



From Planning to Operations
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M.Sc. Program

Network, Fleet and Schedule
Strategic Planning
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Lecture Outline

- **Airline Operations Control**
 - System Operations Control Center Overview
 - Roles and Responsibilities
- **Irregular Operations**
 - Causes and Recovery Considerations
 - Example: Schedule Disruption
- **Ground Operations (Station Control)**
 - Aircraft Arrival and Departure Activities
 - Station Control Challenges at Hubs
- **Operational Variability and Delays**
 - Factors Affecting Flight Delays
 - On-time Performance and Cancellation Rates

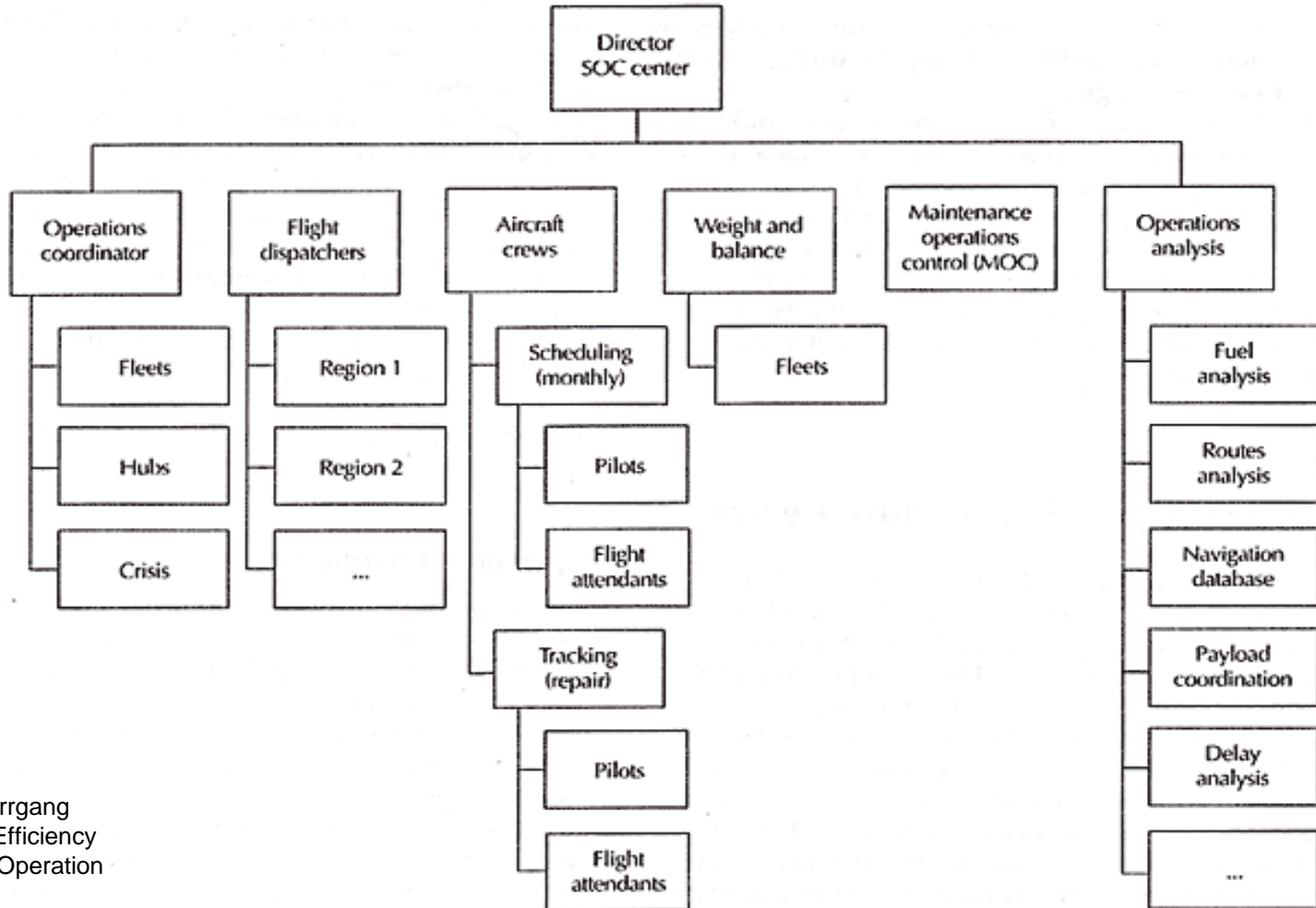
Airline Operations Control

- **System Operations Control**
 - Real-time coordination of all operations and decisions
 - Aircraft flow management and resource (re-)allocation under irregular operating conditions.
- **Dispatch Control**
 - Flight planning, given ATC preferred routes and company constraints/policies.
- **Station Control**
 - Turnaround management of aircraft arrivals/departures on the ground.

System Operations Control (SOC)

- **Coordinates the daily operations of the airline on a dynamic basis.**
- **Objective is to ensure that all flights are operated as close to the schedule plan as possible.**
- **Subject to additional goals and constraints:**
 - Safety of passengers, crew and aircraft
 - On time performance measures
 - Most economical routings and procedures
 - Provide aircraft for “swaps”, extra sections and charter operations

Systems Operations Control Structure



Source: Michael Irrgang
Airline Operational Efficiency
Handbook of Airline Operation

Figure 12-5 The SOC Center of an Efficient Airline.

Typical Airline SOCC Goals

- **Ensure a safe, on-time and efficient operation**
- **Monitor weather conditions worldwide; issue weather alerts**
- **Implement Severe Weather Action Plan (SWAP) as necessary**
- **Monitor flight irregularities, implement recovery plans**
- **Quickly return the schedule to on-time after major disruptions**
- **Communicate effectively with all entities**
- **Make notifications to senior management and others in a timely manner**
- **Use Voice Mail System to broadcast routine operational updates**

Irregular Operations – Causes

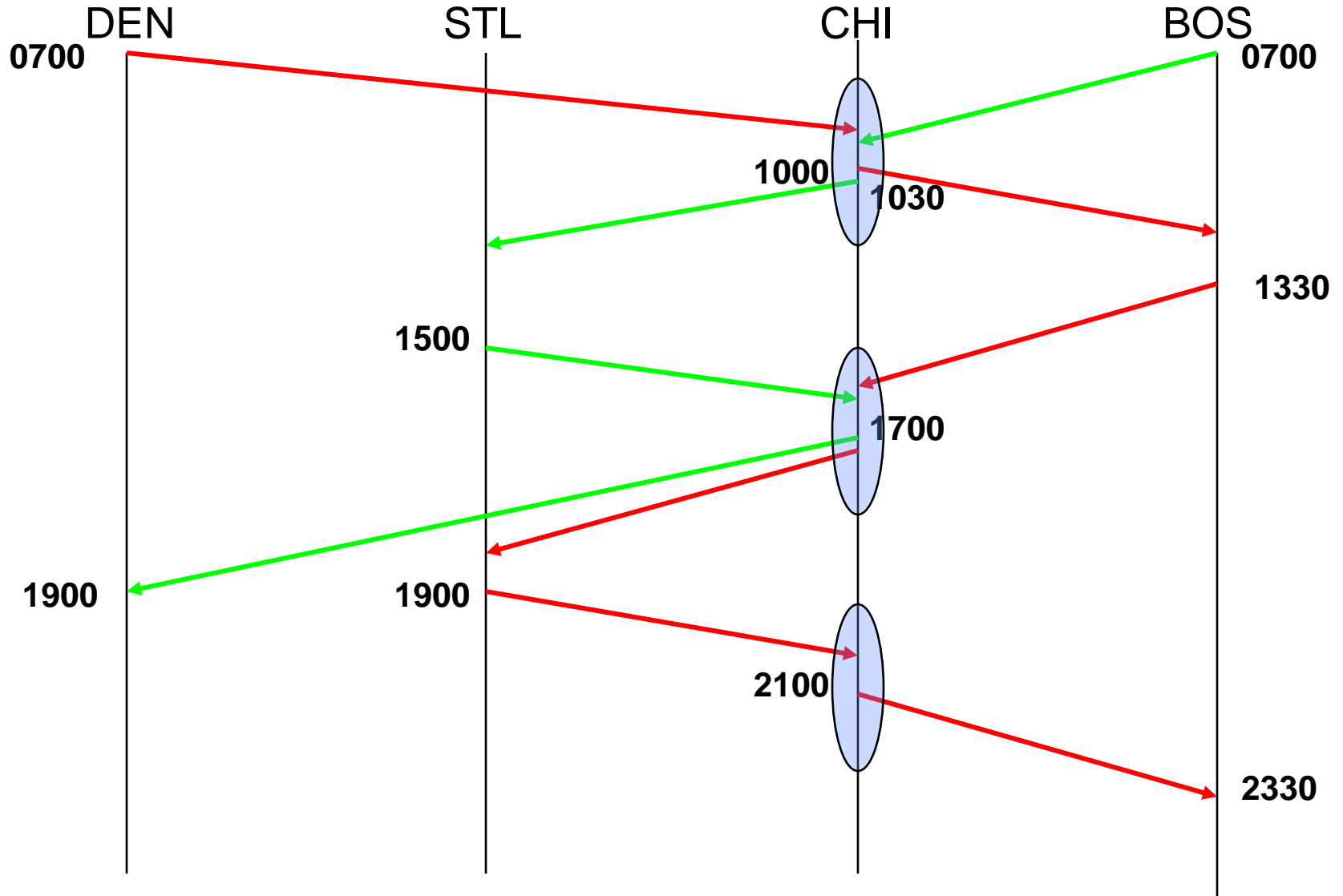
- **Weather/ATC/maintenance delays**
- **Diversions – weather/mechanical/medical**
- **Weight restrictions**
- **Planned/unplanned fuel stops**
- **Civil unrest/strikes**
- **Fuel shortages/facilities problems**
- **Capacity constraints/airport configurations**

