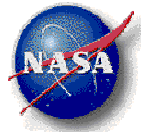


Estimating Required Capacity for Air Transportation Design

Shannon Zelinski

NASA Ames Research Center

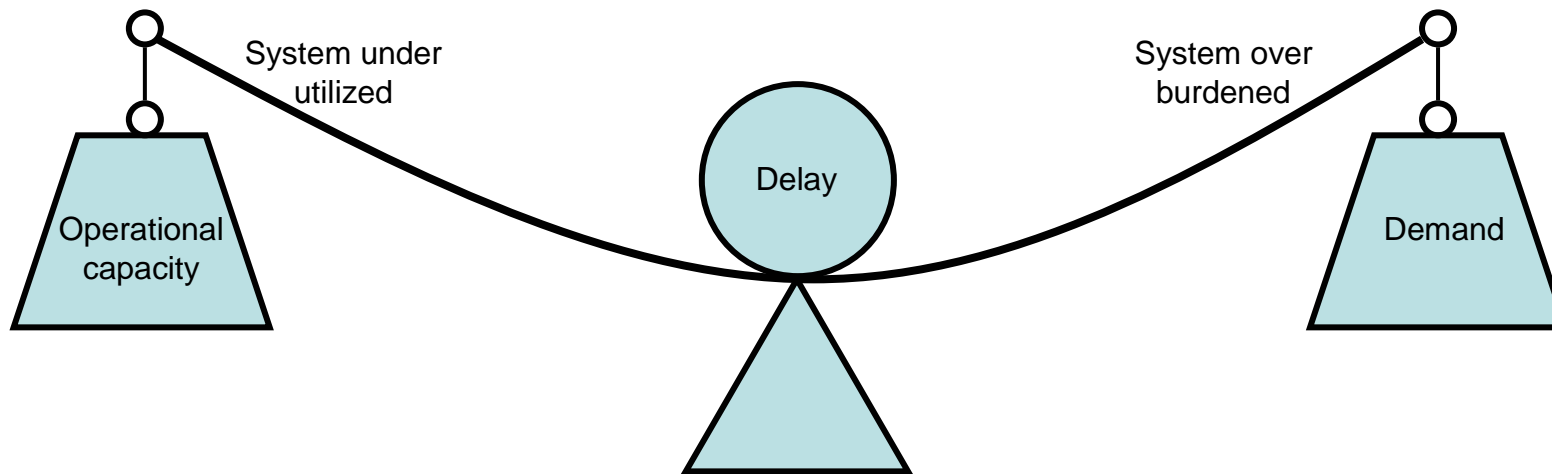


Outline

- Motivation for required capacity
- Estimating required capacity
- Validating the estimates
- Example demand analysis
- Summary

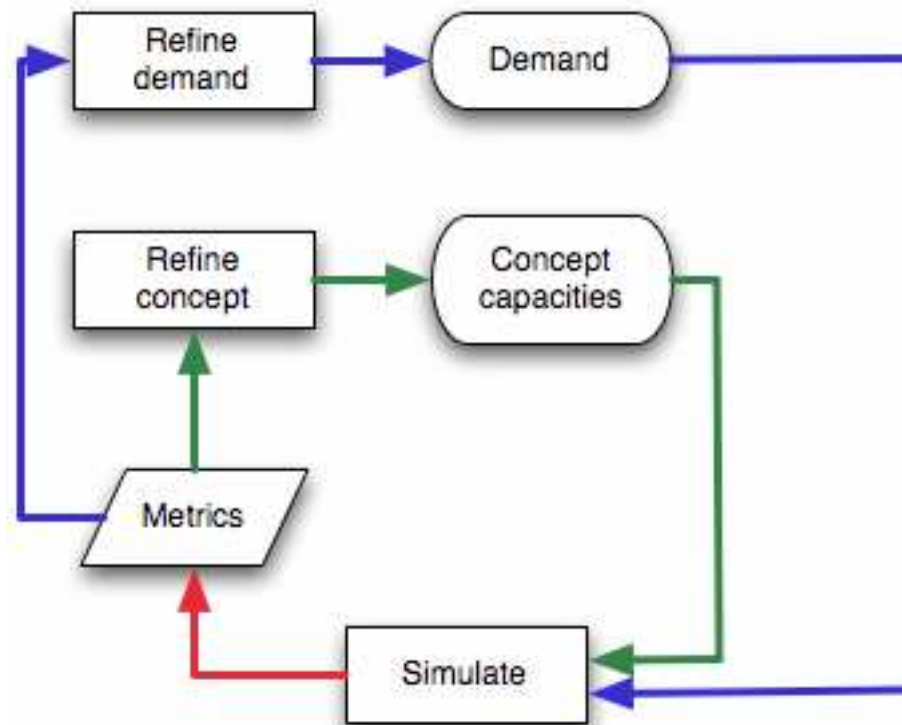
Motivation

- Design air transportation system with balanced capacity and demand.
- Design capacity and demand concepts together instead of separately.



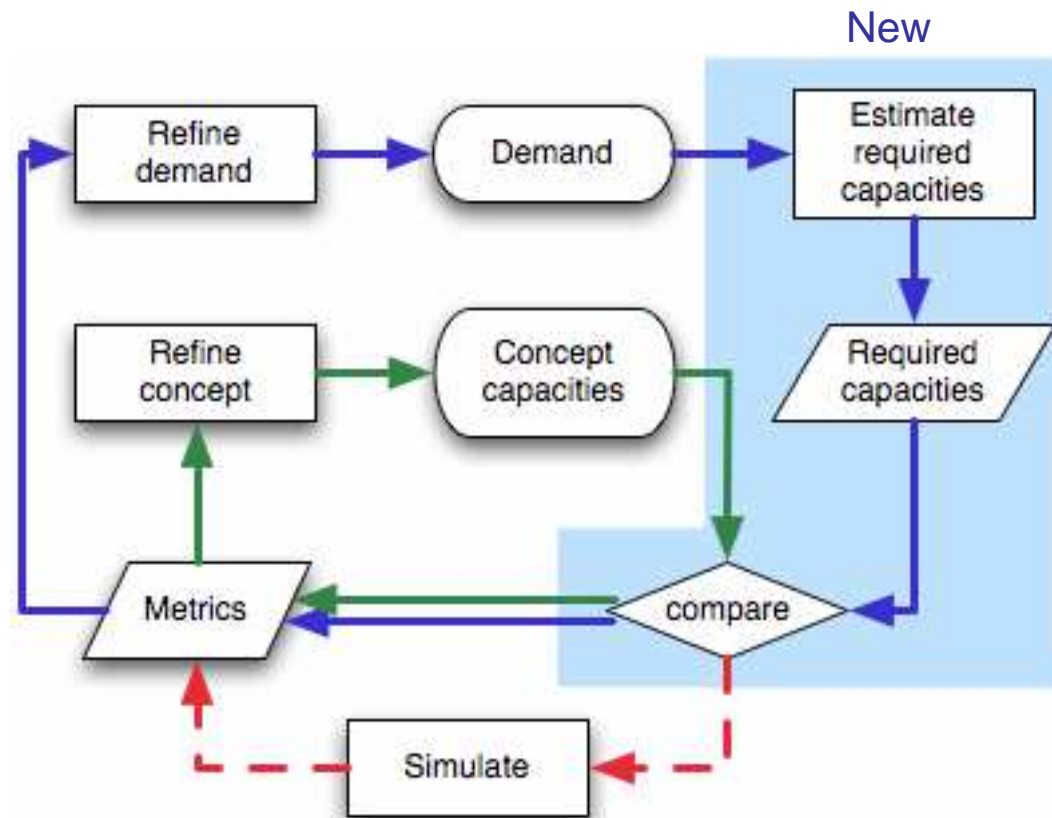
- Required capacity - minimal operational capacity required to support given demand subject to given delay constraints.

