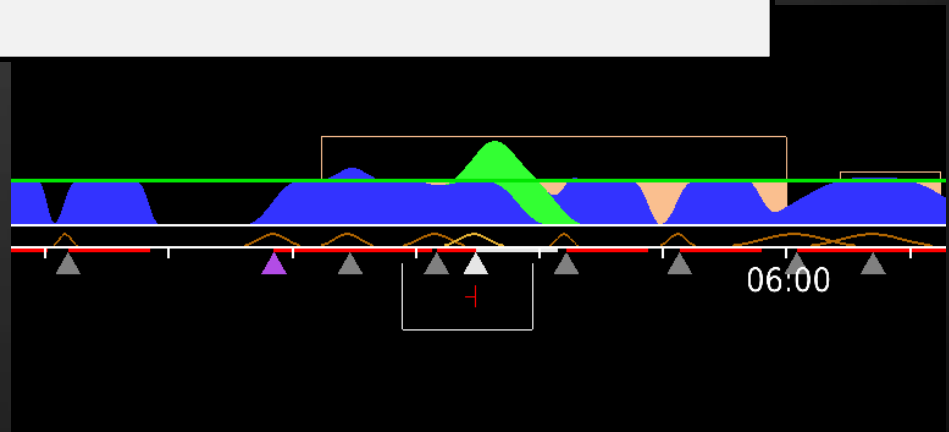


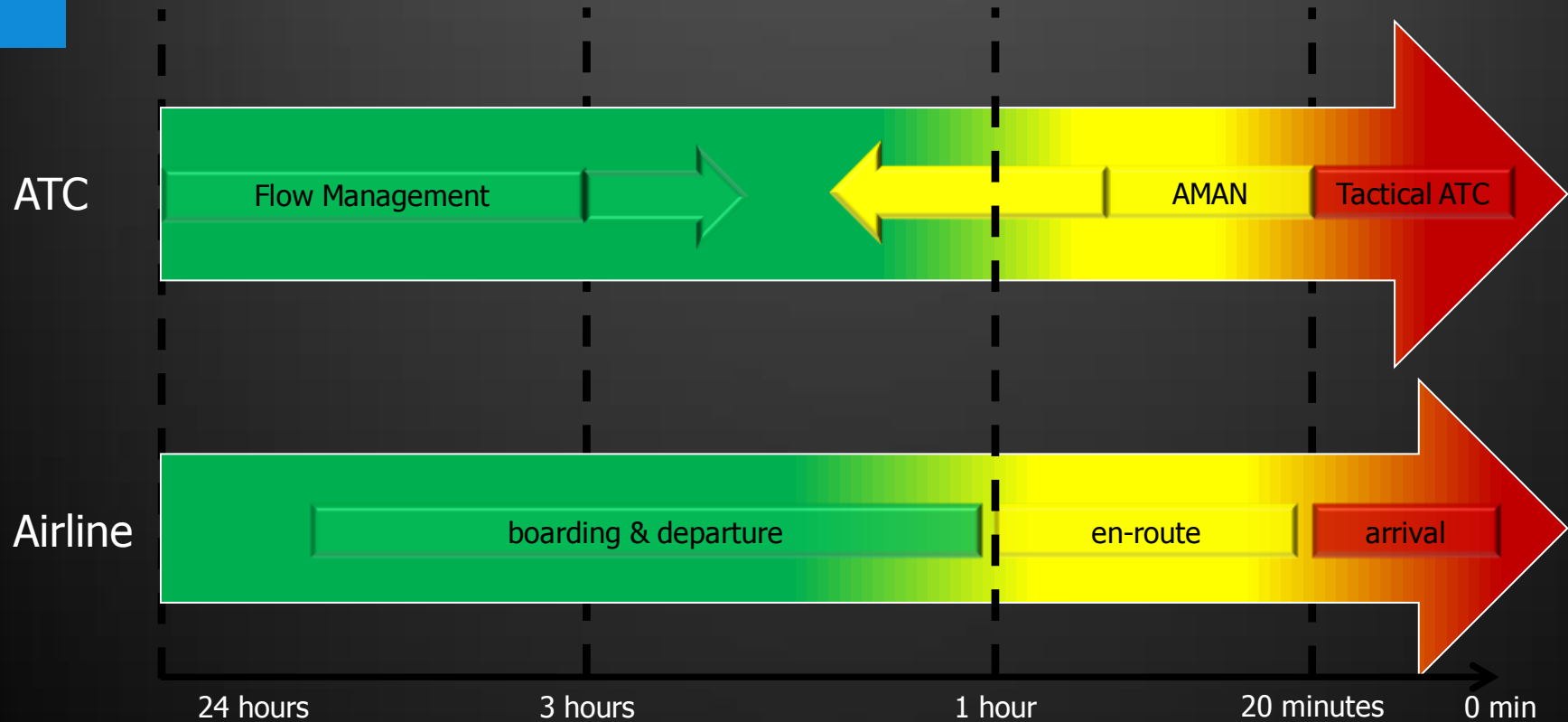
Supporting Arrival Management by Visualizing Uncertainty