SOC Recovery Considerations

- **Number of customers inconvenienced**
- **Re-protection for the customers**
- **Special considerations – air/sea groups, sports groups**
- **Down-line impact on other customers**
- **Complexity of balancing aircraft rotations and crew routings**
- **Maintenance requirements (Line and/or Base)**
- **Market integrity (completion factor, on-time performance)**
- **ATC slot protection (LGA/ORD/DCA)**
- **Weather considerations – Severe Weather Action Plan**
- **Route profitability, all else being equal**

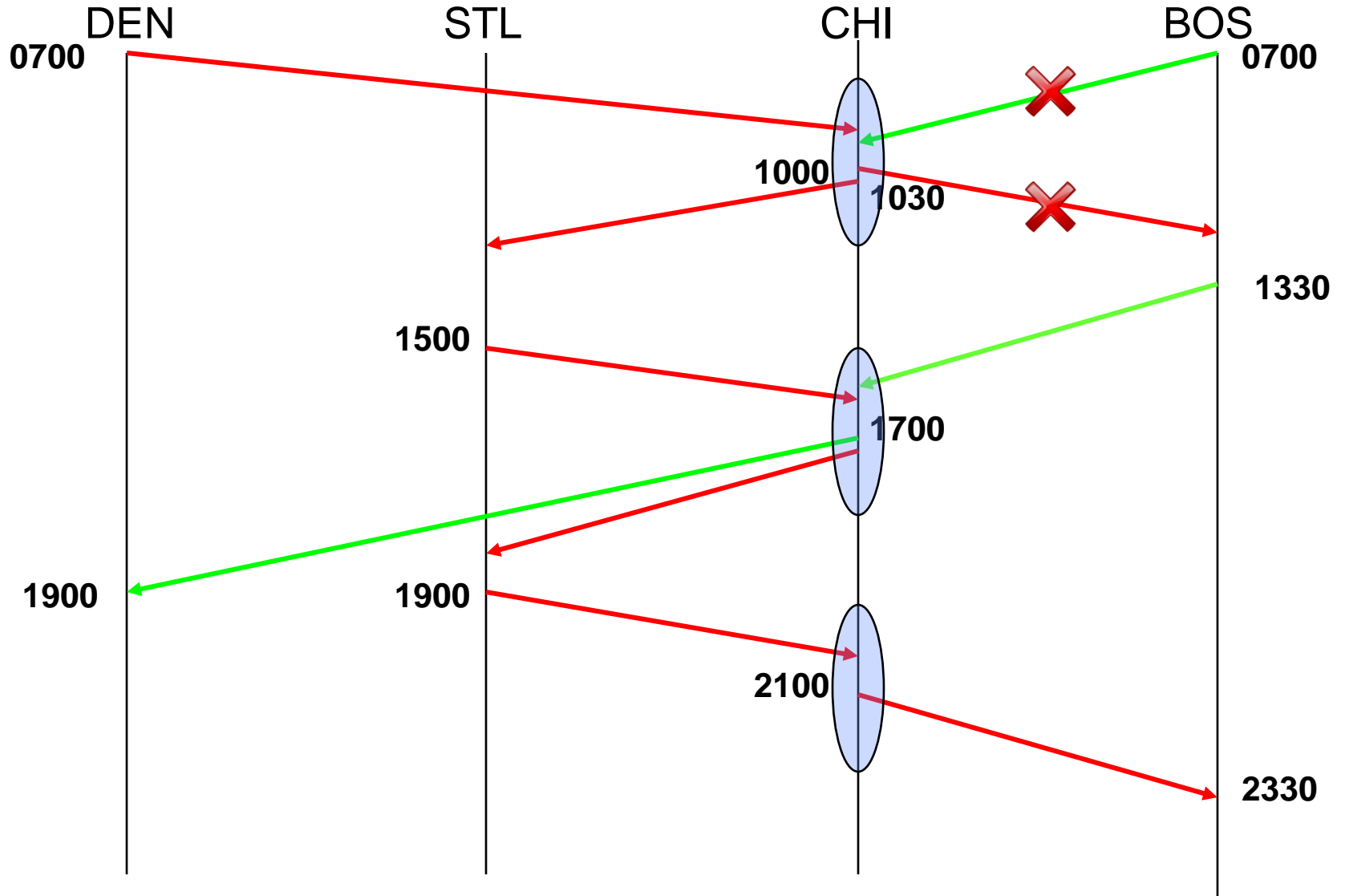
Example: Schedule Disruption

5-hour Snow Delay at BOS for 0700 Flight



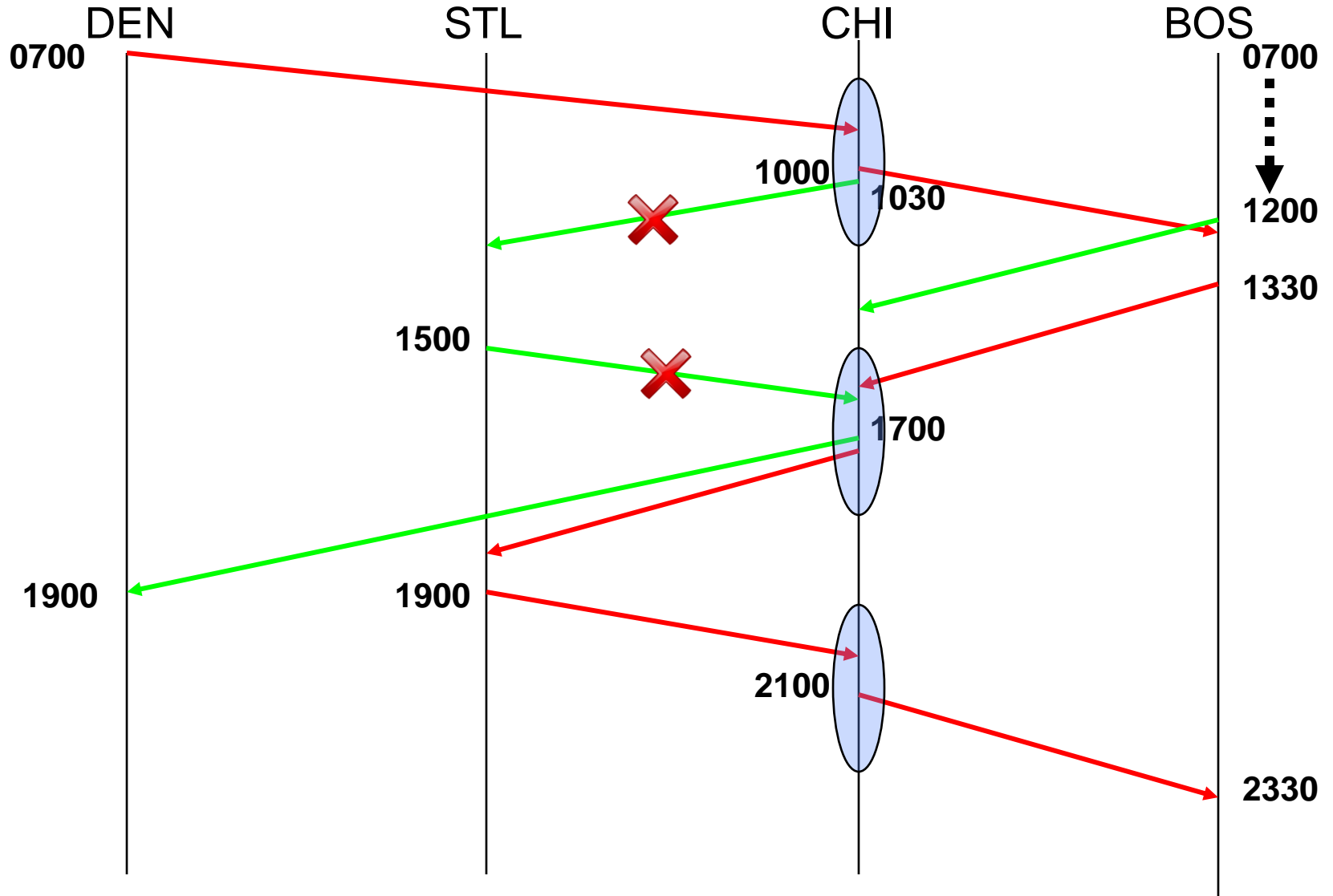
Option 1: Cancel 0700 BOS-CHI

CHI-BOS must be cancelled; aircraft re-routed



Option 2: Delay 0700 BOS-CHI to 1200

Cancel CHI-STL-CHI turn; aircraft rotations intact



Ground Operations (Station Control)

- **Overall objective is to ensure completion of schedule plan within company goals for on-time performance without compromising safety.**
- **Process passengers, baggage and cargo subject to numerous operational constraints:**
 - Limited number of gates, many with constraints on aircraft size
 - Airport flow limitations on taxiways and runways
 - Availability of airport and ground crew resources
 - Weather (both local and en route) as well as airport field conditions
 - Air traffic control (ATC) congestion and delays

Minimum Aircraft Turnaround Time

- **To achieve on-time performance, efficient turnaround of aircraft at stations is essential:**