Previously Used Design Process

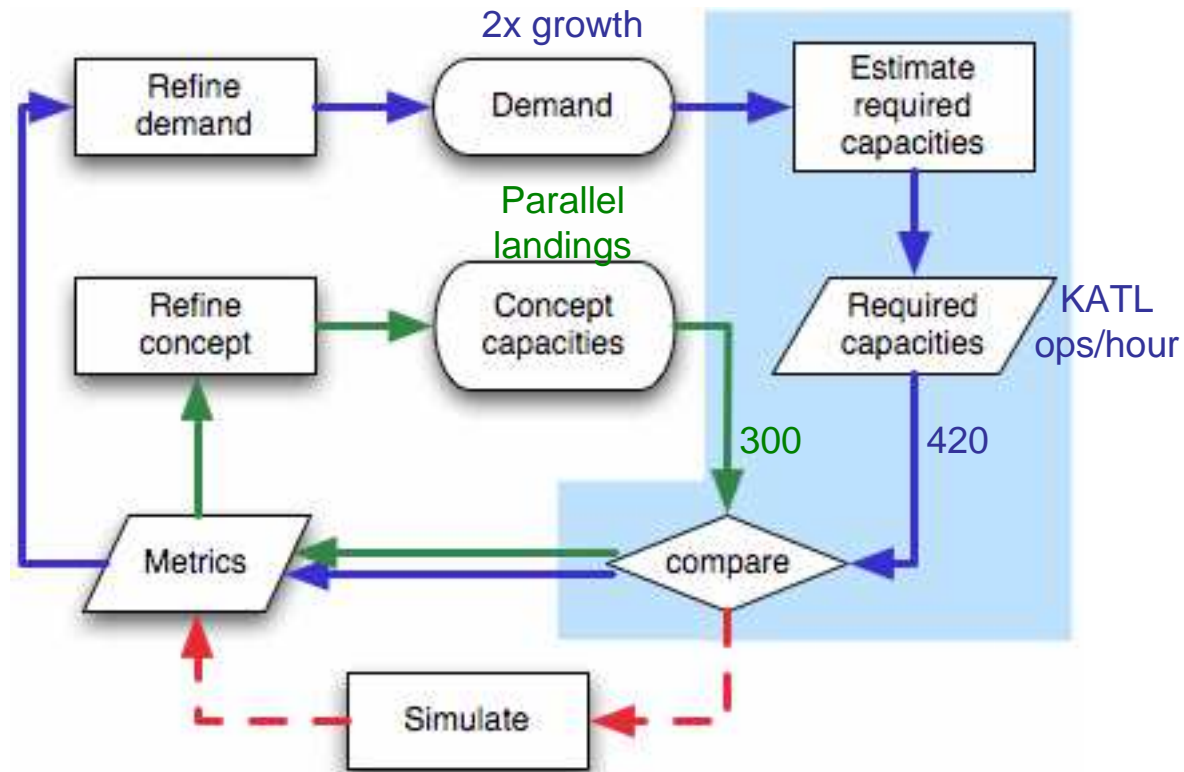


Limitation - simulating ridiculous delays

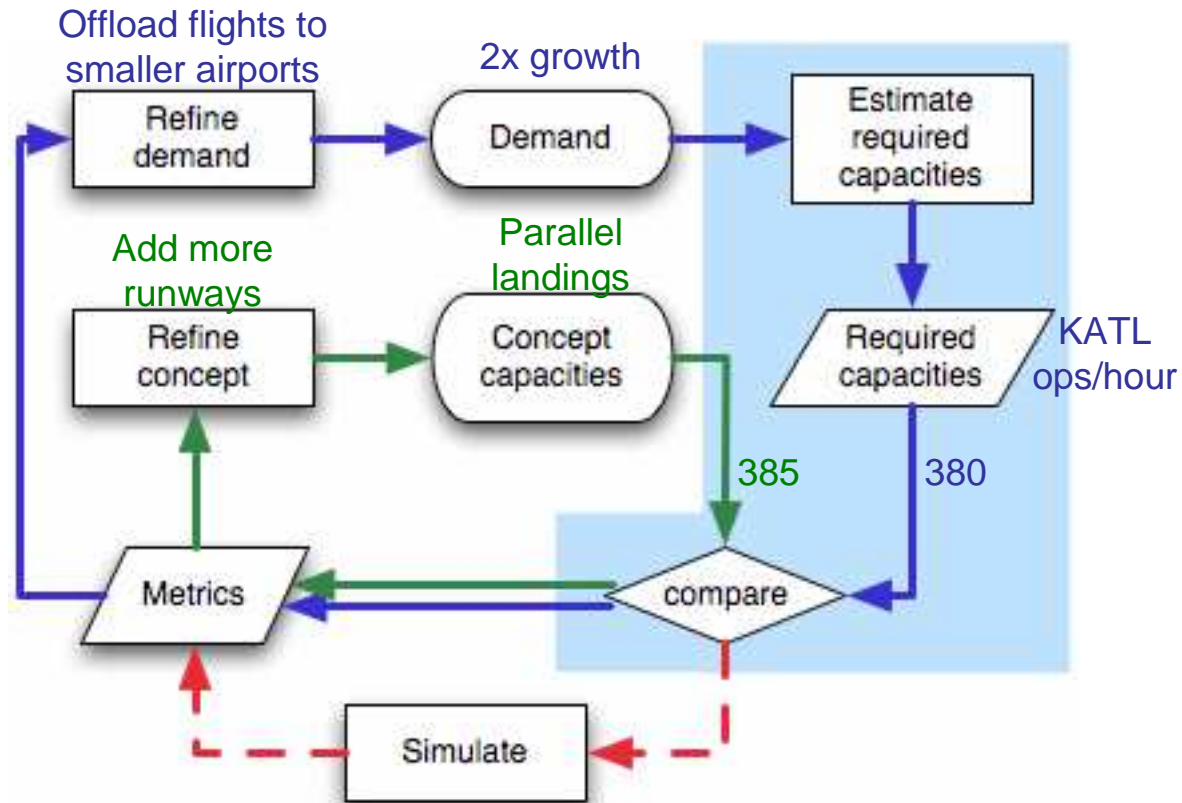
Proposed Design Process



Proposed Design Process



Proposed Design Process

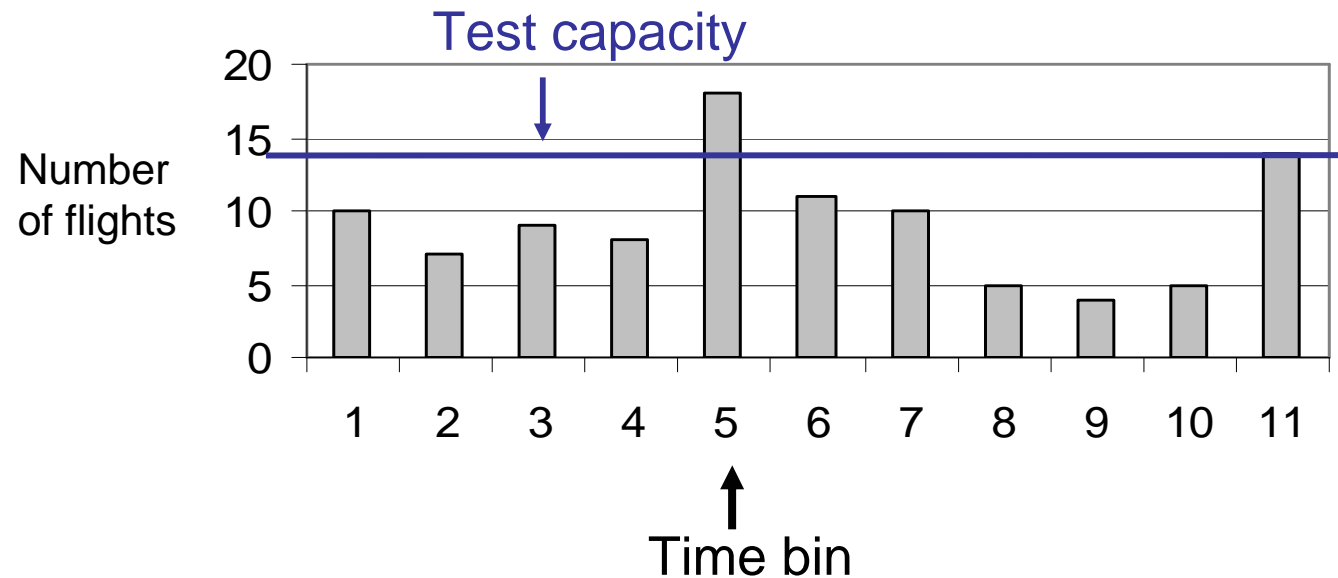


Estimating Required Capacity

- Required capacity for a single facility depends on:
 - demand profile
 - delay constraints
 - demand/capacity ratio constraint
- Shift flights in demand profile to meet test required capacity.
- Increment test required capacity until all constraints are met.

