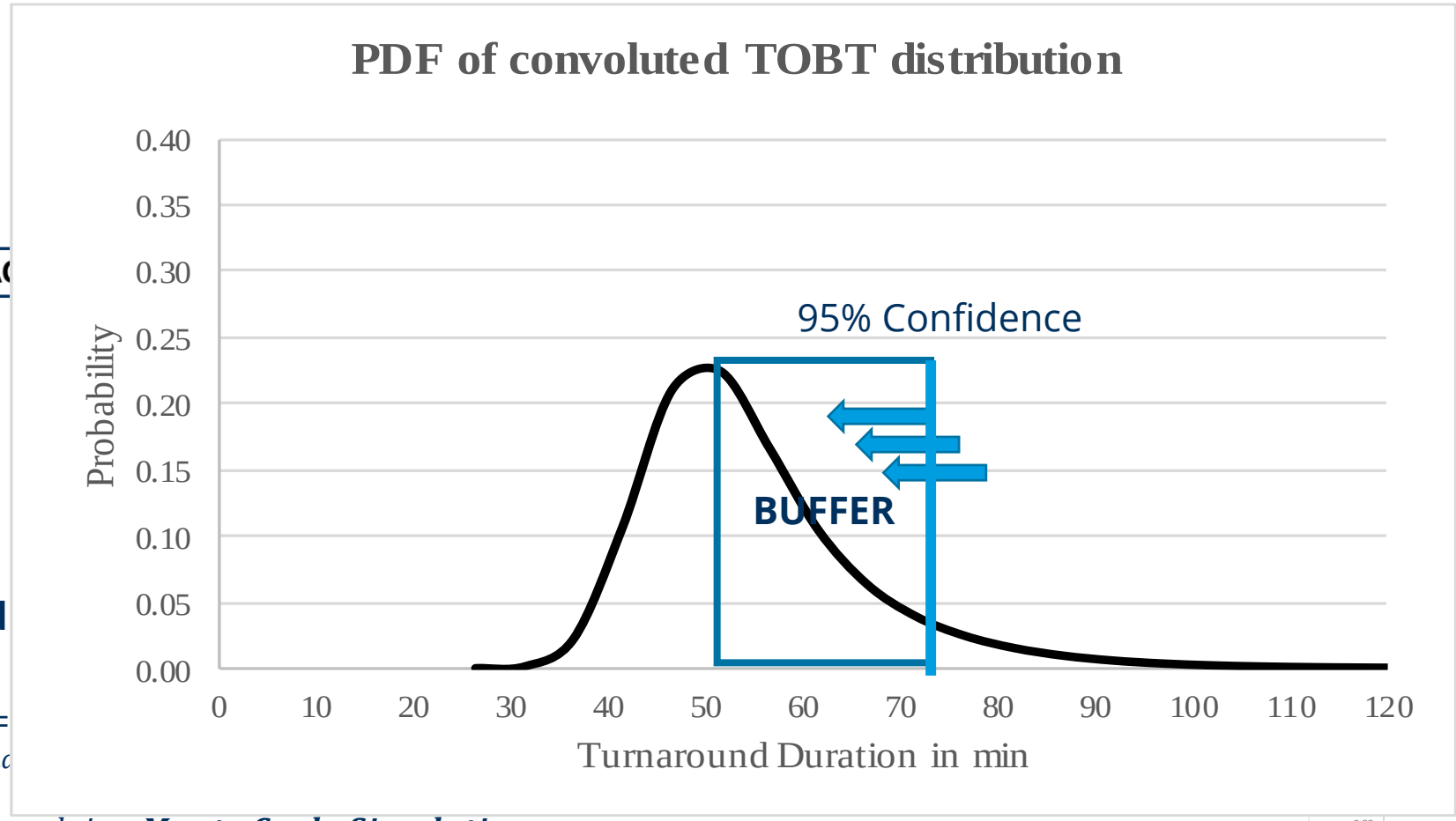


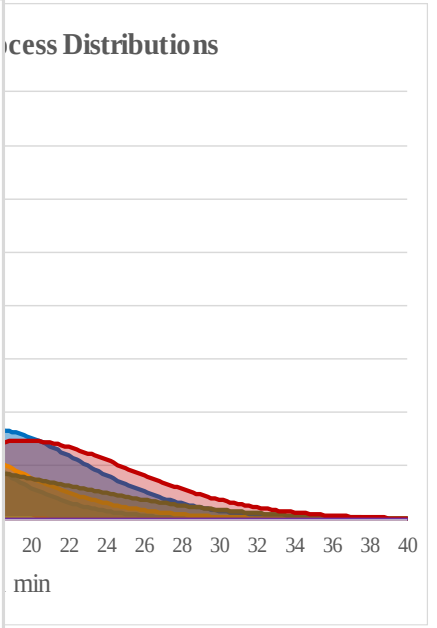
A320 GOM
MinGT = 45min
Seems simple?!

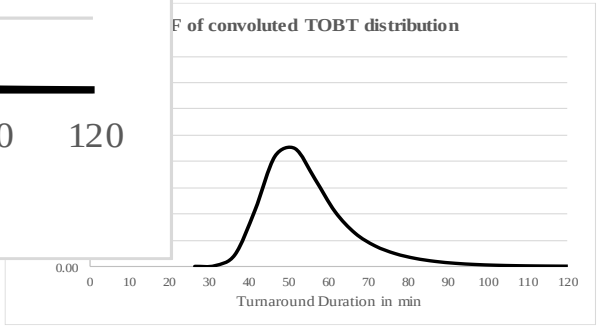
- Fricke & Schultz (2009) – Delay impacts onto turnaround performance
- Schultz et al. (2013) – Boarding on the critical path of the turnaround
- Oreschko et al. (2014) – Turnaround prediction concept: proofing and control options by microscopic process modelling
- Schultz (2018) – Implementation and application of a stochastic aircraft boarding model
- Evler et al. (2018) – Stochastic control of turnarounds at hub airports
- Asadi et al. (2019) – Coping with uncertainties in predicting the aircraft turnaround time