 - “Minimum Objective Ground Time” (MOGT) sets a standard for minimum time necessary to prepare an arriving aircraft for departure on its next flight.
 - Determined with time studies by industrial engineers, and specified for each aircraft type, perhaps differently by airport.
 - Planned schedules typically exceed MOGT at least periodically to allow for additional buffer in case of unexpected delays, to preserve acceptable average on-time performance.

Aircraft Arrival Activities

- **“Above The Wings”**
 - Pre-position the jet bridge 5 minutes before planned arrival time
 - Open door and deplane passengers
 - Cabin interior cleaning
- **“Below The Wings”**
 - Ensure aircraft ramp is clear of equipment
 - Stage required ground equipment (baggage carts given aircraft load)
 - Direct aircraft to gate
 - Chock wheels
 - Position baggage conveyors and carts
 - Unload bags or containers from aircraft holds
 - Service aircraft lavatories
 - Replenish potable water

Aircraft Departure Activities

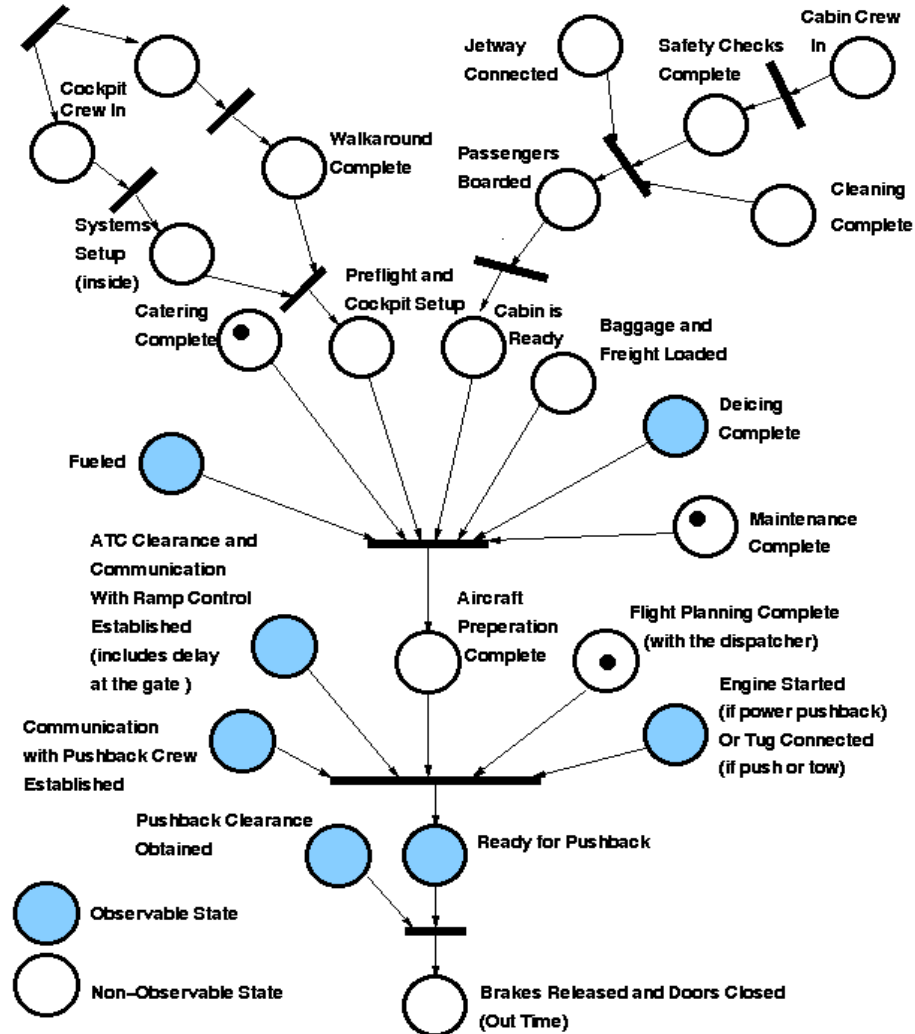
- **“Above The Wings”**

- Check in passengers and perform required security screening
- Cater aircraft with food and beverages
- Process upgrade and standby requests; board passengers
- Perform flight close-out – updates passenger records and loads

- **“Below The Wings”**

- Load baggage or containers
- Perform “walk-around” (visual check of entire aircraft)
- Update load plans given final passenger count and cargo volume
- Pushback and start aircraft engines
- Stage ground equipment for next arrival