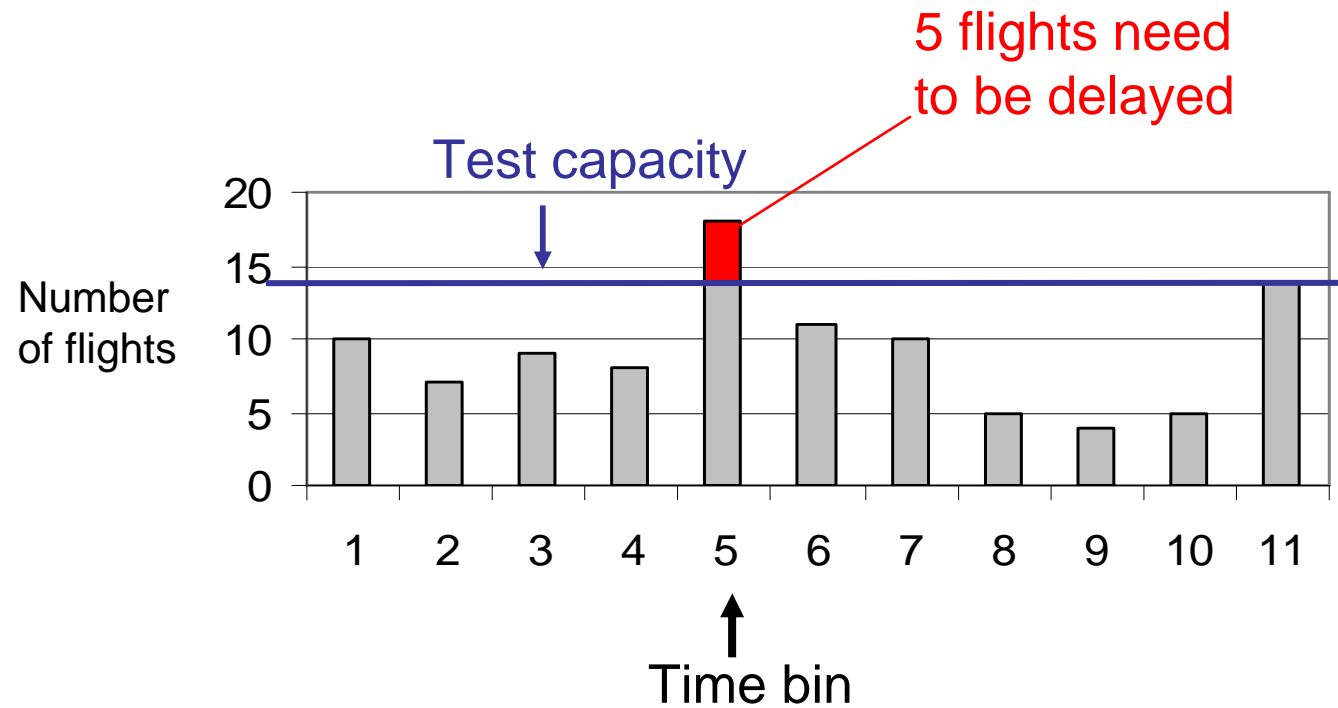
Required Capacity Algorithm

Start with test capacity that satisfies the demand/capacity ratio



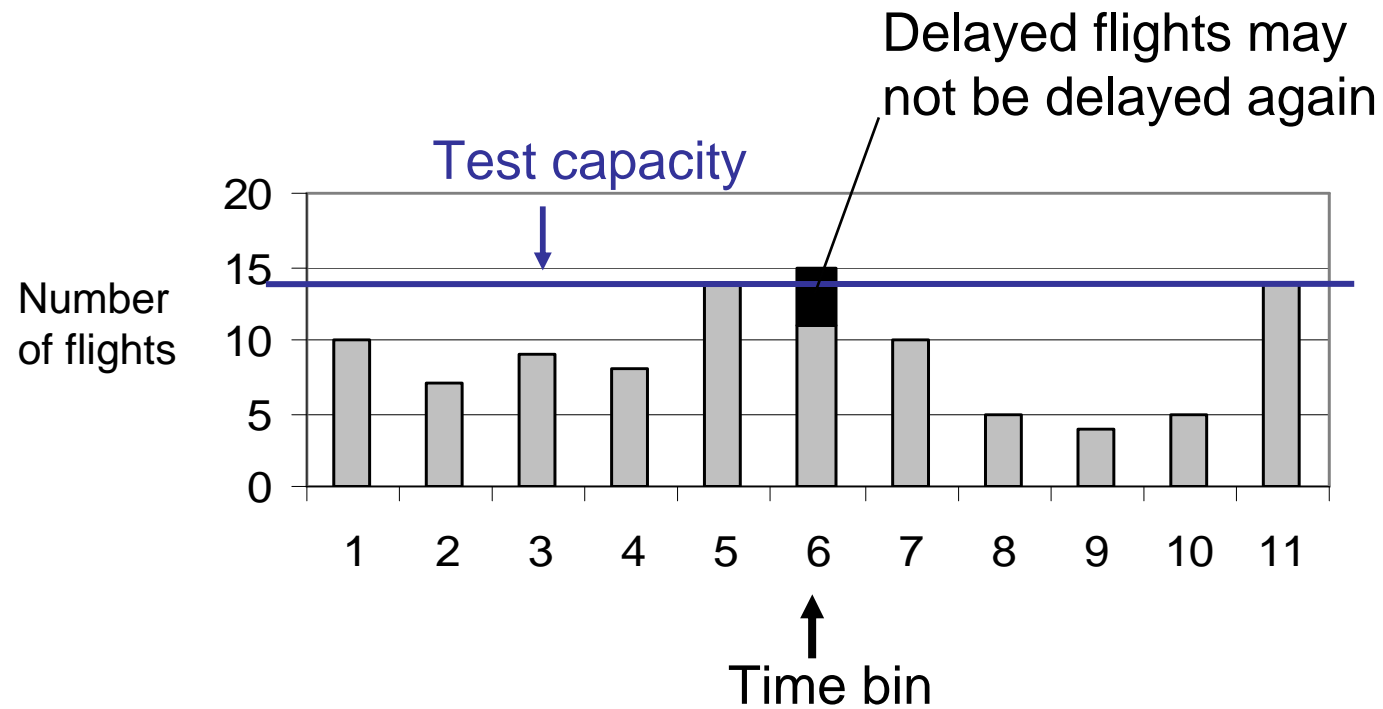
Bin size = Flight delay constraint

Required Capacity Algorithm



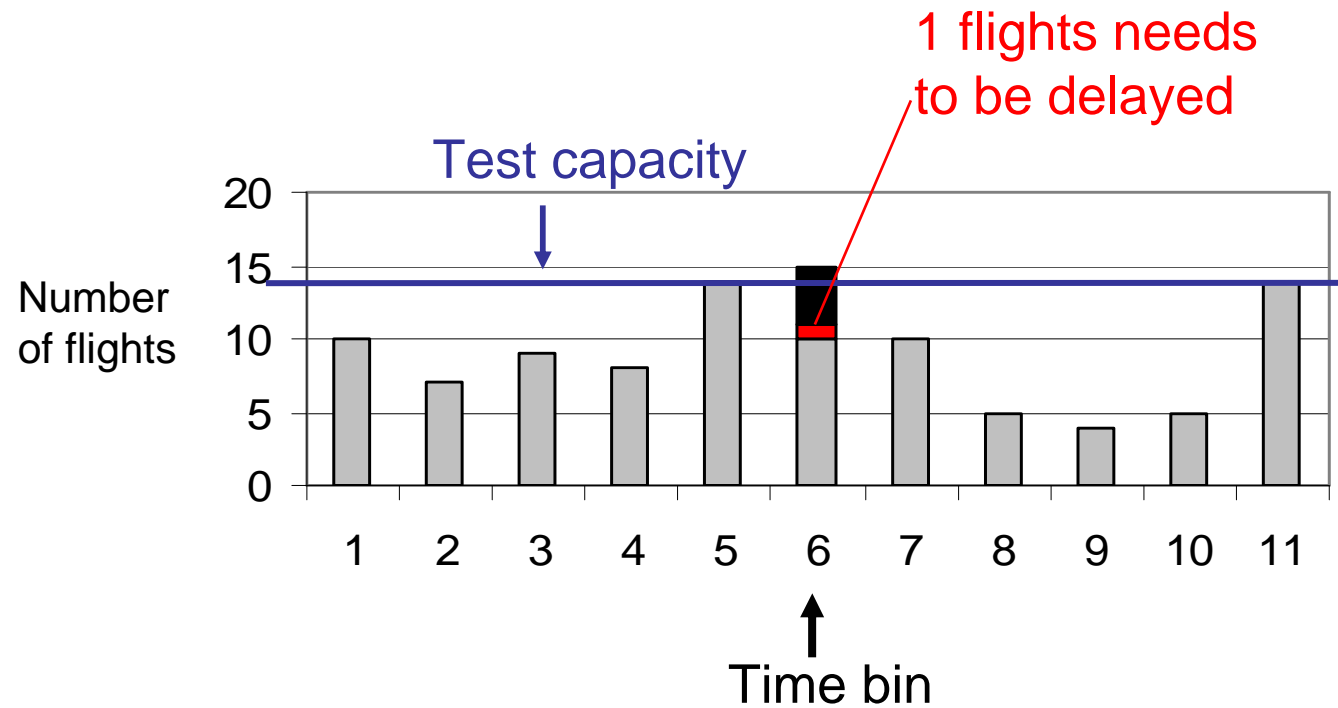
Bin size = Flight delay constraint

Required Capacity Algorithm



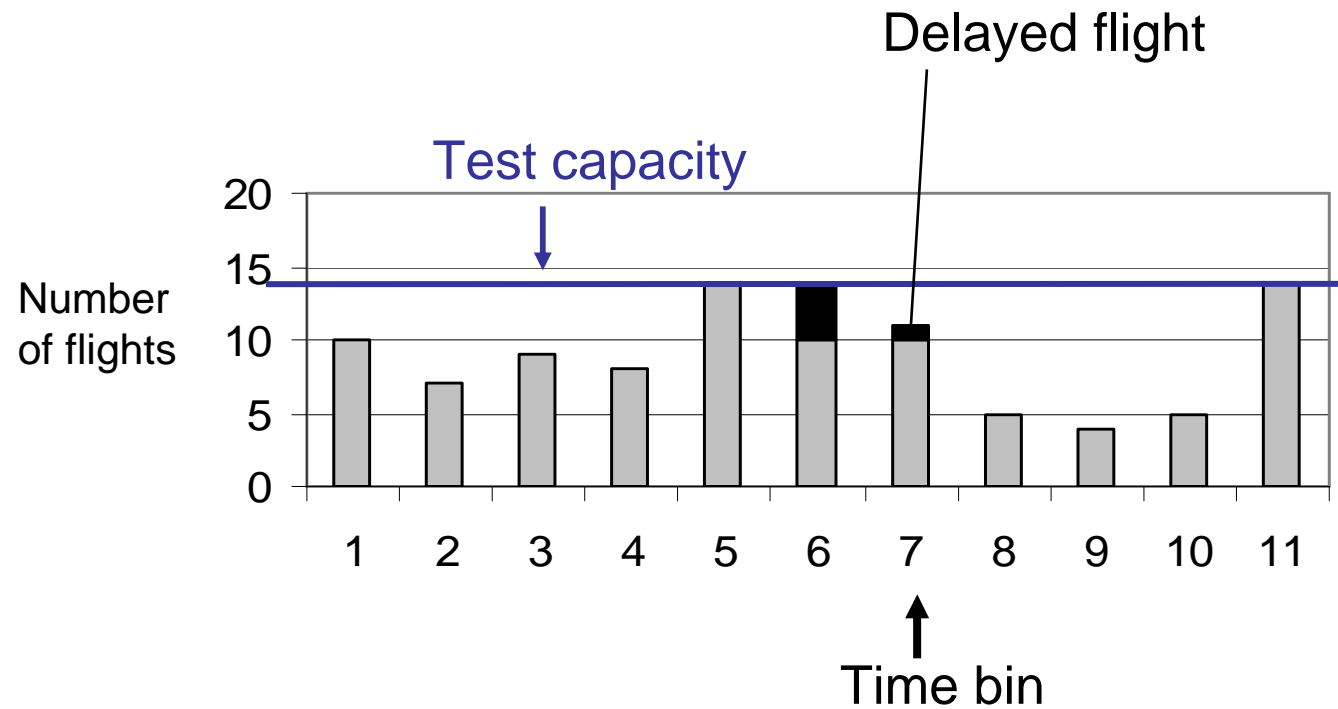