The Third SESAR Innovation Days

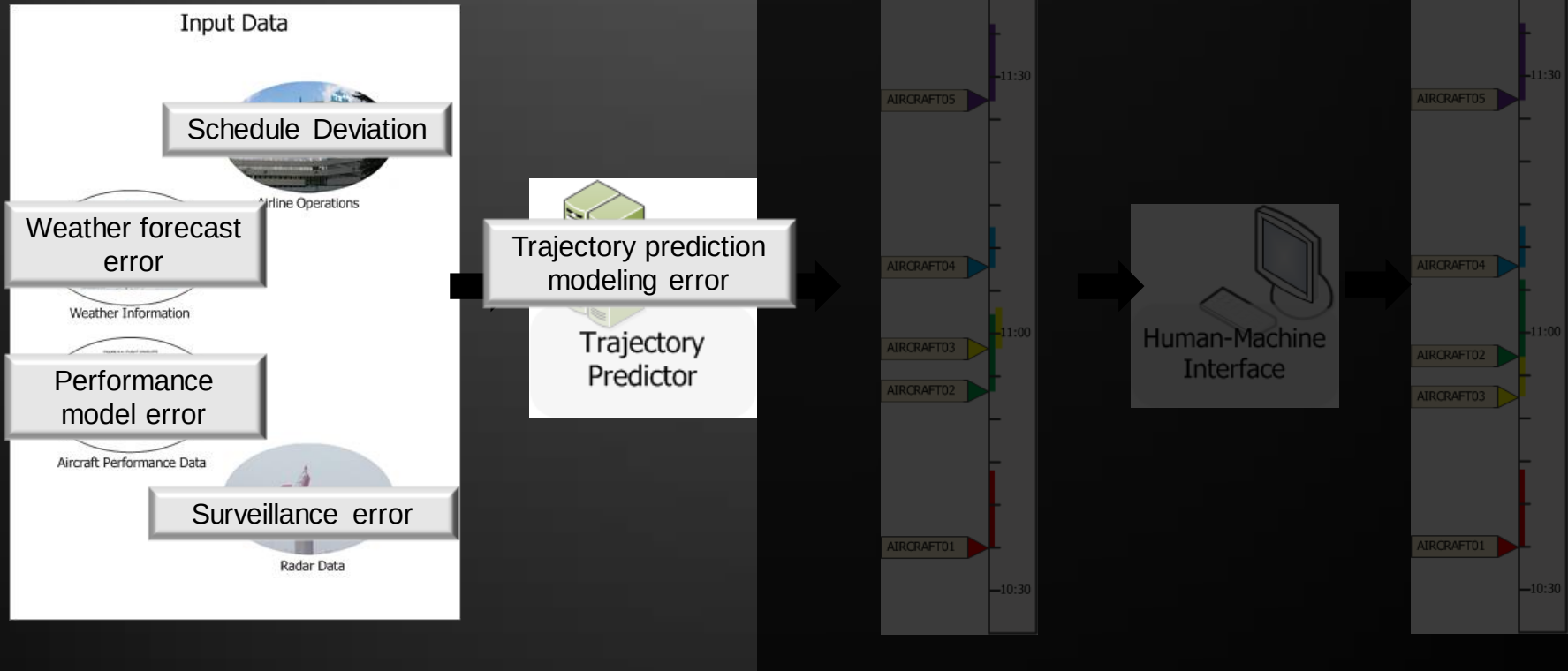
Ir. M. Tielrooij



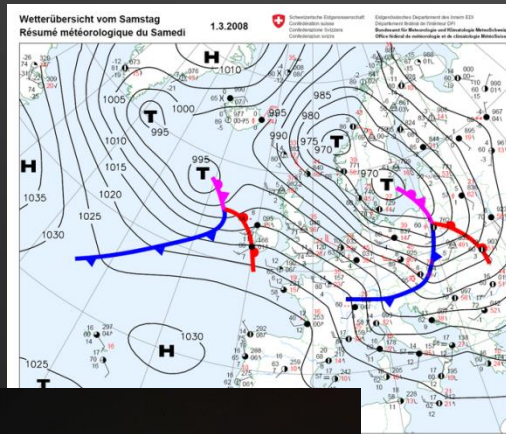
AMAN: Extending the Horizon



AMAN Process



Uncertainty

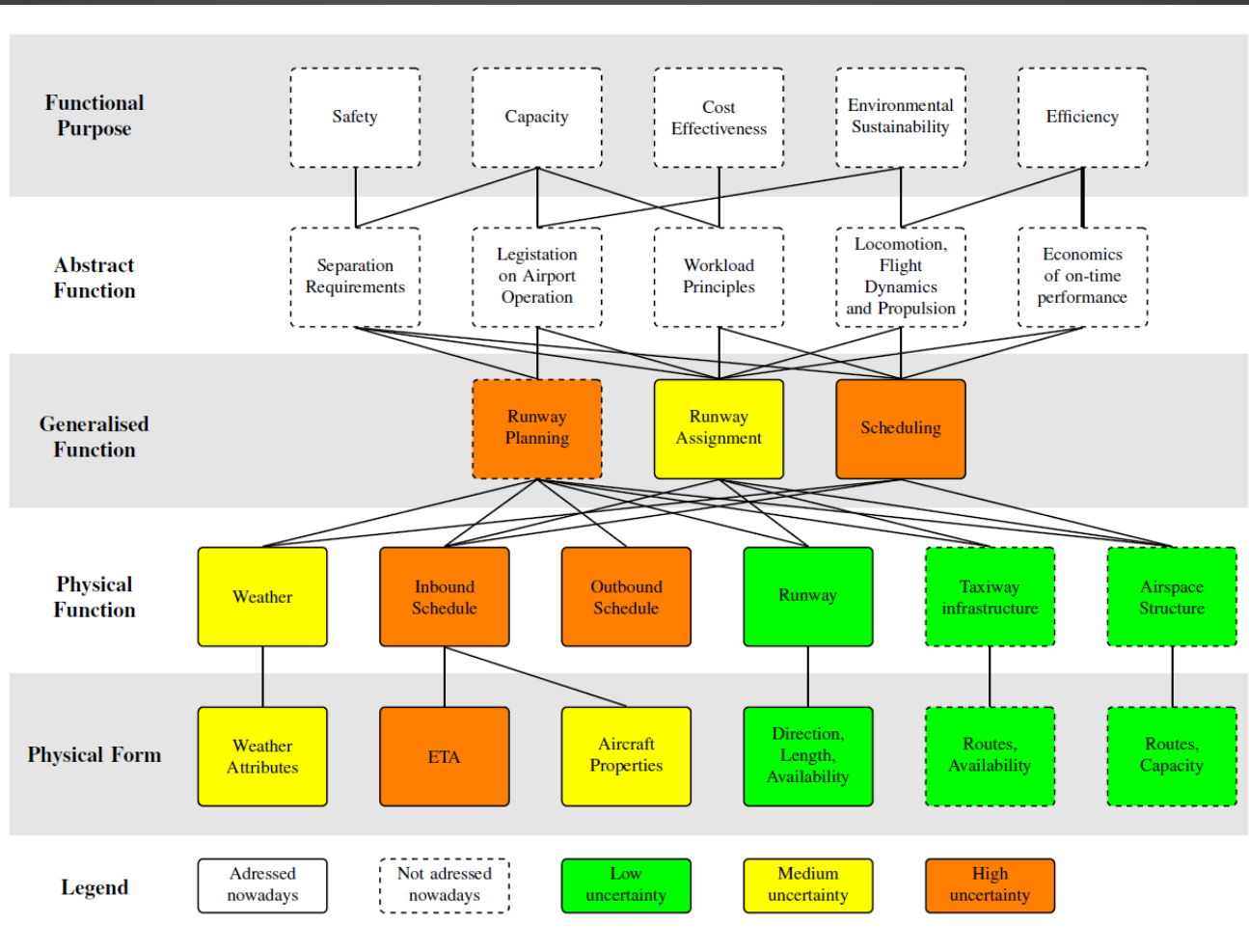


19 busiest connections from Amsterdam

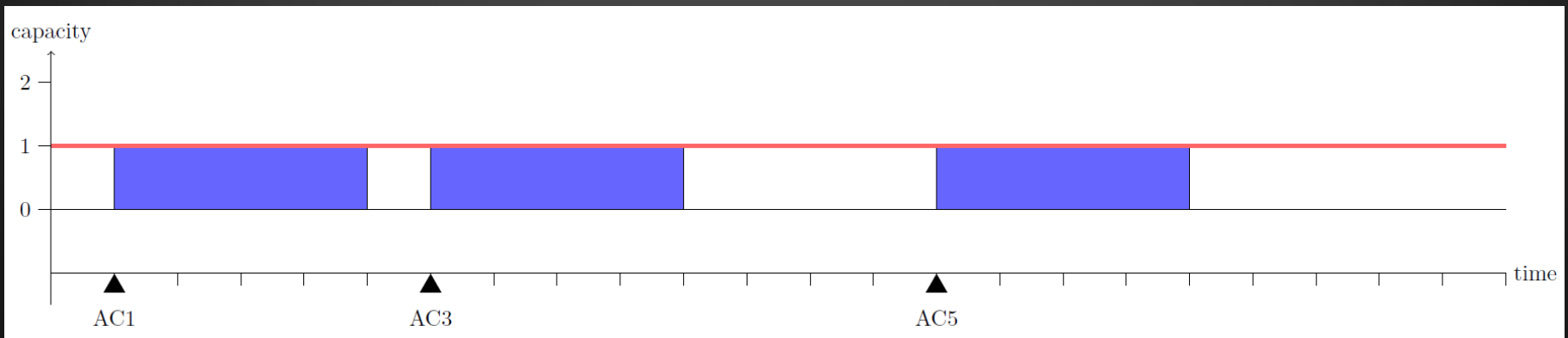
Addressing Uncertainty

- Improve prediction
- Close the loop
