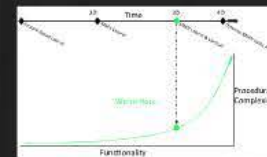


How Procedures Have Changed

No Procedures

Flying was dangerous and not standardized



Instrument Approach Procedures

A method to consistently guarantee terrain clearance



STARs (conventional)



STARs (RNAV OPD)



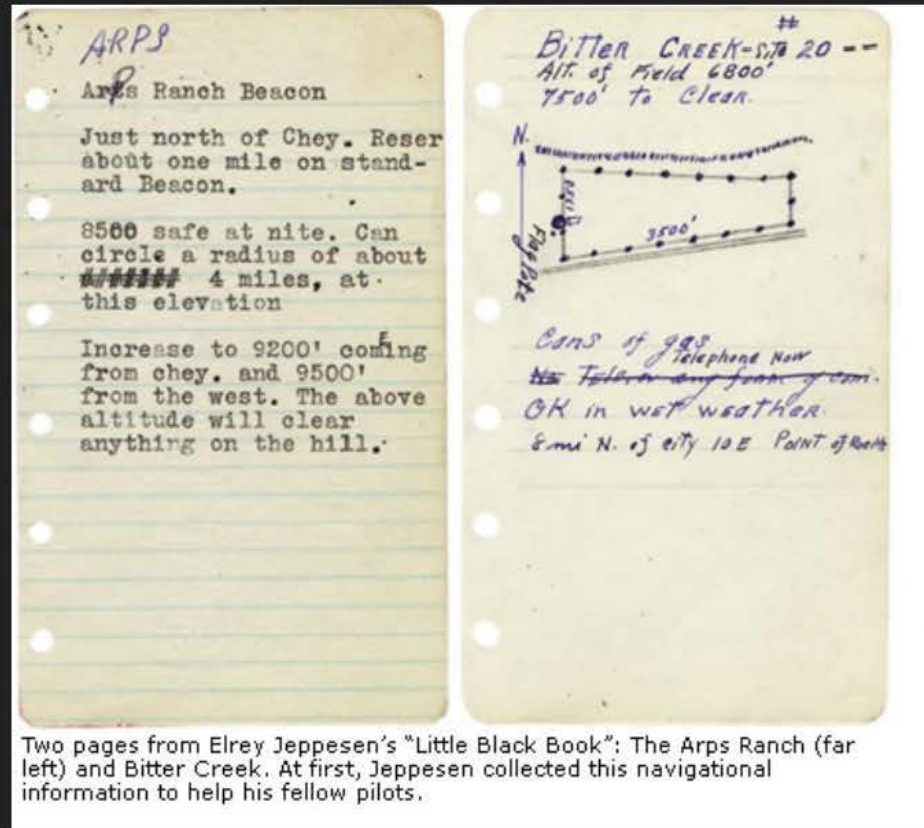
Noise reduction, fuel savings, route standardization, and flow management. (FAA, 2014)