Bin size = Flight delay constraint

Required Capacity Algorithm



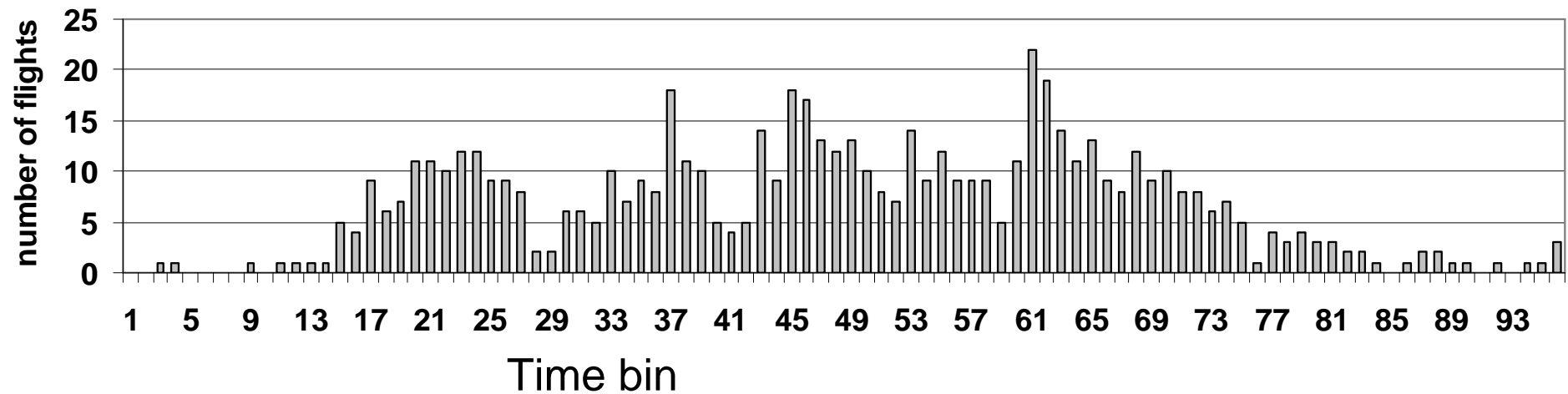
Bin size = Flight delay constraint

Required Capacity Algorithm



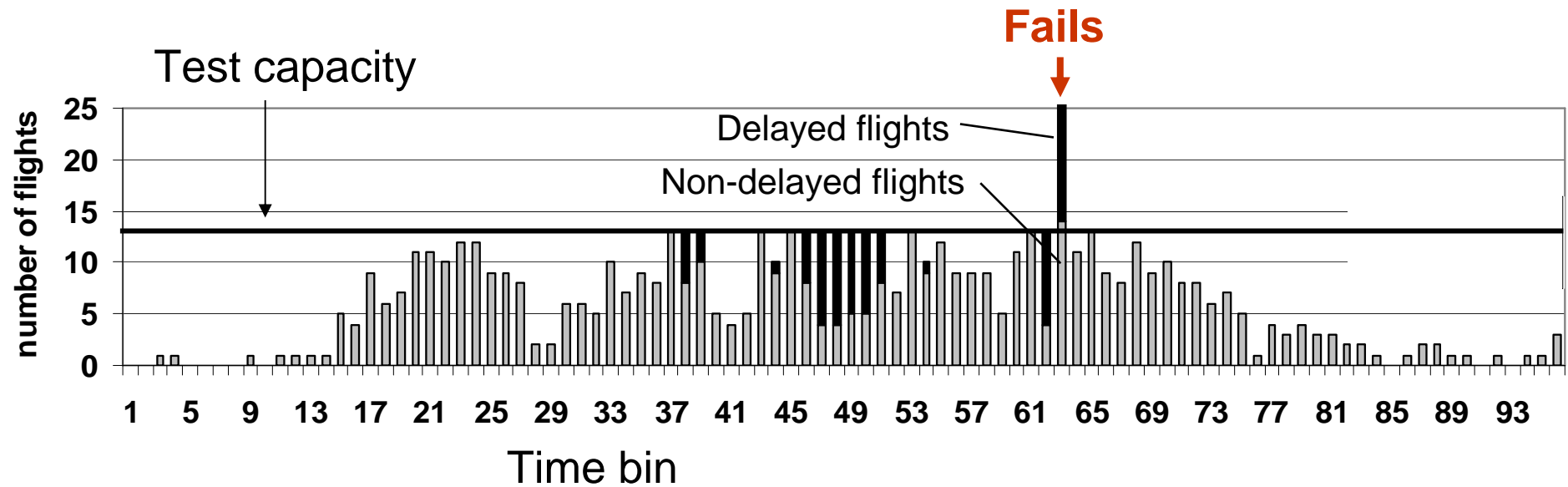
Estimator Example

Demand profile



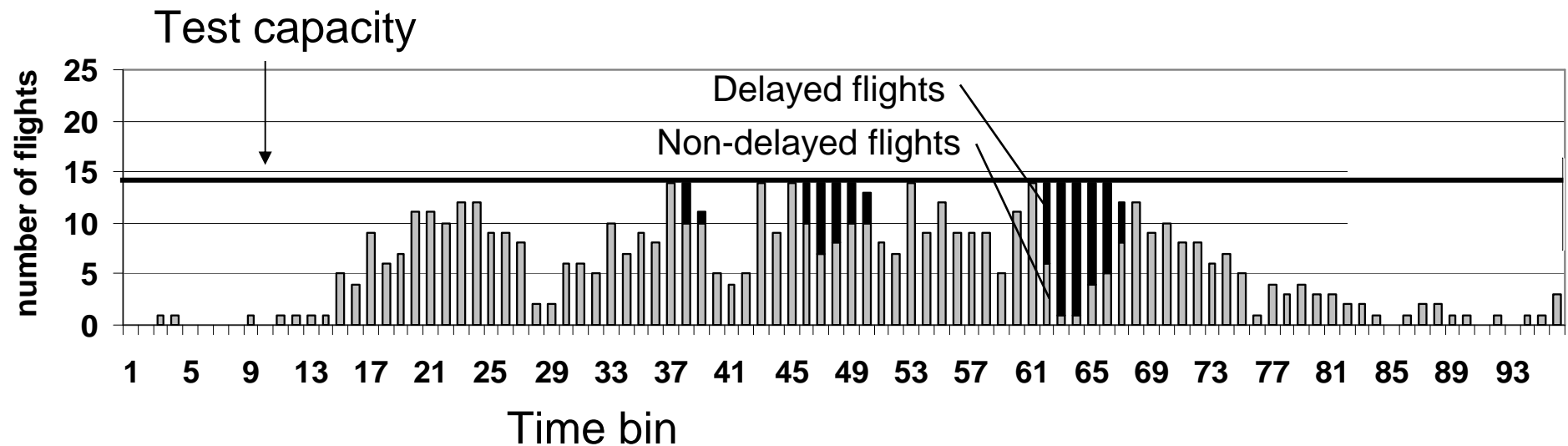
Estimator Example

Test required capacity fails