IFL Research Focus on Airport Operations

Stochastic EOBT Prediction with Inbound on-time/delayed







IB → AC

Ground

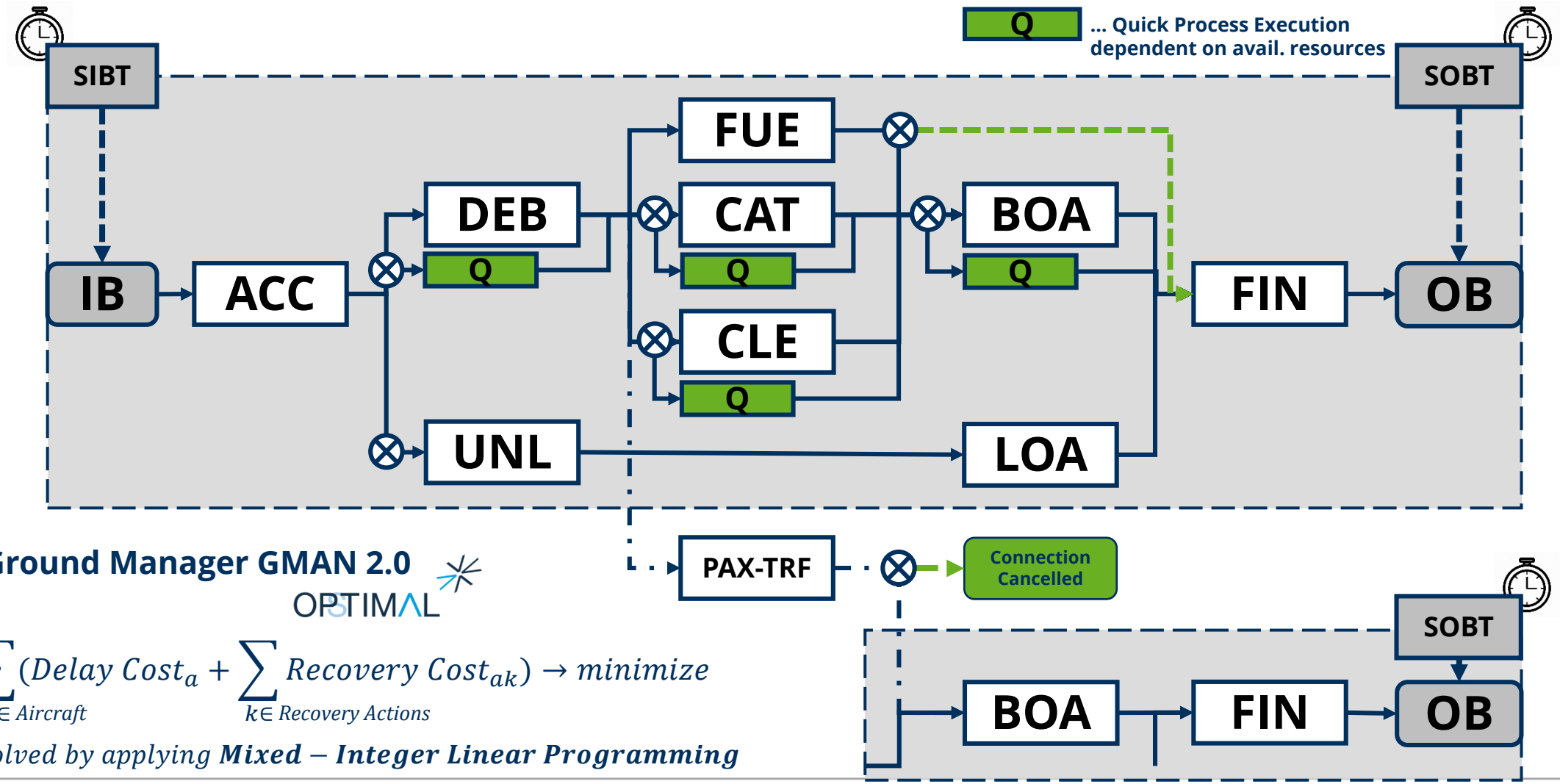
$EOBT =$

DU …Stocha

Solved by applying ***Monte Carlo Simulation***

IFL Research Focus on Airport Operations

Stochastic Control of Multiple TOBTs



Ground Manager GMAN 2.0

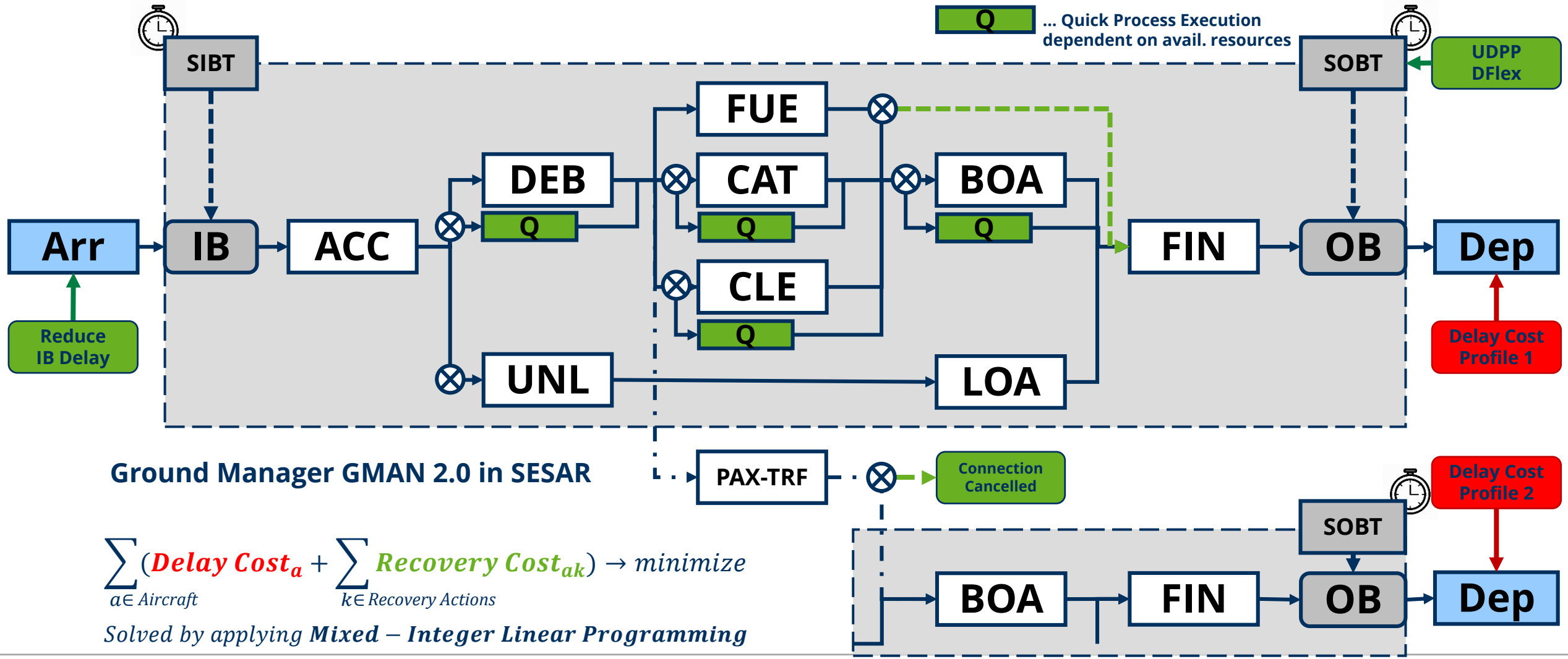
OPTIMAL

$$\sum_{a \in \, Aircraft} (Delay\ Cost_a + \sum_{k \in \, Recovery\ Actions} Recovery\ Cost_{ak}) \rightarrow minimize$$

Solved by applying $\boldsymbol{Mixed - Integer\ Linear\ Programming}$

Dissertation Topic Jan Evler

Airline Operations Recovery in Hub-Networks



$$\sum_{a \in \, Aircraft} (\boldsymbol{Delay\ Cost_a} + \sum_{k \in \, Recovery\ Actions} \boldsymbol{Recovery\ Cost_{ak}}) \rightarrow minimize$$