No Procedures

Flying was dangerous and
not standardized

Instrument Approach Procedures

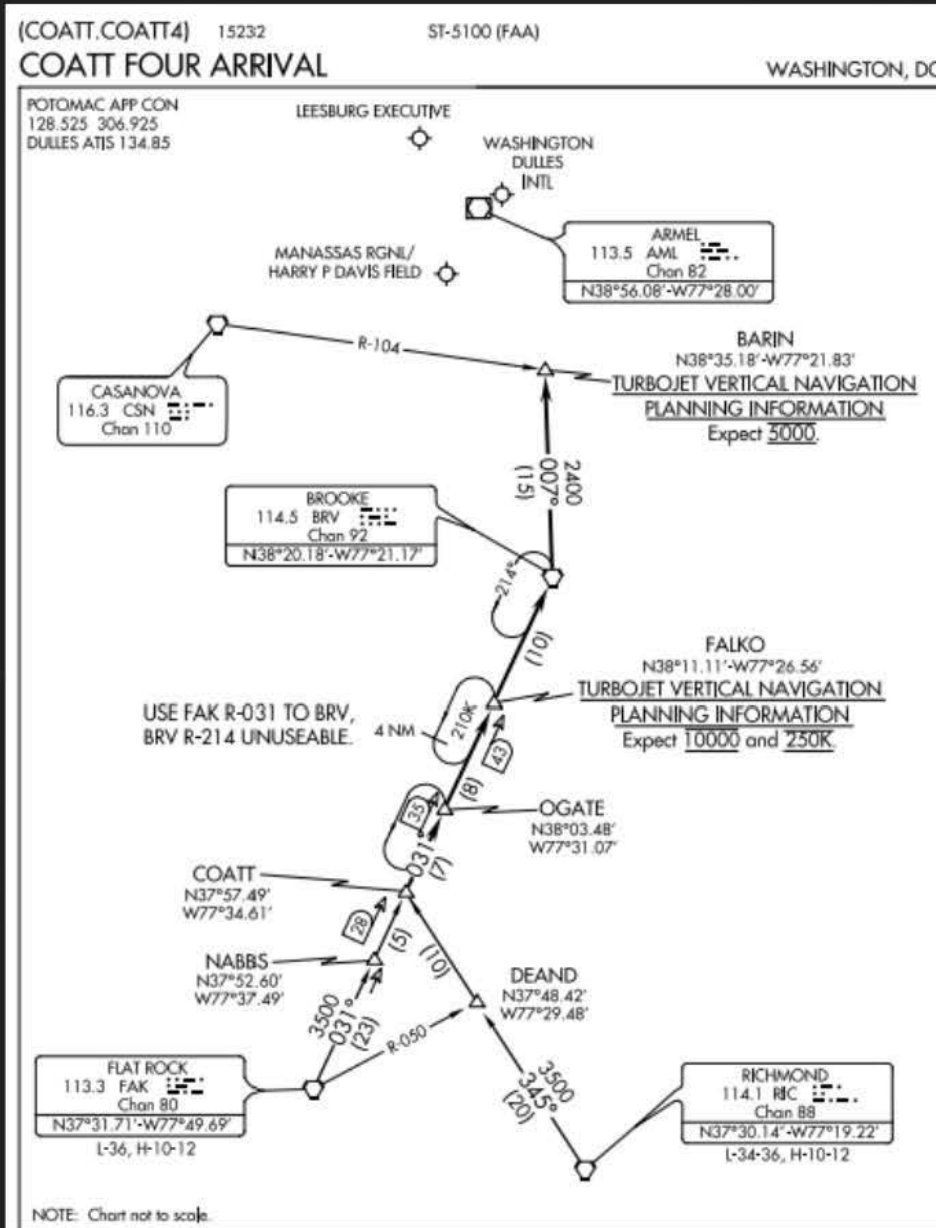
A method to consistently guarantee terrain clearance



Two pages from Elrey Jeppesen's "Little Black Book": The Arps Ranch (far left) and Bitter Creek. At first, Jeppesen collected this navigational information to help his fellow pilots.

STARs (conventional)

Standardized Routing & Terrain Clearance



STARs (RNAV OPD)

(ROBUC.ROBUC2) 16147 ST-58 (FAA)
GENERAL EDWARD LAWRENCE LOGAN INTL (BOS)
ROBUC TWO ARRIVAL (RNAV) Arrival Routes BOSTON, MASSACHUSETTS