- Account for remainder

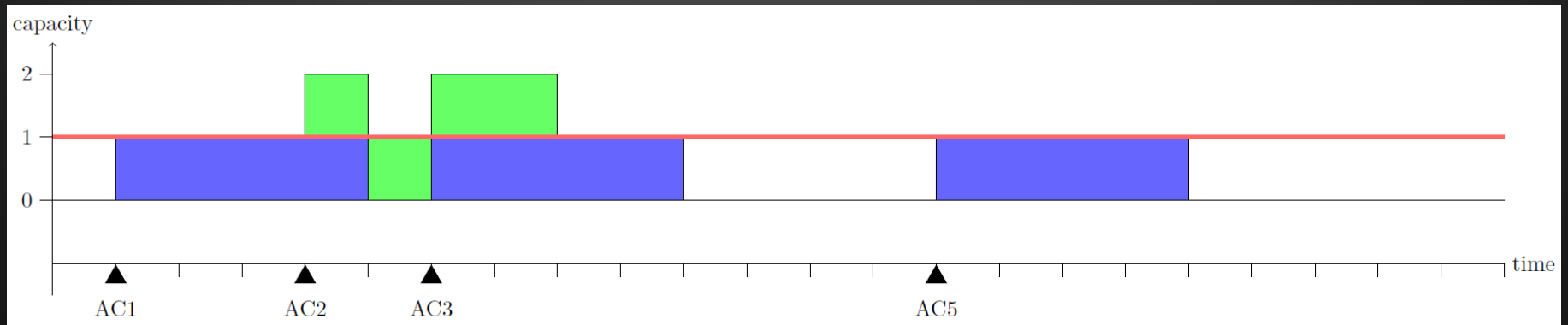
Abstraction Hierarchy



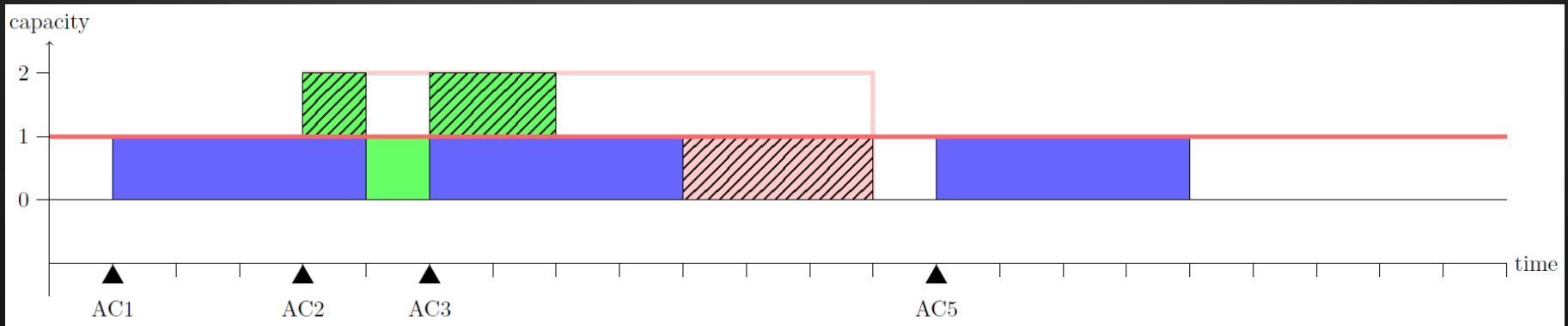
Visualisation: Relating ETA and Separation



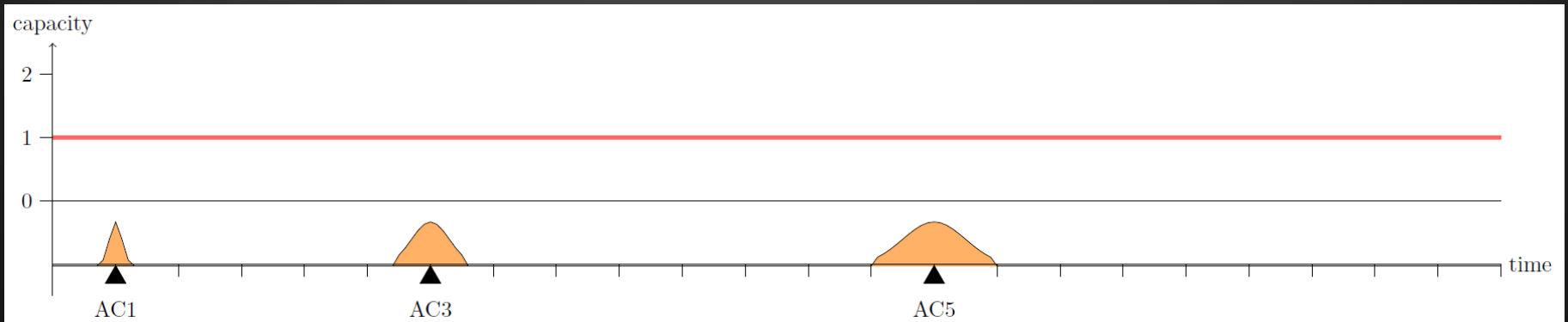
Visualisation: Relating Separation, Demand, and Capacity



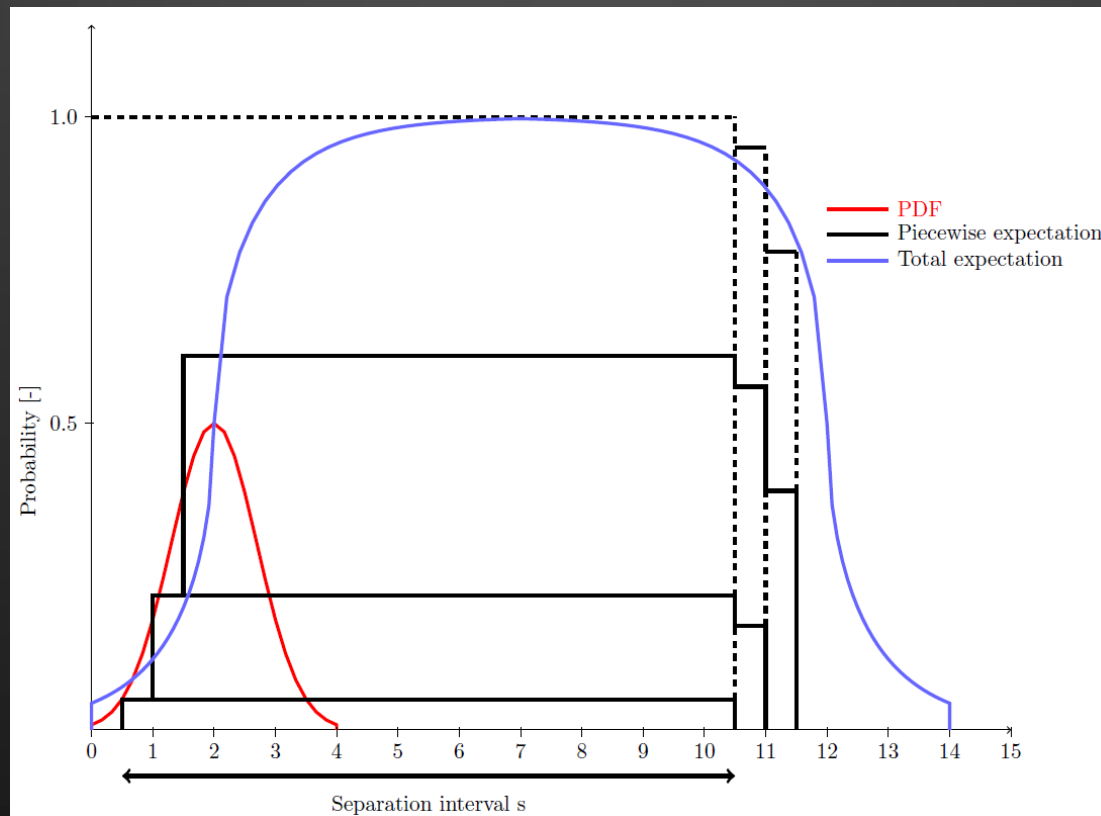
Visualisation: Demand and Capacity, and Delay