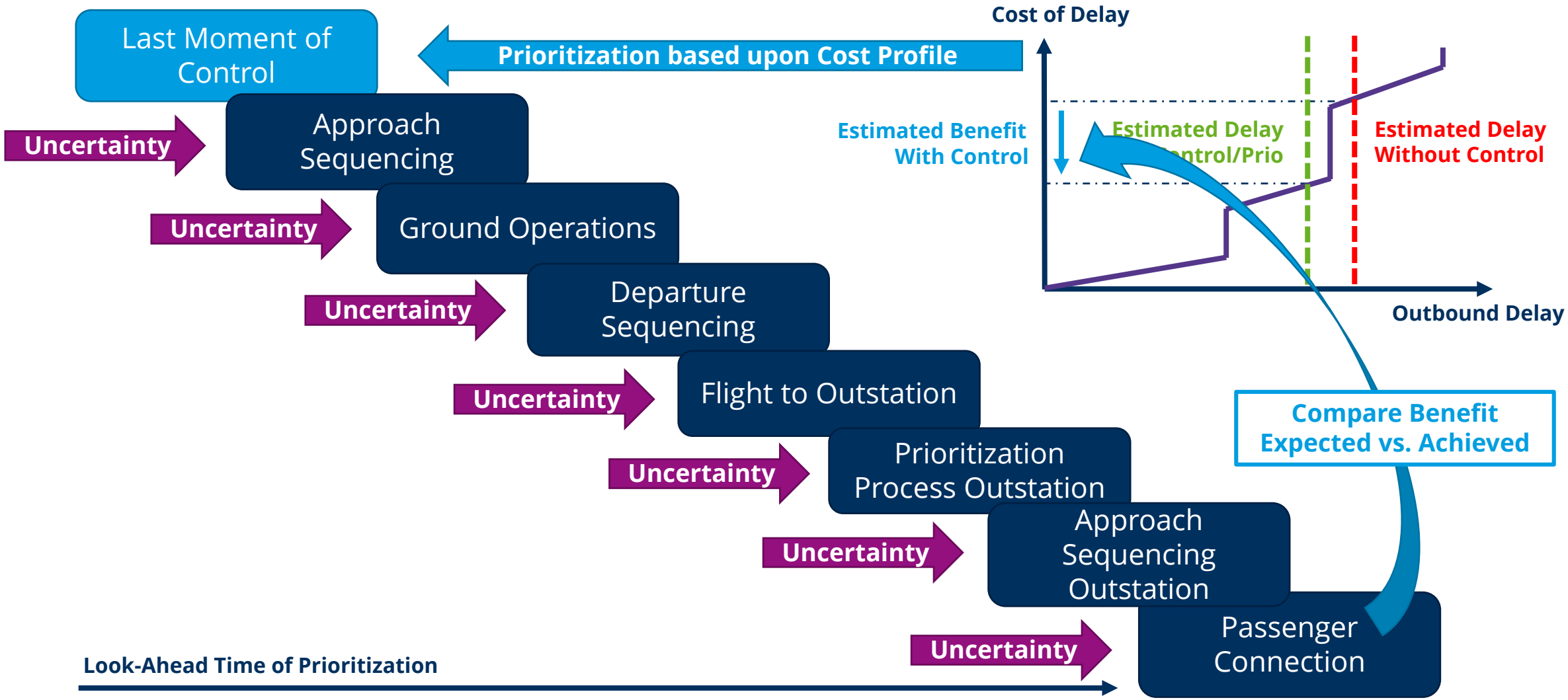
Solved by applying $\boldsymbol{Mixed - Integer\ Linear\ Programming}$