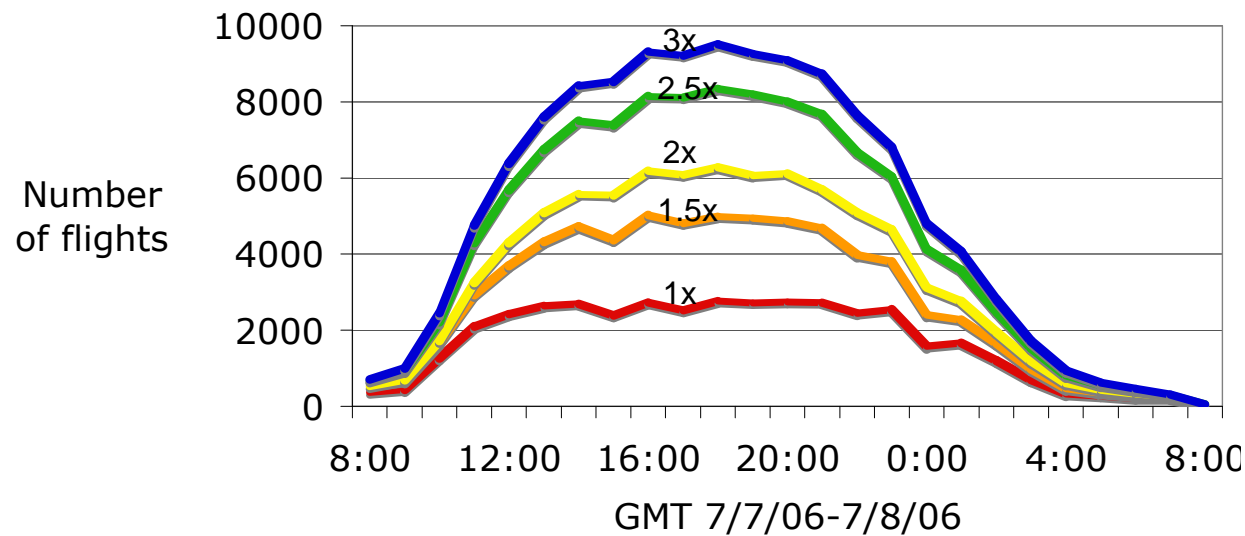
Estimator Example

Test required capacity **passes**



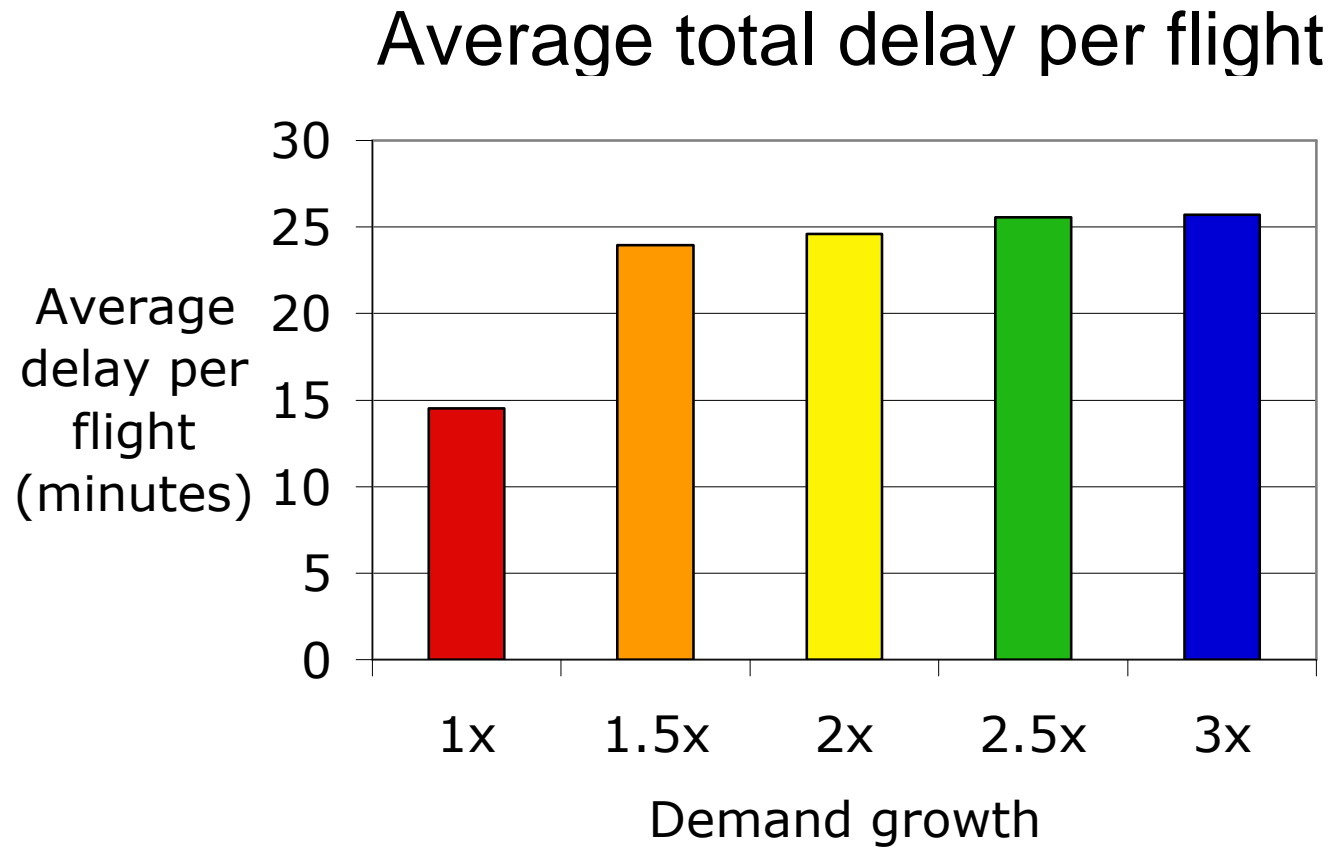
Validating Required Capacities in Simulation

Total scheduled gate departures per hour



Simulate these demand scheduled in Airspace Concept Evaluation System (ACES) using estimated required capacities.

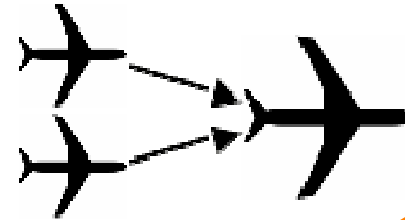
Simulation Delay Results