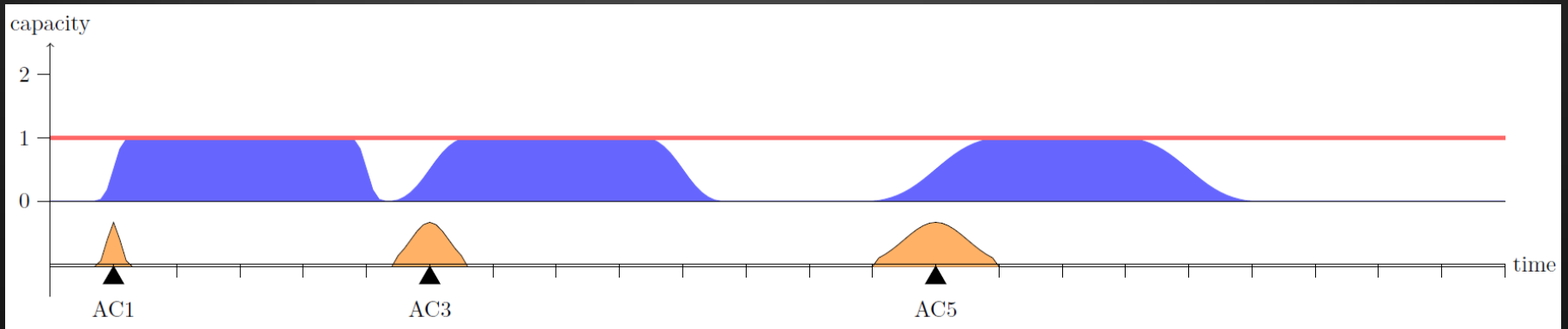
Visualisation: Showing Uncertainty



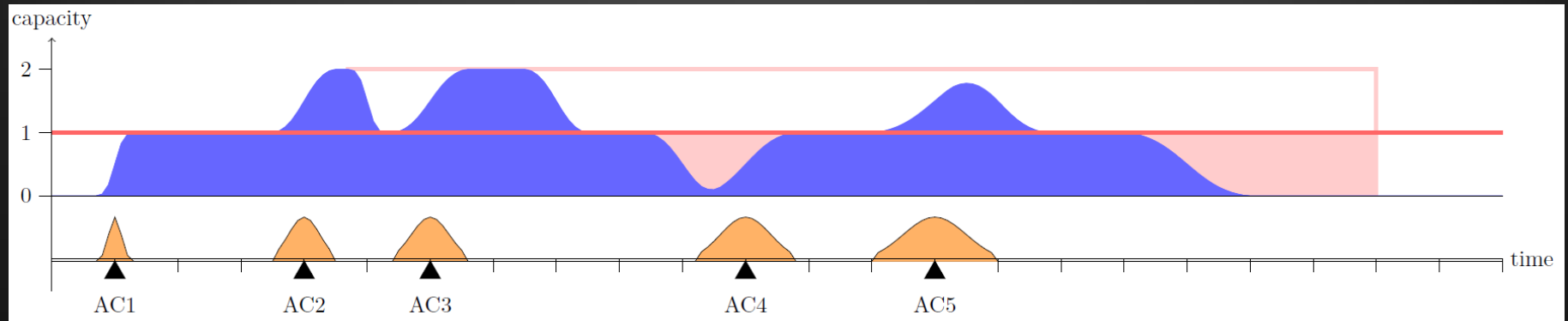
Visualisation: Relating Uncertainty to Demand



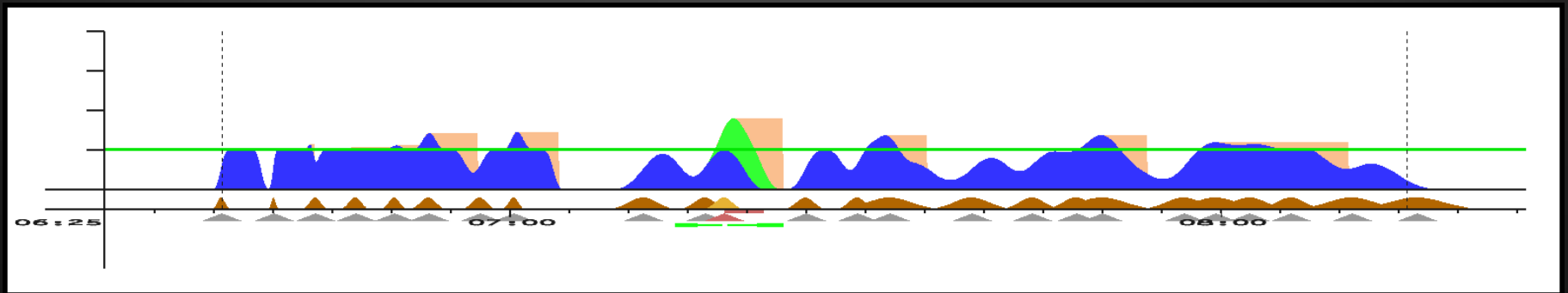
Visualisation: Relating Uncertainty to Demand