On Gate Departure Preparation



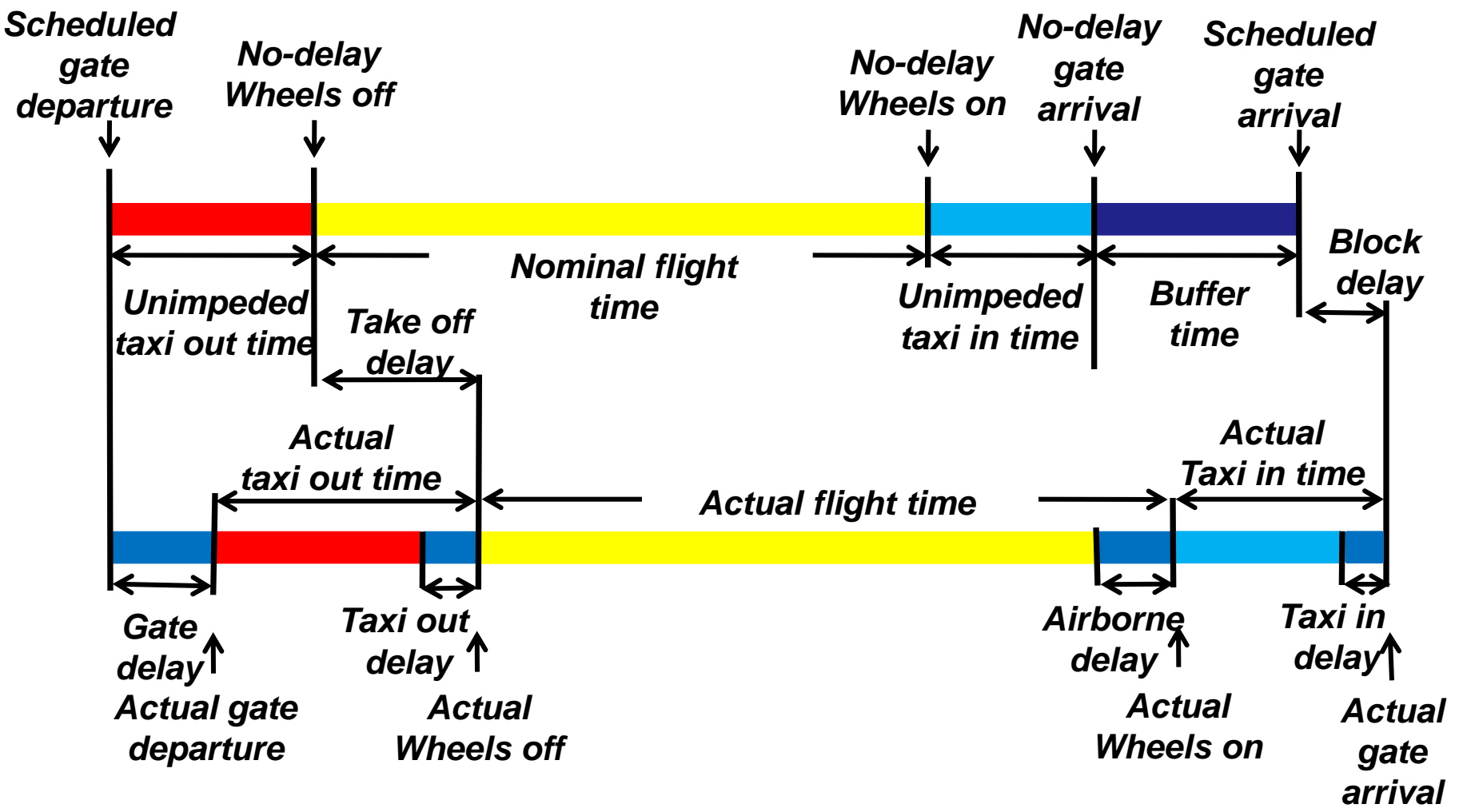
Petri Net Analysis

Source: Prof. John Hansman

Station Control Challenges at Hubs

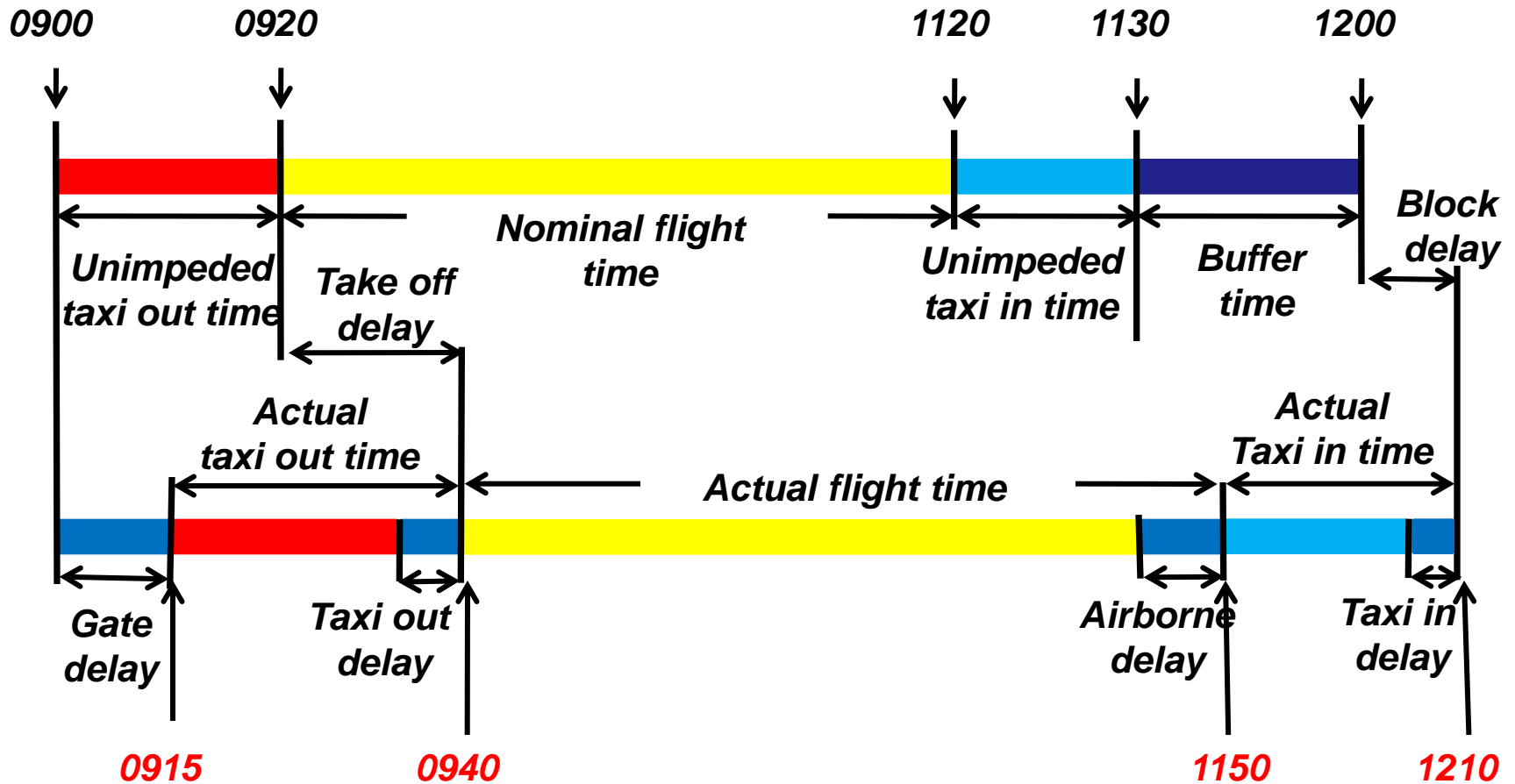
- **Ensuring that passengers and baggage make connecting flights.**
- **Decisions to hold or release flights without connecting passengers and/or bags depend on:**
 - Number of flights from hub to destination
 - Seats available on subsequent flights to destination
 - Aircraft schedule/routing for remainder of the day
 - Local hotel availability and costs for misconnects
- **Some airlines now use optimization tools to make hub operational decisions.**