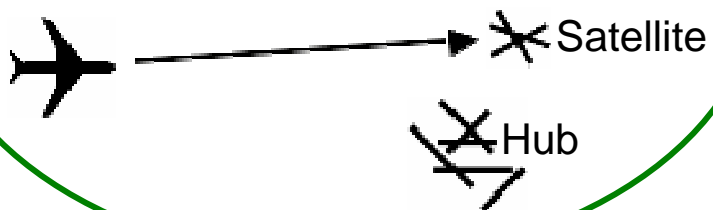
Possible Demand Futures

A. Unmodified demand growth

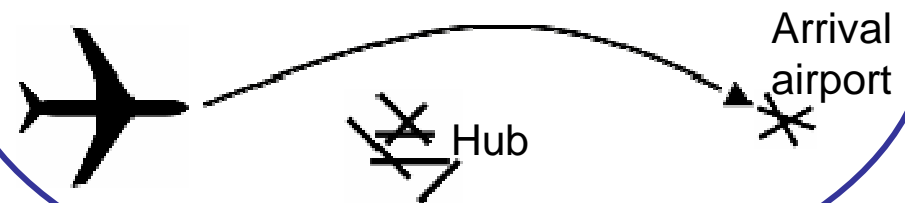
B. Combine flight with bigger aircraft



C. Divert hub passengers to satellite airports with smaller aircraft



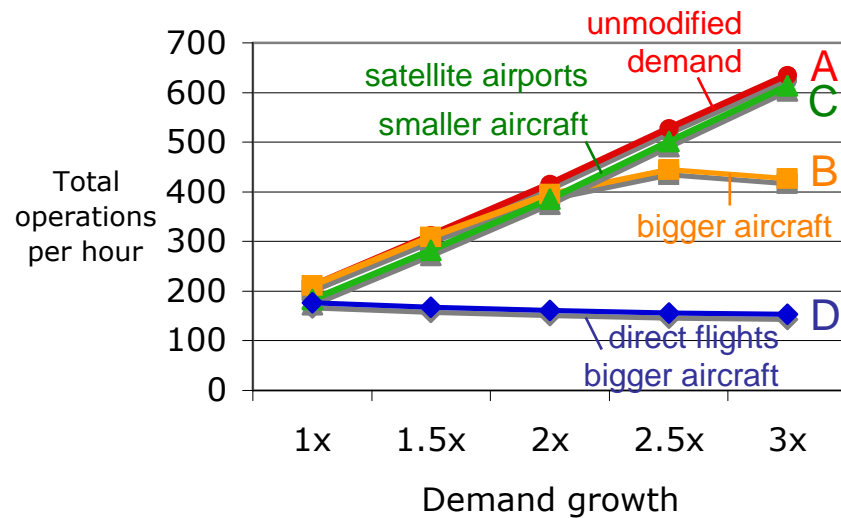
D. Divert connecting hub passengers to direct flights with bigger aircraft