Visualisation: Relating Uncertainty to Demand

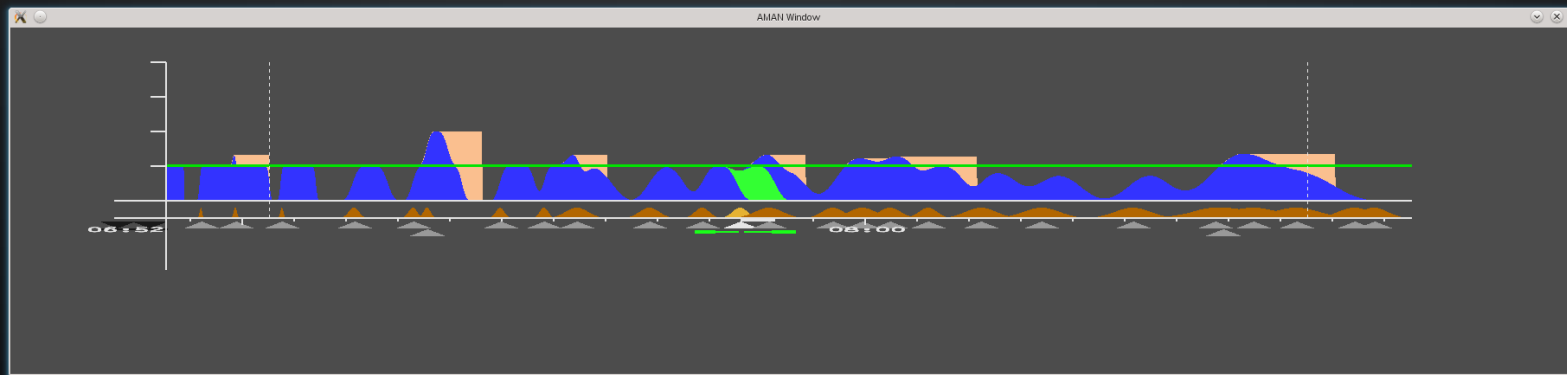


Initial Concept

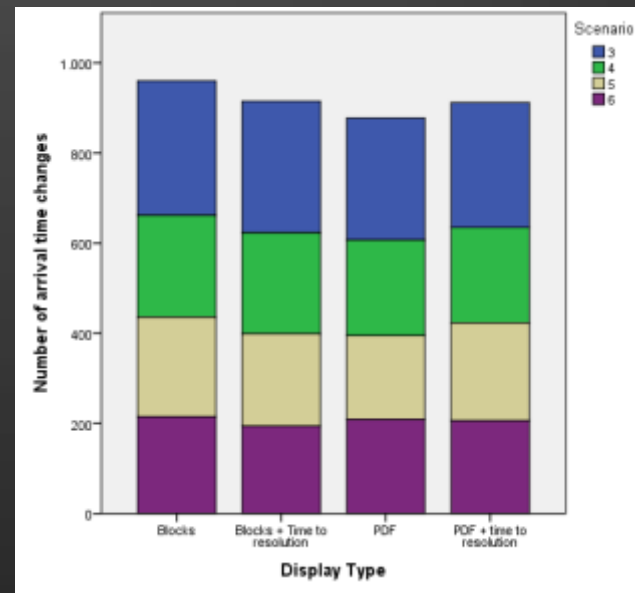
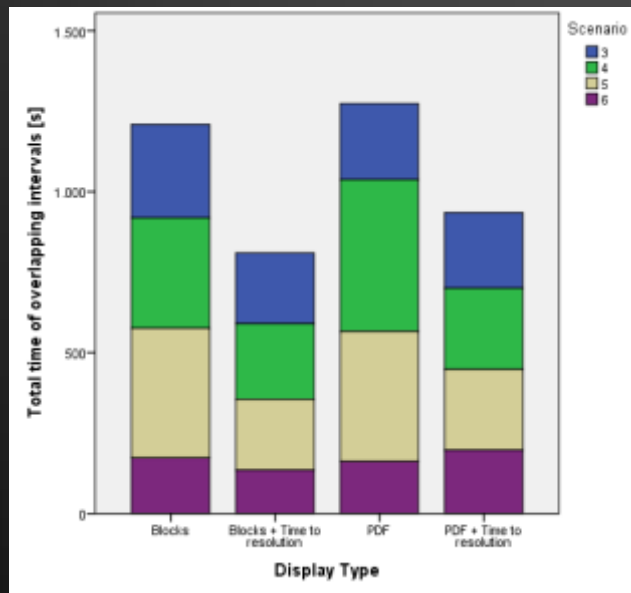


Experiment

- 7 Aerospace Engineering students
- PC simulation without operational context
- 4 Demanding but feasible scenarios
- 8 + 16 runs

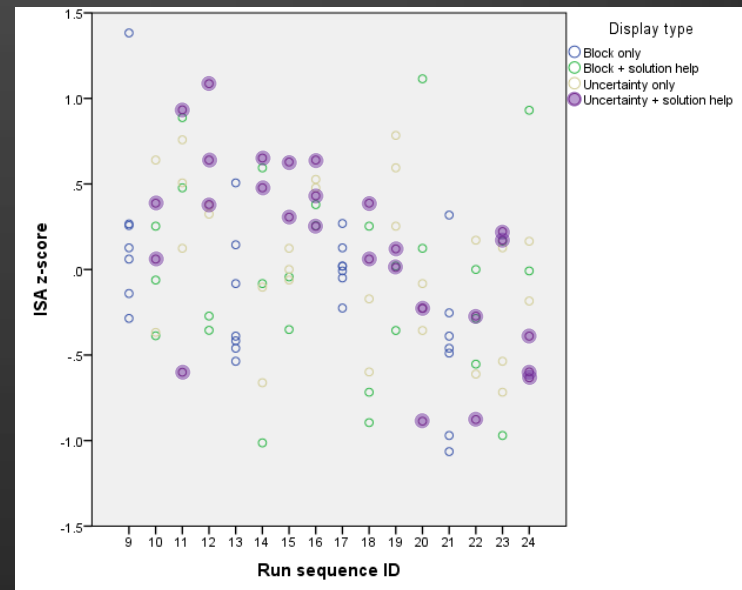


Results: Relating Demand to Delay



Results: Workload

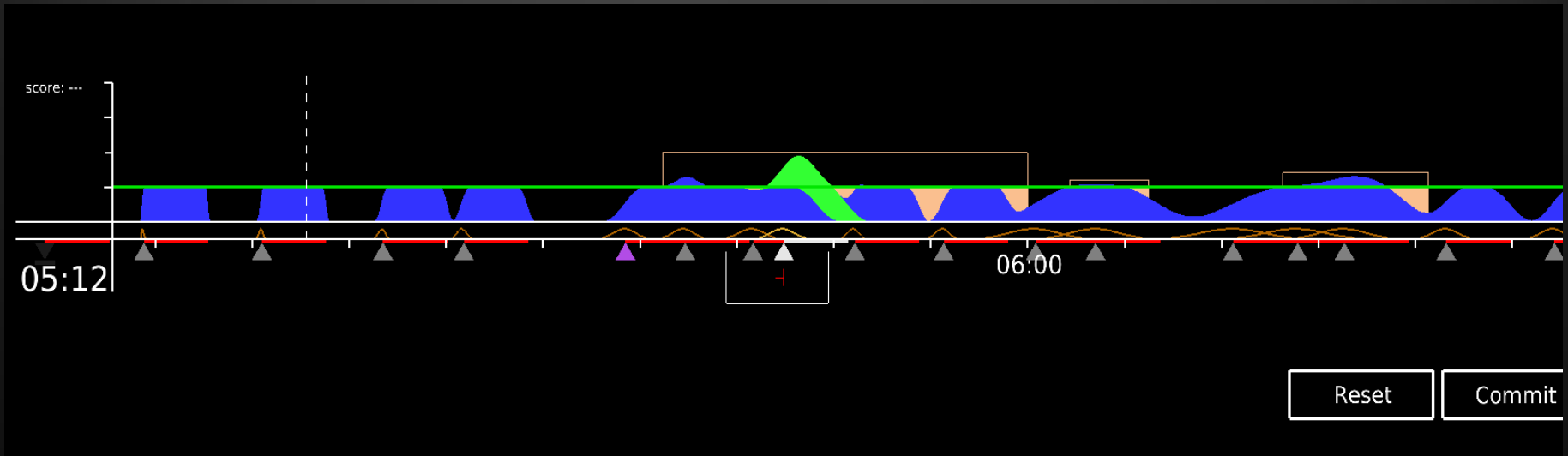
- Subjects used knowledge on uncertainty
- Display difficult to understand
- Training insufficient