Dissertation Topic Jan Evler

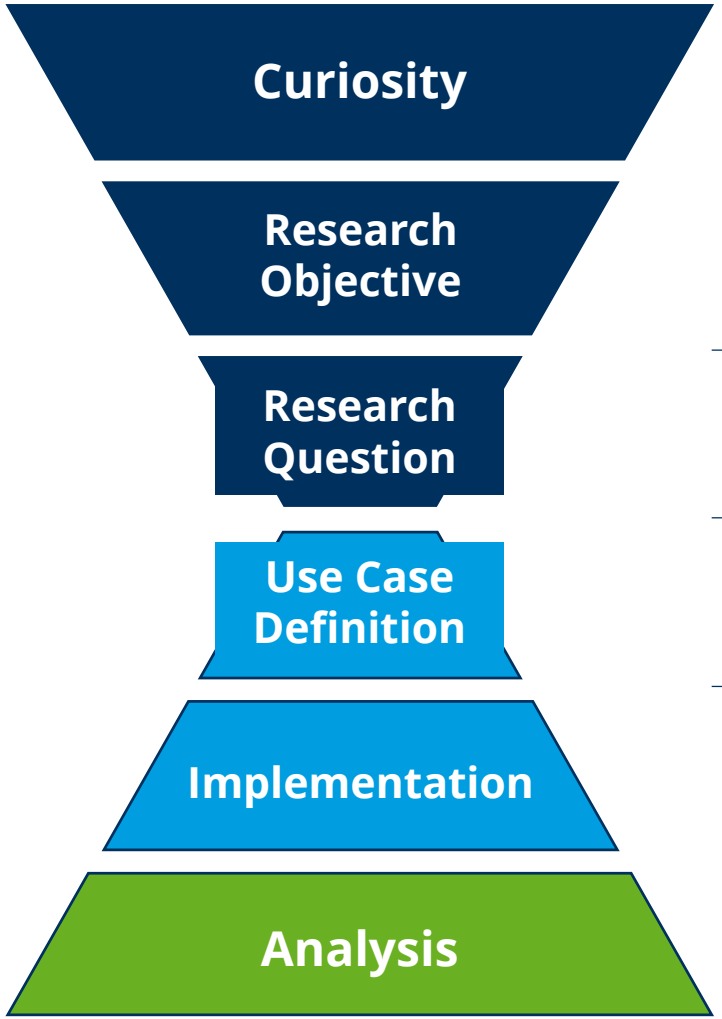
Ground Operations as Crucial Control Element in Airline Networks