Estimator Airport Analysis

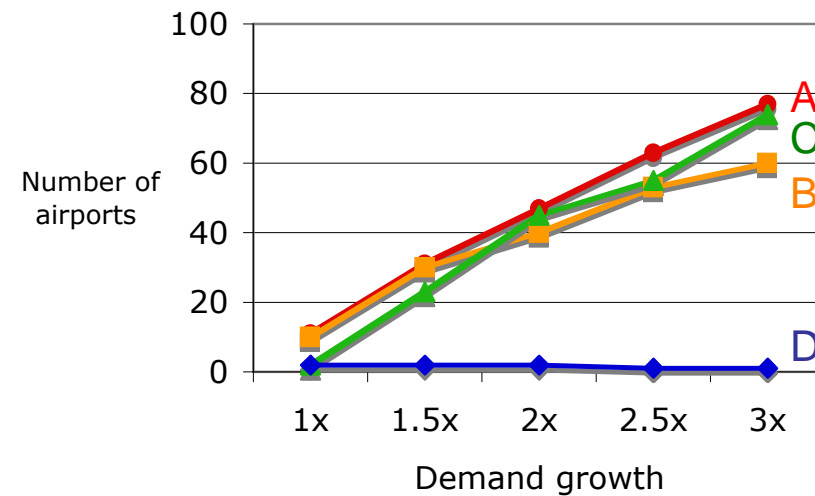
Depth

Maximum required airport capacity



Breadth

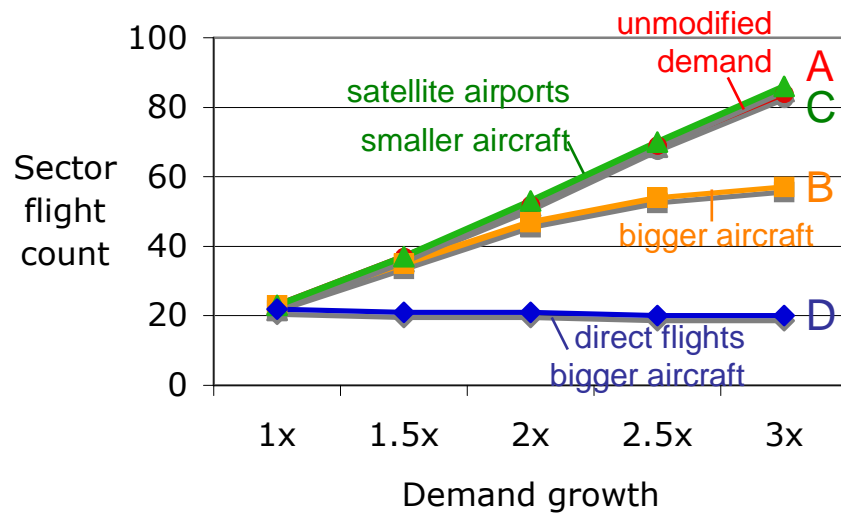
Number of airports requiring additional capacity over today



Estimator Sector Analysis

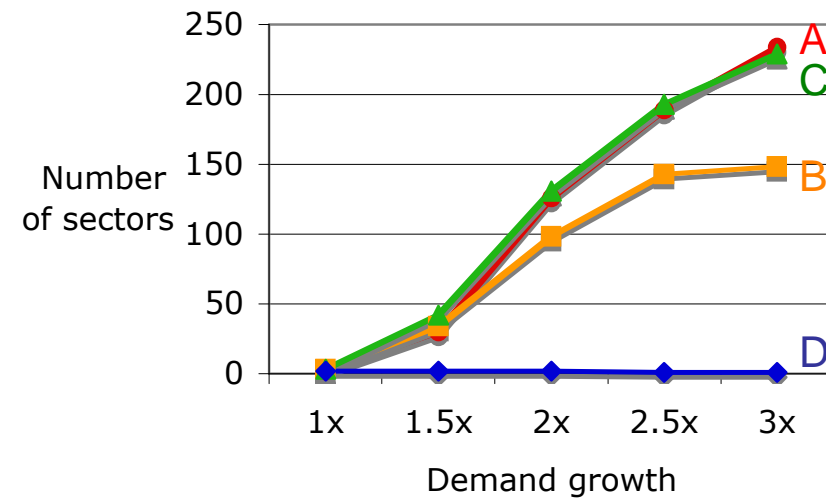
Depth

Maximum required sector capacity

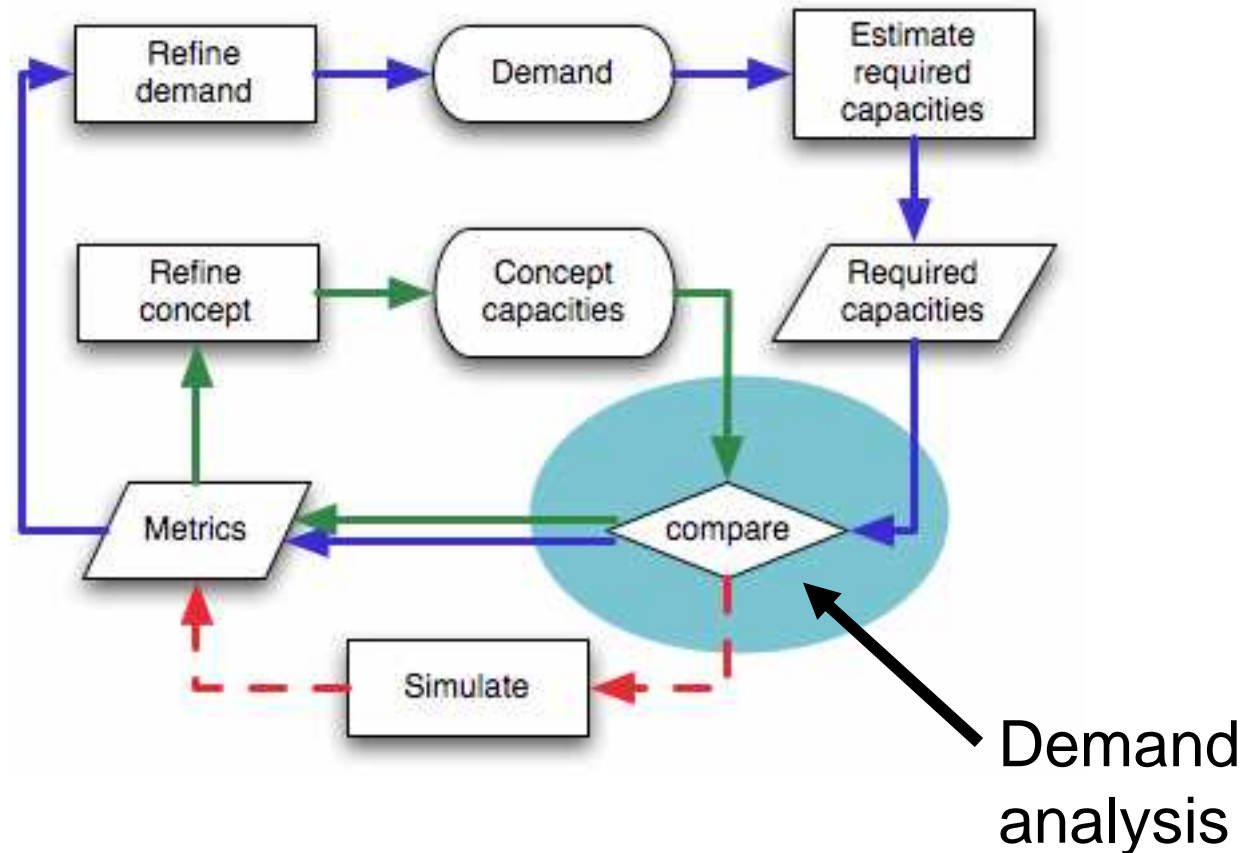


Breadth

Number of sectors requiring additional capacity over today



Proposed Design Process



Summary

- Estimate required capacities for use in a new design process.
- Required capacities depend on demand and delay constraints.
- Required capacities scale well in validation (delay curve flattens with respect to demand).
- Sample demand analysis shows the first step in the new design process.