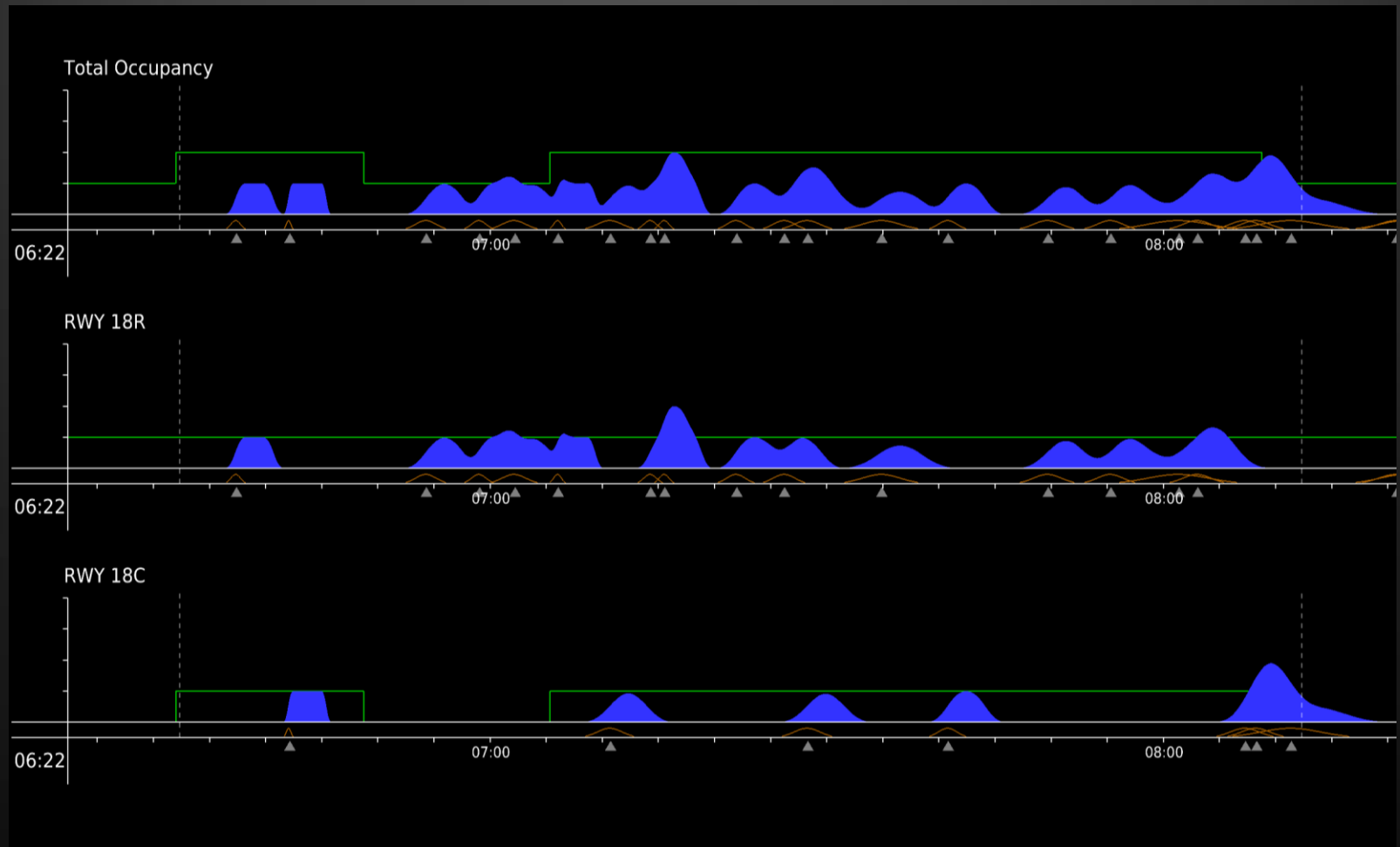
Conclusions and next steps

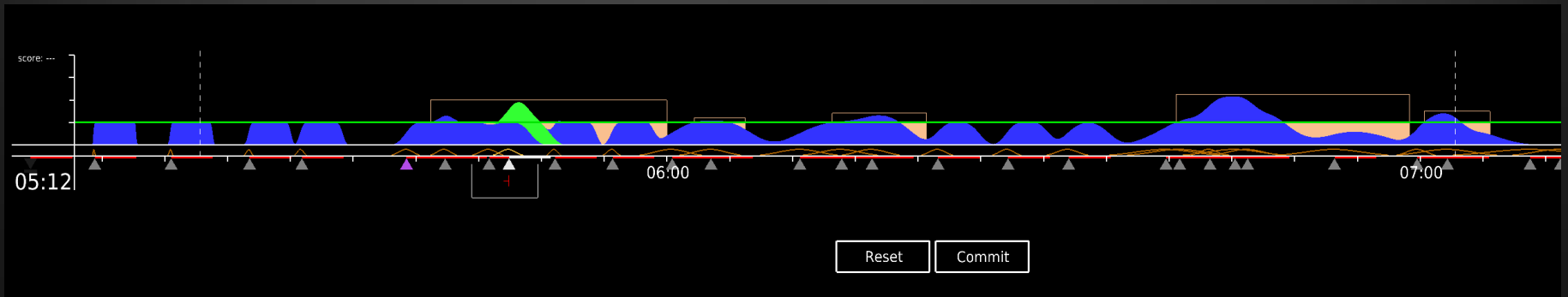
- Visualising uncertainty is difficult to make easy
- Relating demand to delay improves decision making
- Improve experiment, sufficient training
- Create uncertainty model
- Test in operational setting