Operational Variability and Flight Delays



Source: Gerasimos Skaltsas

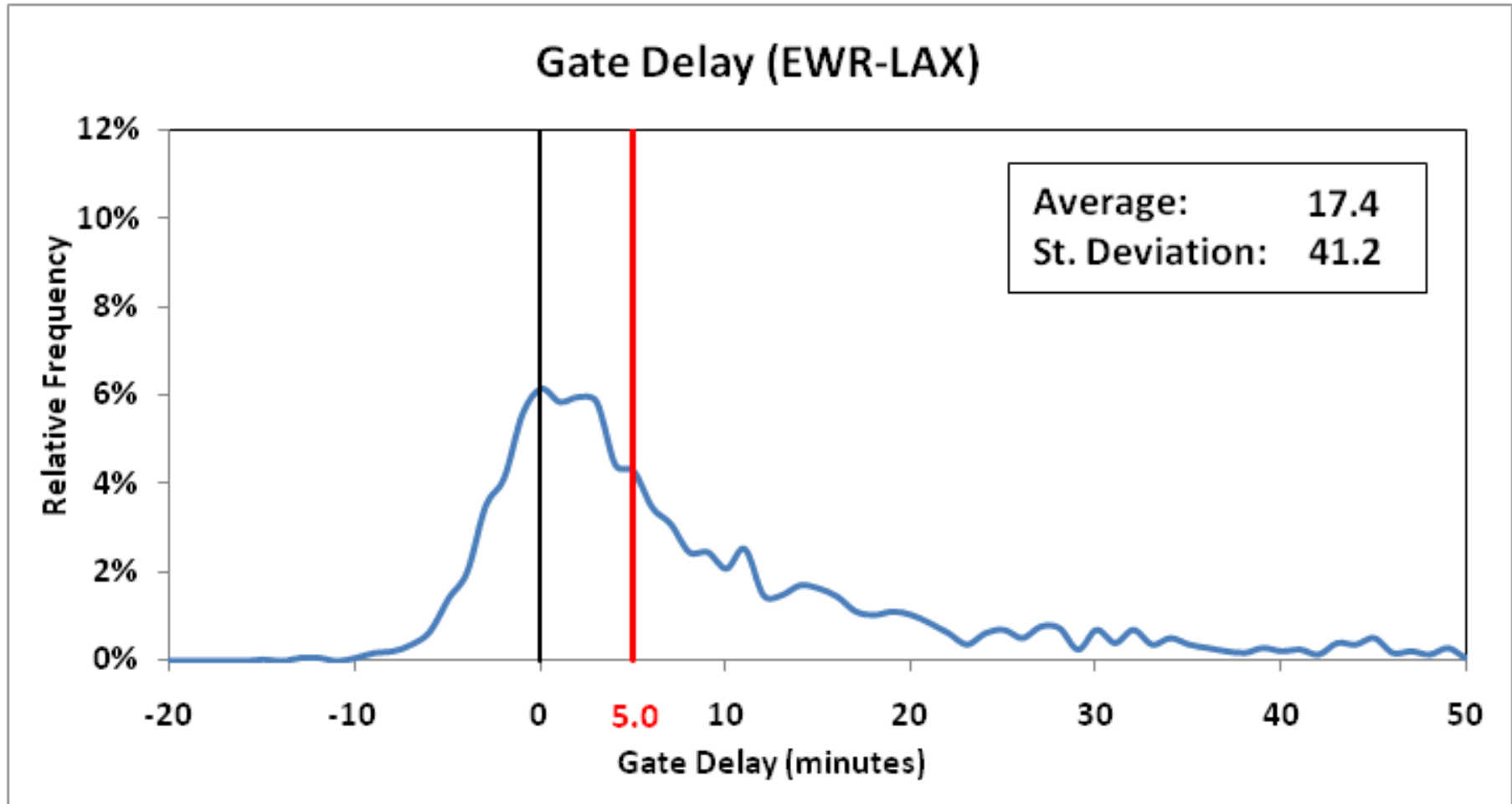
Example: Planned vs. Actual Flight Times



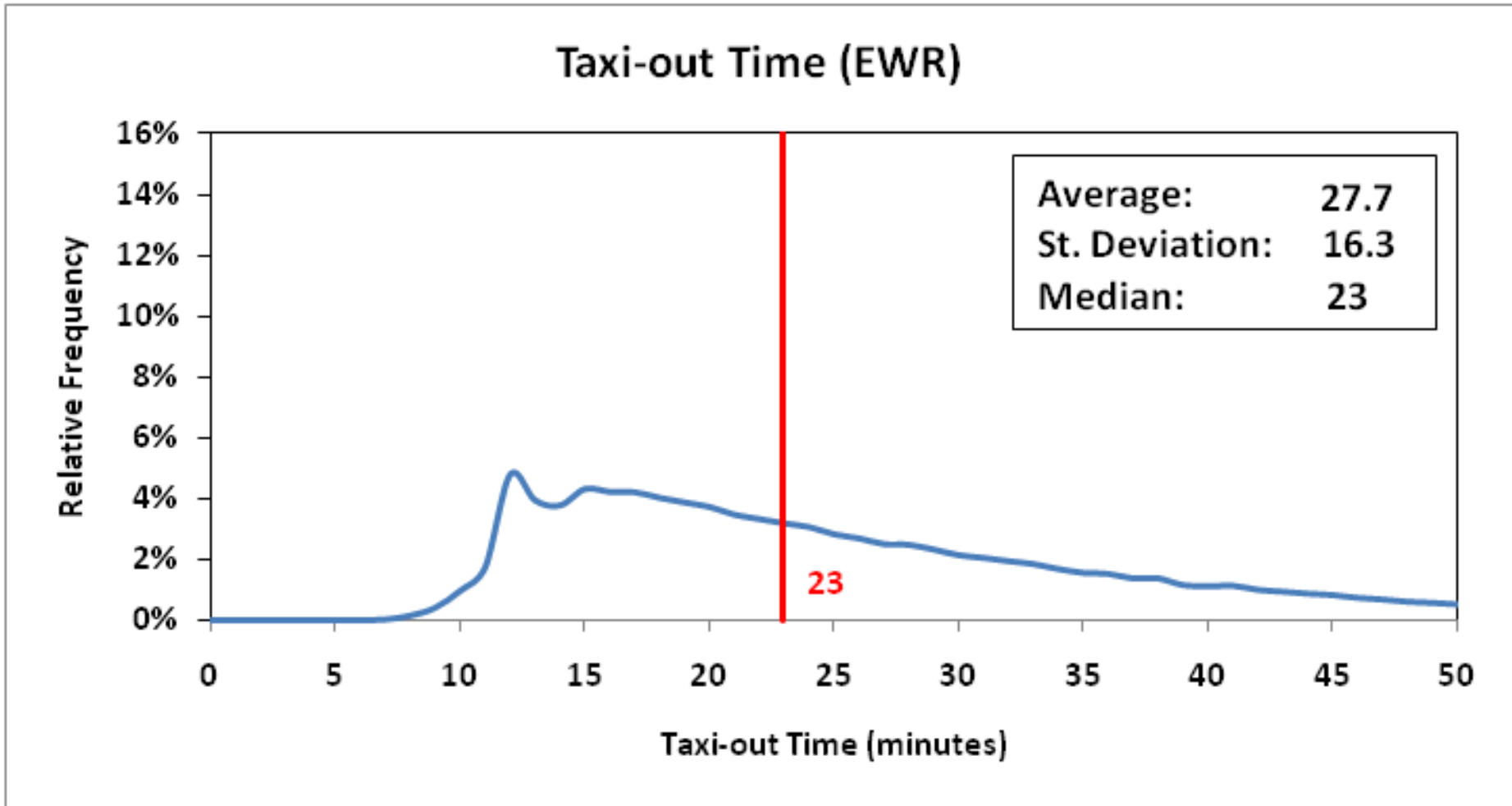
Where and Why Delays Can Occur

- **At the gate**
 - Unavailable aircraft
 - Unavailable crew
- **Taxi out**
 - Weather
 - Congestion
 - Ground delay program or ground hold
- **Airborne time**
 - Congestion
 - Weather
- **Taxi in**
 - Congestion
 - Weather
 - Gate blockage