Over n partially parallel aircraft rotations this prioritization process may appear irrational from outside

Prioritization Process of Flights from Airline Perspective



Research Design



Different Approach to Airline Operations Management – Flexible Buffer Times and Standardized Operations Recovery

Integration of All Airline Operations Recovery Actions into **One Stochastic Control Model**

Does the Integrated Control Model **Improve the Airline Operations Recovery Performance** under Uncertainty?

Development of A **Decision Support Tool** for Airline Ground Operations Controllers (GMAN 2.0)

Scenario Techniques for Hub-Airline Network: Variable Inbound Delay and Available Recovery Resources

Dissertation

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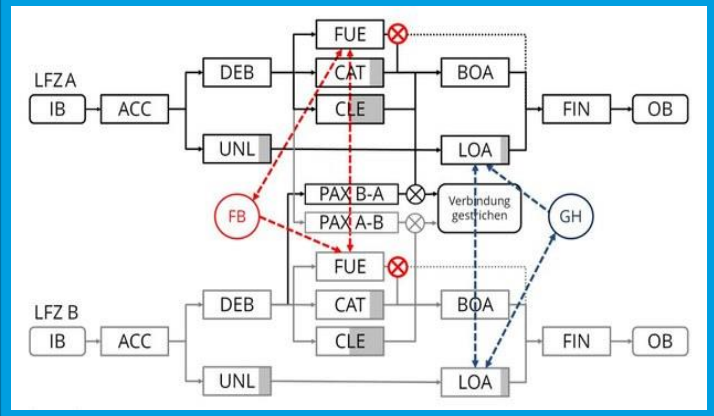
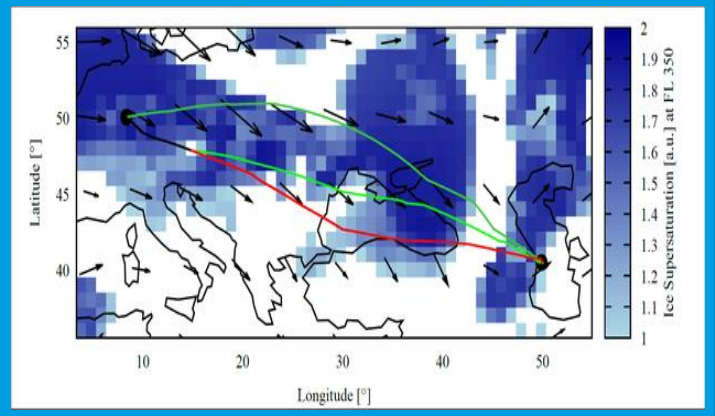
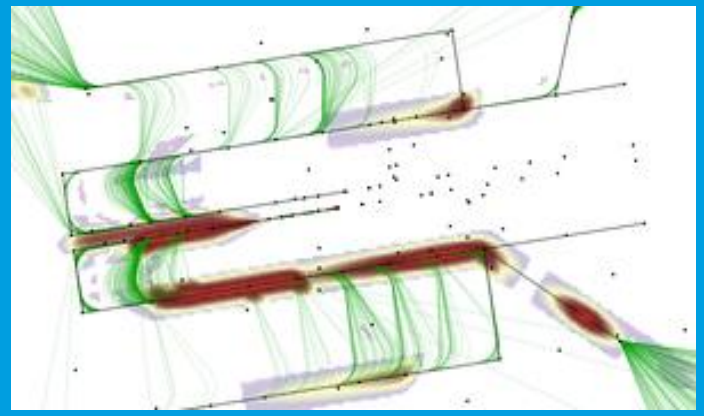


Airport Operations



Trajectory Optimization



Safety

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