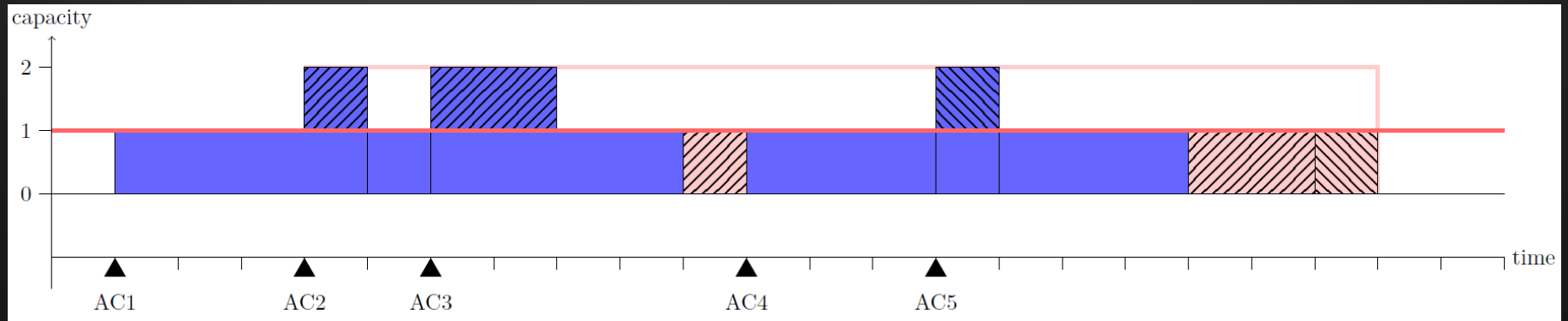
Next Prototype

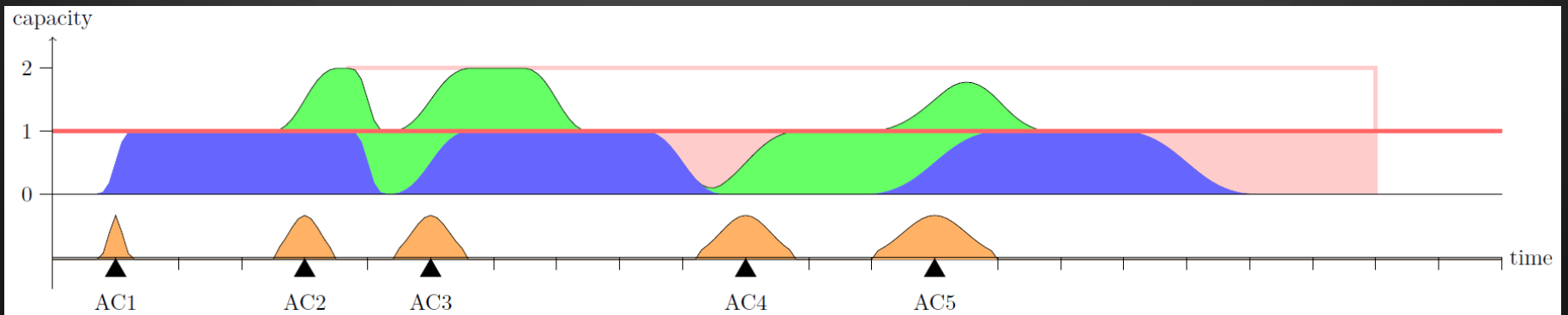


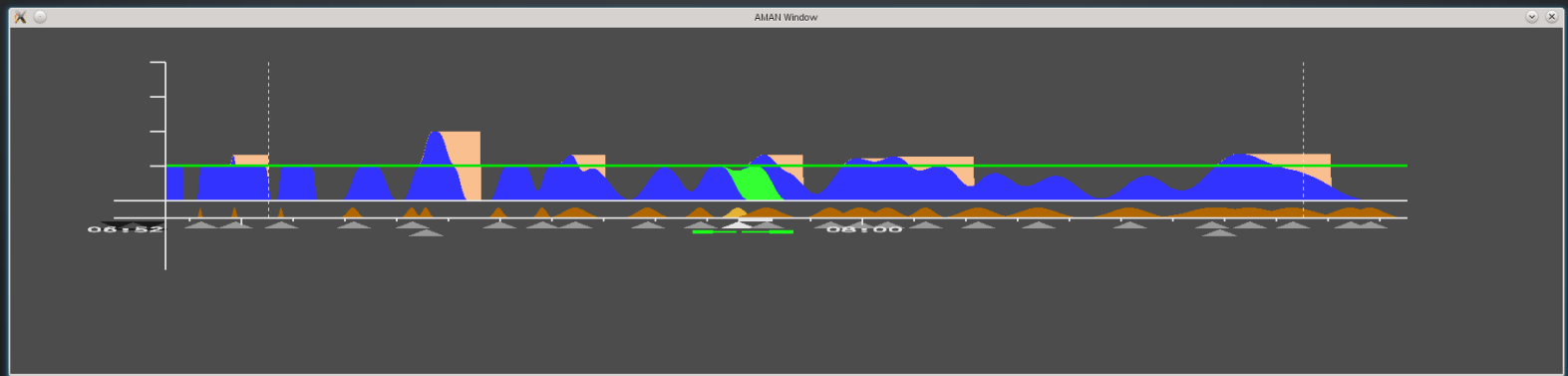
Supporting Runway Assignment



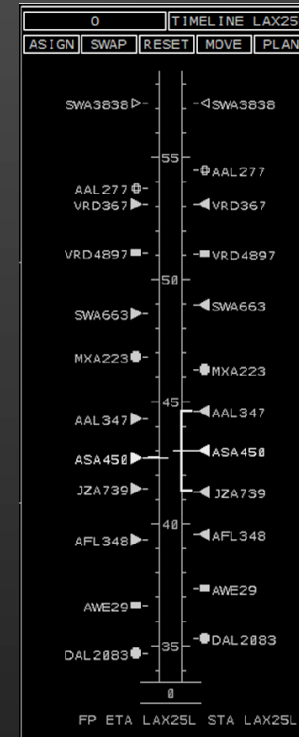
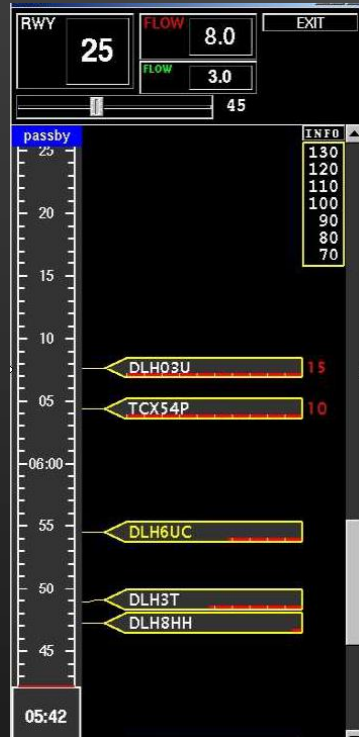