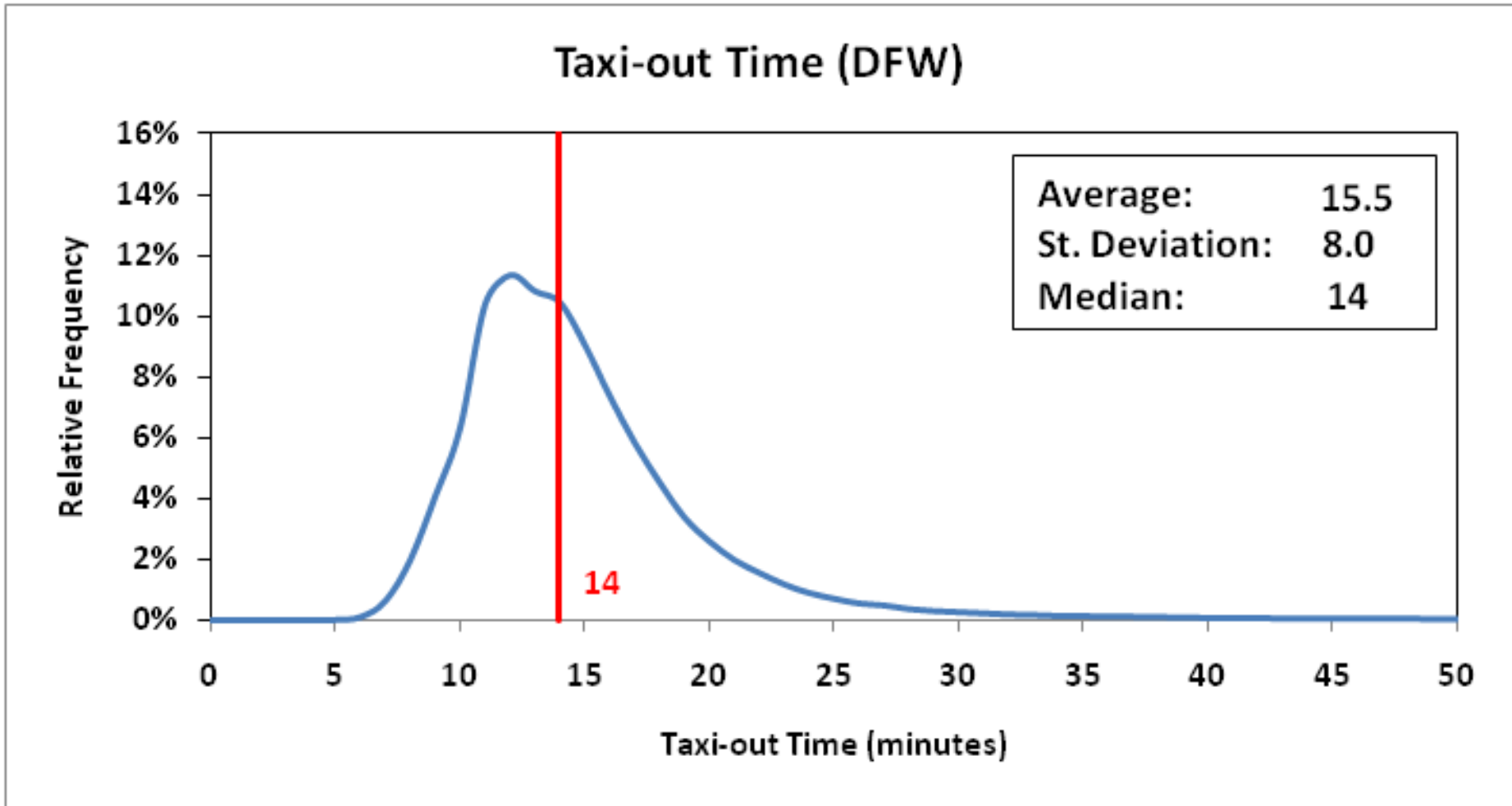
GATE DELAY = Actual Gate Departure – Scheduled Gate Departure