Visualizing Uncertainty



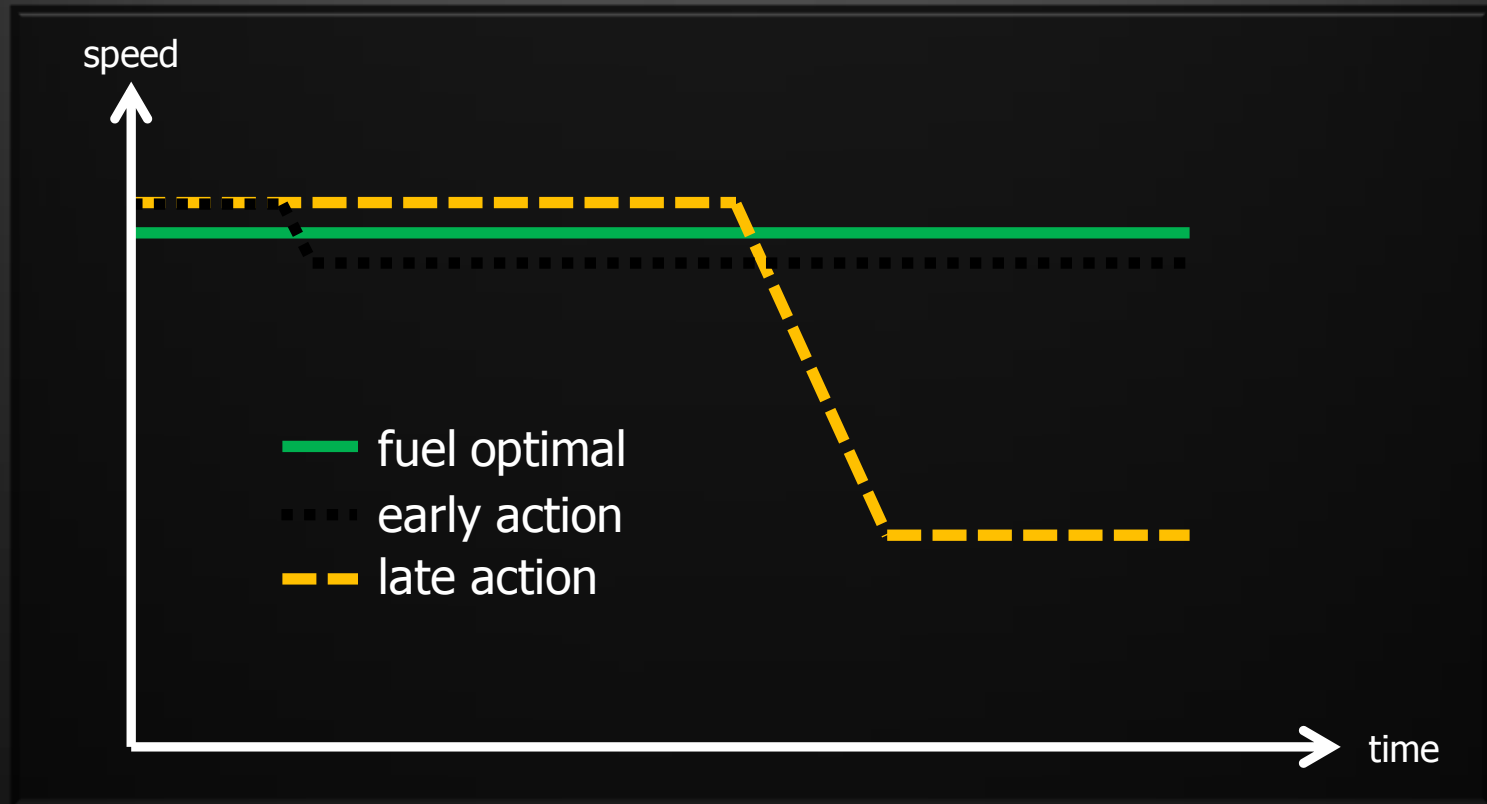
Demand

Arrival Schedule
Aircraft Types
Weather

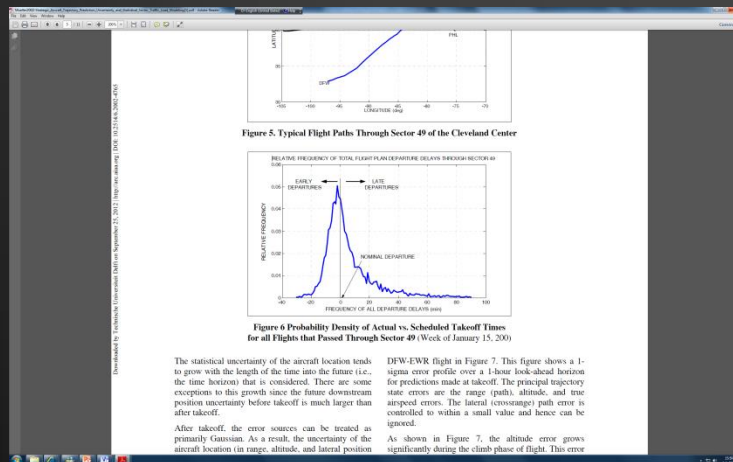
vs

Capacity

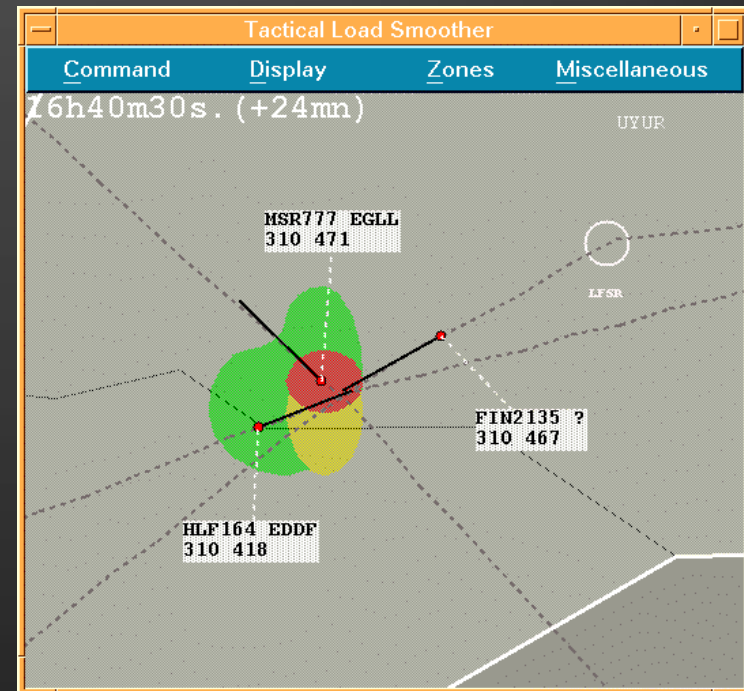
Runways
Taxiways
Airspace
Weather



Uncertainty

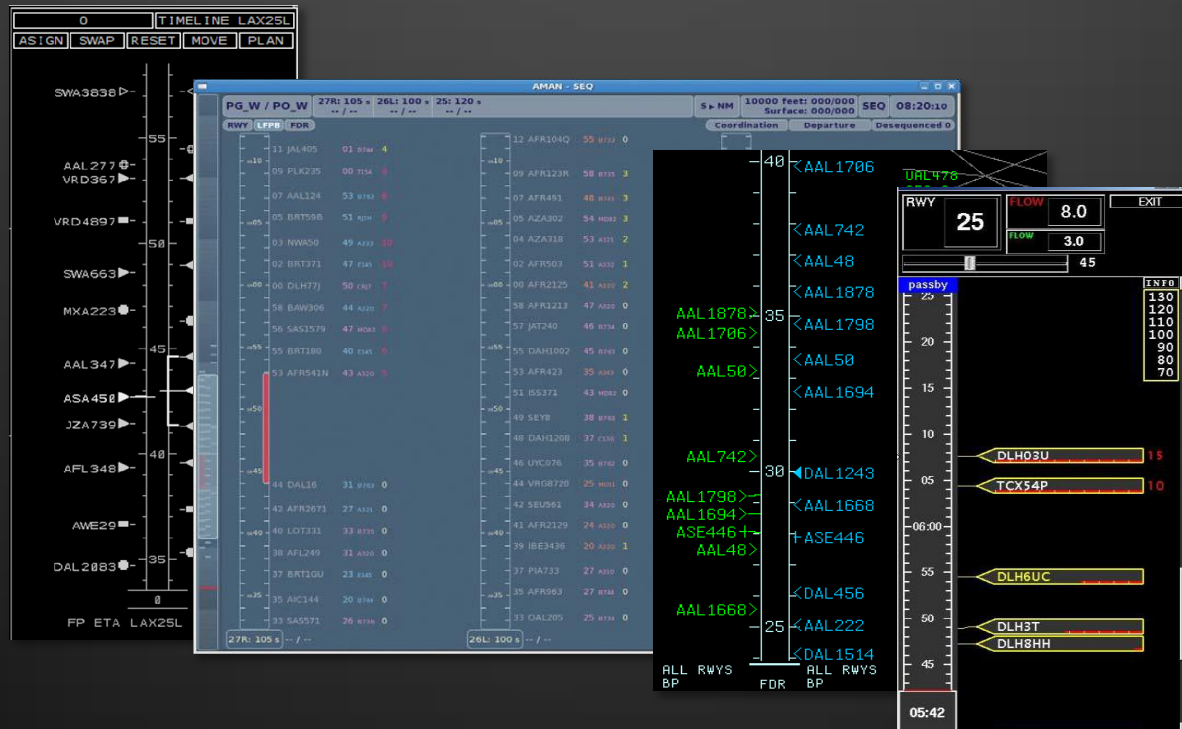


Typical departure time error (Mueller et. al. 2002)



Uncertainty in plan view (Nicholls et. al. 2003)

Visualizing Uncertainty



The multidisciplinary approach is based upon the proven CSE and EID frameworks

The five steps of CSE:

- Work Domain Analysis *what is the purpose of the system?*
- Control Task Analysis *what must be done?*
- Strategies Analysis *how can it be done?*
- Cooperation Analysis *how can work be shared?*
- Worker Competencies *how can operators best be supported?*

Example displays using the ecological approach