Taxi Out Time Distribution EWR



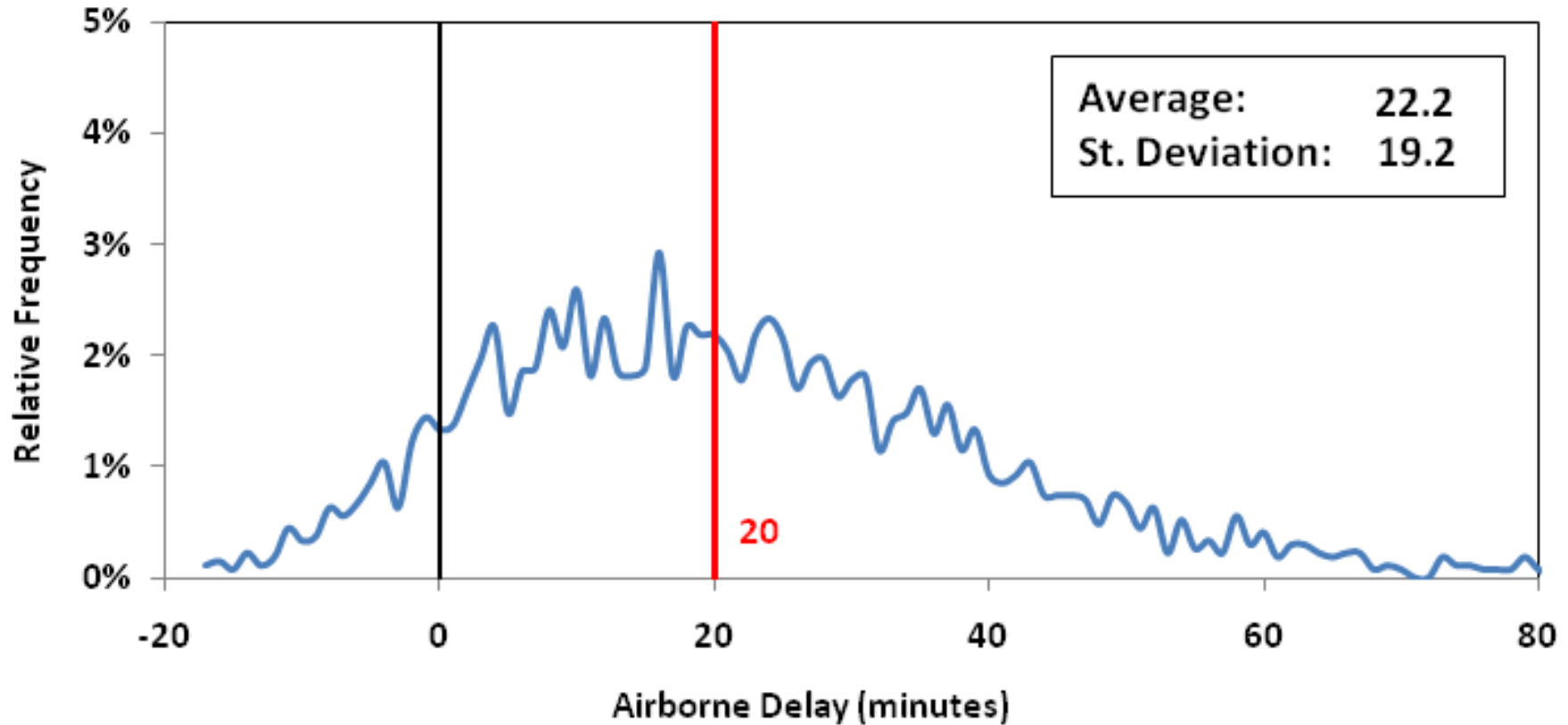
Taxi Out Time Distribution DFW



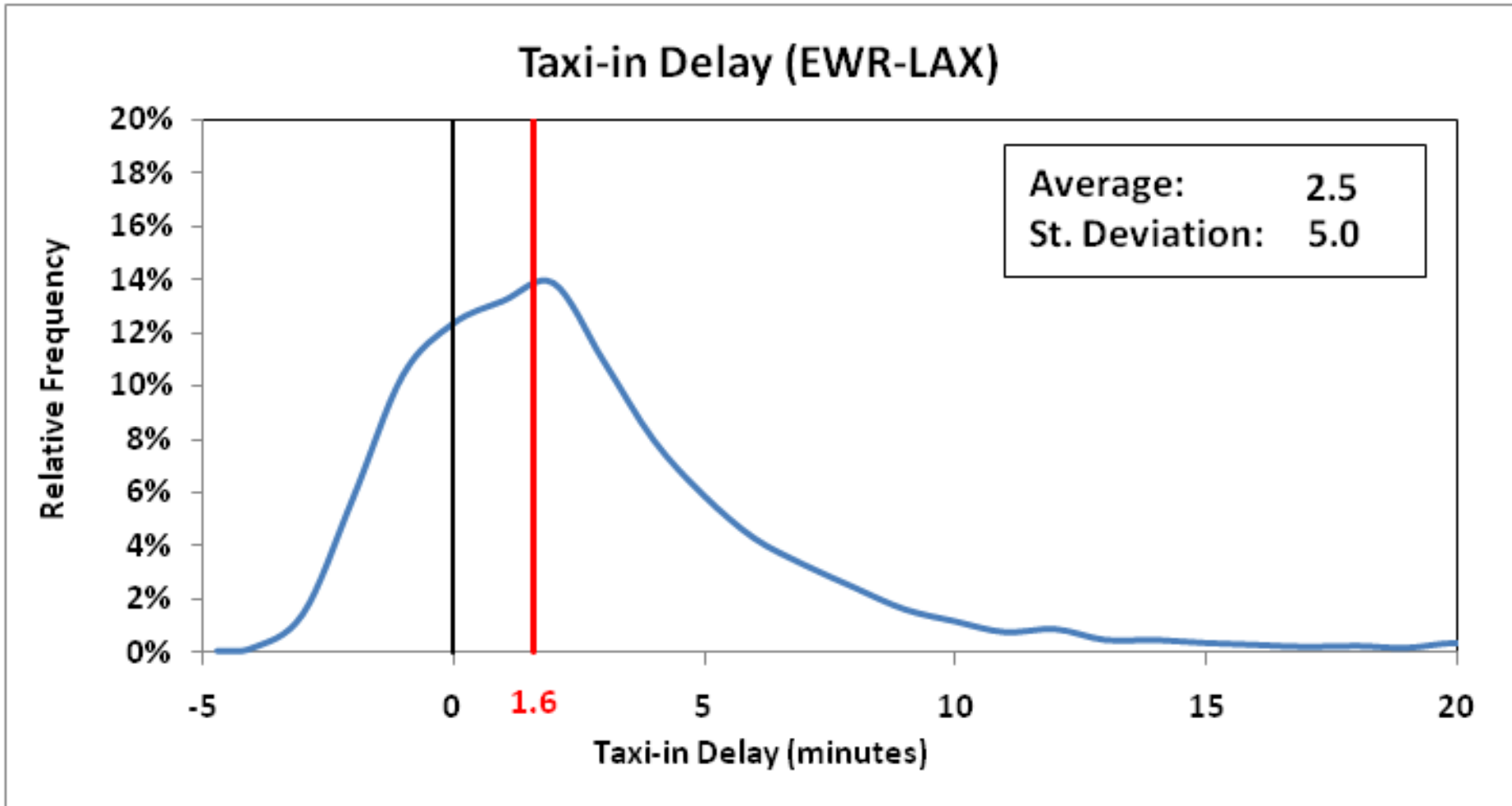
Source: Gerasimos Skaltsas

AIRBORNE DELAY = Actual Flight Time – Nominal Flight Time

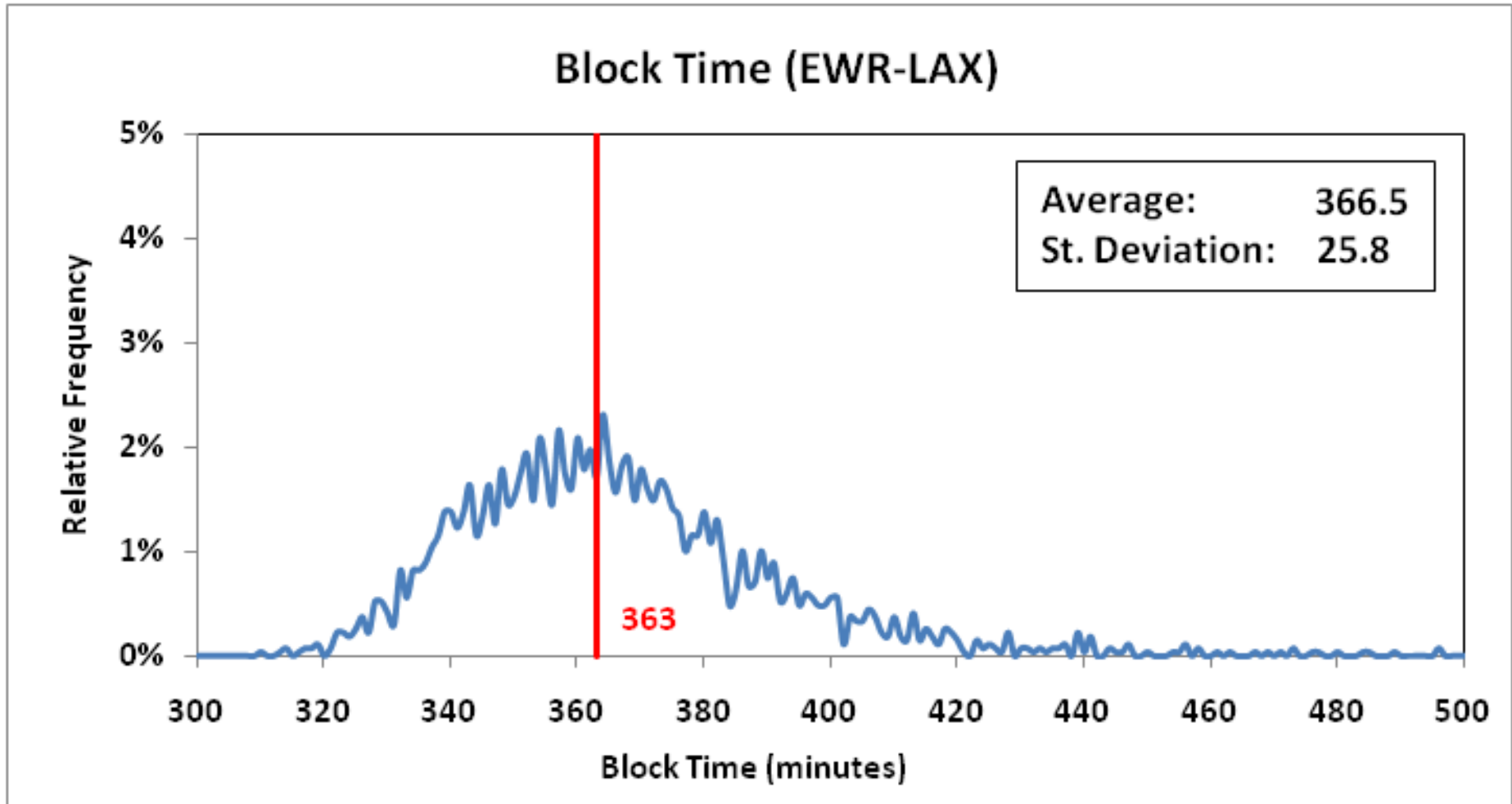
Airborne Delay based on Nominal Flight Time (EWR-LAX)



TAXI IN DELAY = Actual Taxi-In Time – Nominal Taxi-In Time (Airport, Carrier)

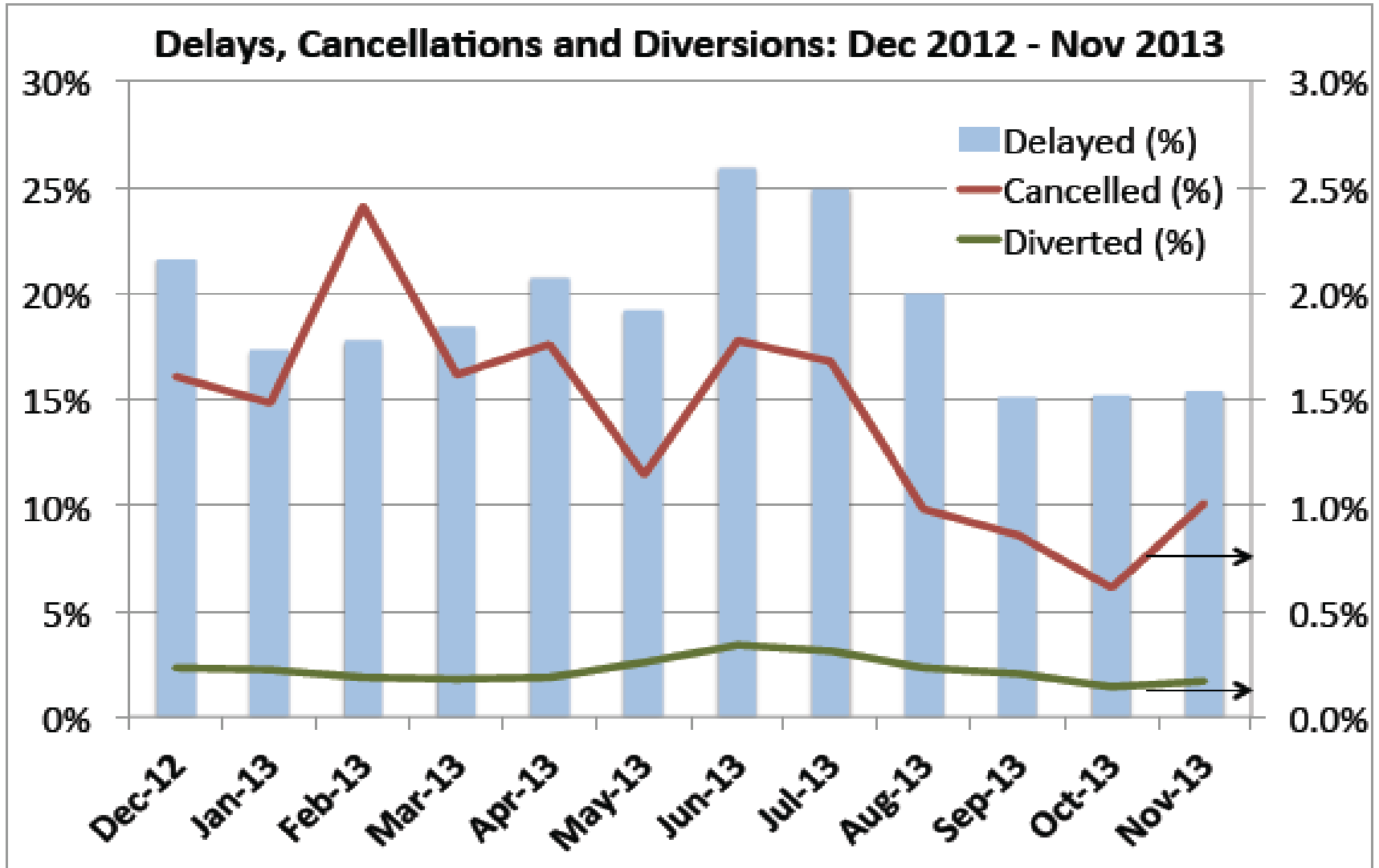


Variability in Actual Block Times

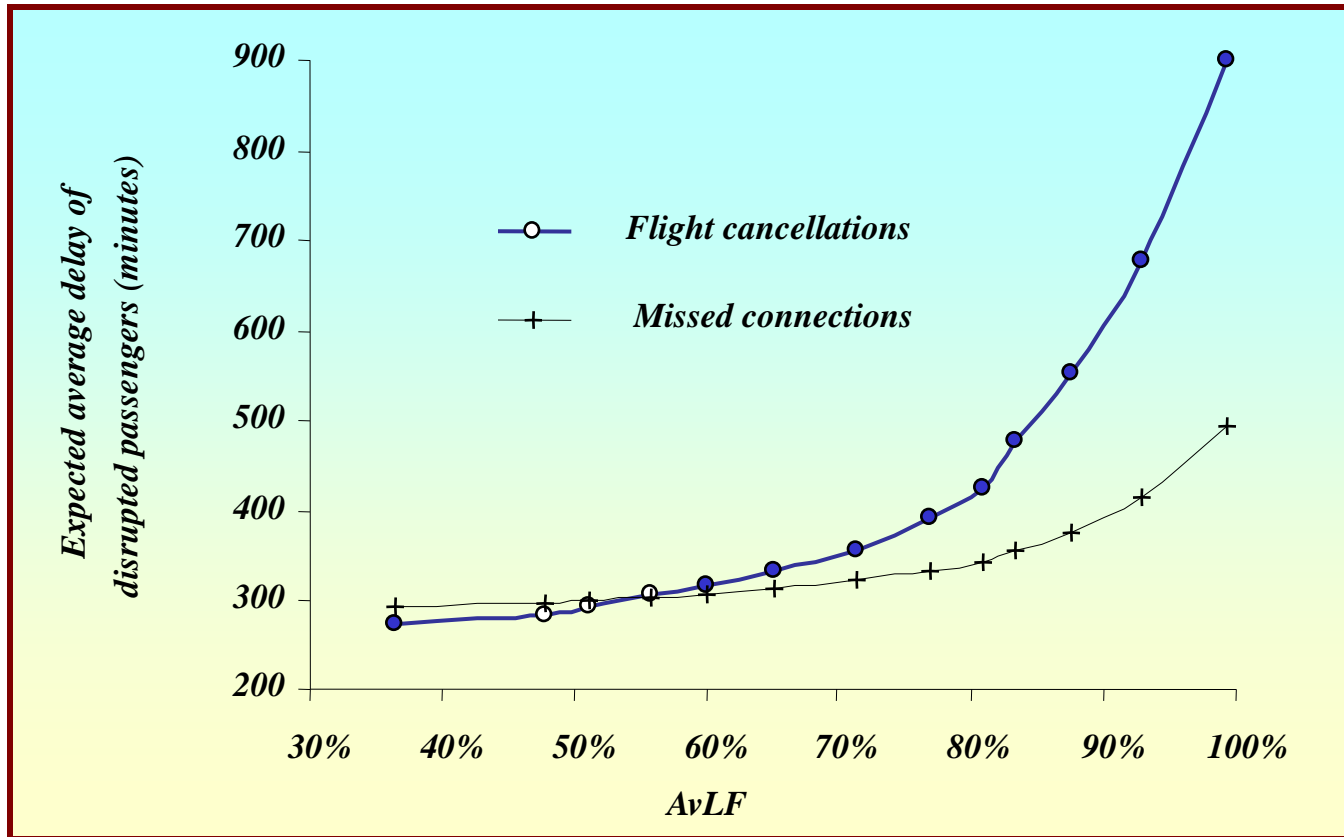


Source: Gerasimos Skaltsas

% of Flights with Arrival Delay > 15 minutes (US Domestic Flights December 2012–November 2013)



Impacts on Passengers: Missed Connections and Re-accommodation



Passengers, disrupted because of a flight cancellation, become increasingly more difficult to re-accommodate as load factors increase