BOSTON APP CON
120.6 263.1
ATIS
135.0

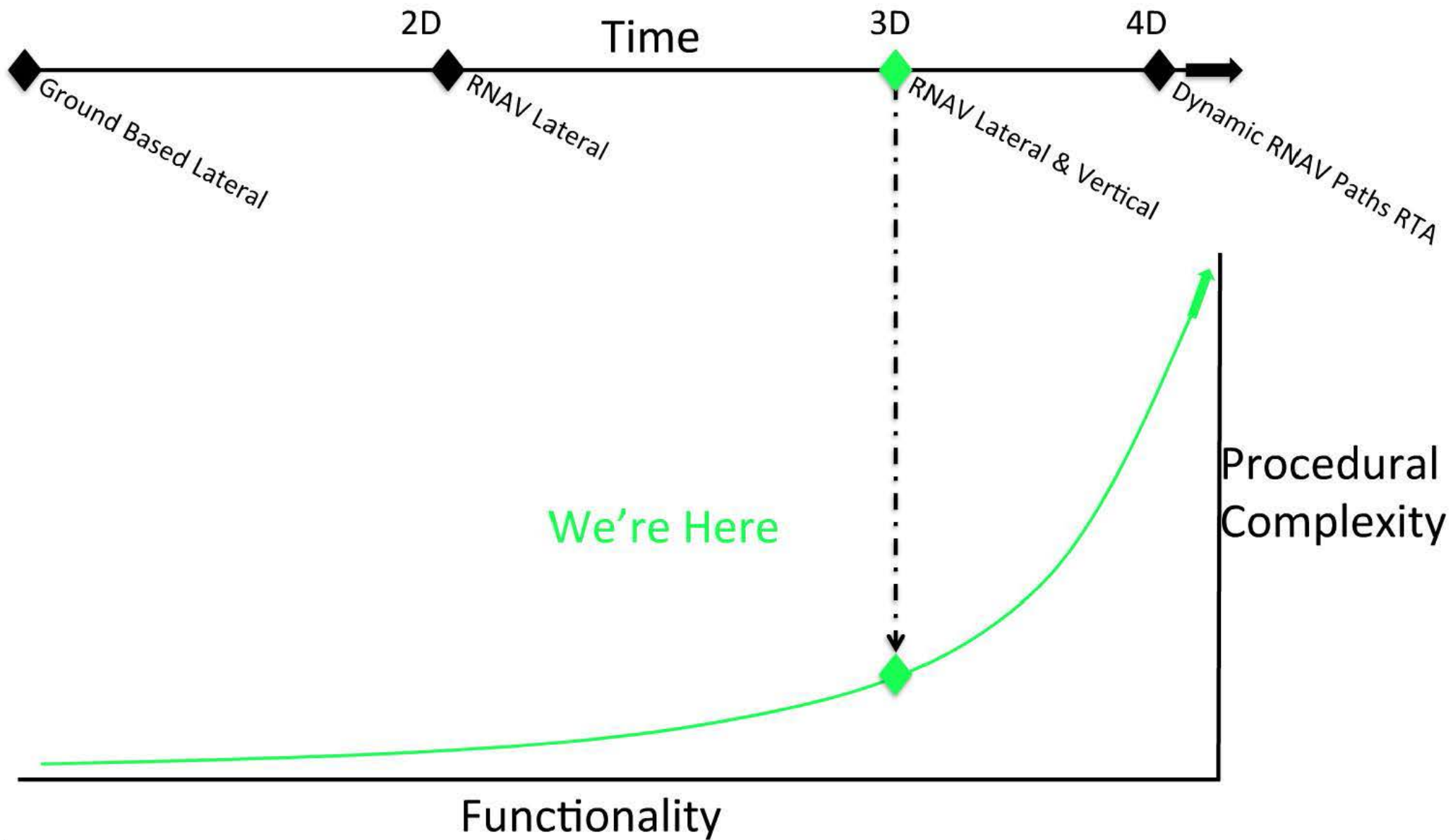
NOTE: RADAR required.
NOTE: RNAV 1.
NOTE: DME/DME/IRU or GPS required.
NOTE: Turboprop aircraft only.
NOTE: RUIZE transition assigned by ATC only.



NOTE: Chart not to scale.

(NARRATIVE ON FOLLOWING PAGE)

Noise reduction, fuel savings,
route standardization, and
flow management.
(FAA, 2014)



Why we looked at OPD STARs

ASRS Reports from Pilots

1. Controller interventions
2. Autopilot and FMS errors
3. Procedure design

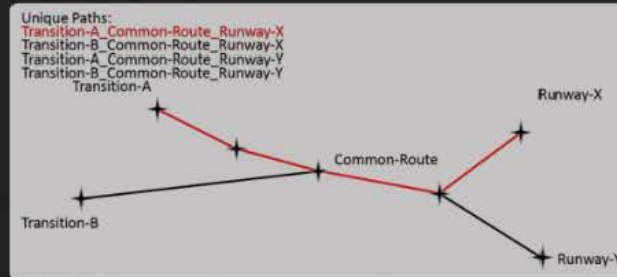
ASRS Reports from Controllers

1. Inter-controller communications
2. Pilot non-compliance
3. Misinterpreted instructions

Factors Influencing Adherence



Method






Overlay Flights on Routes

- Entry Waypoint
- Exit Waypoint
- Exit Waypoint

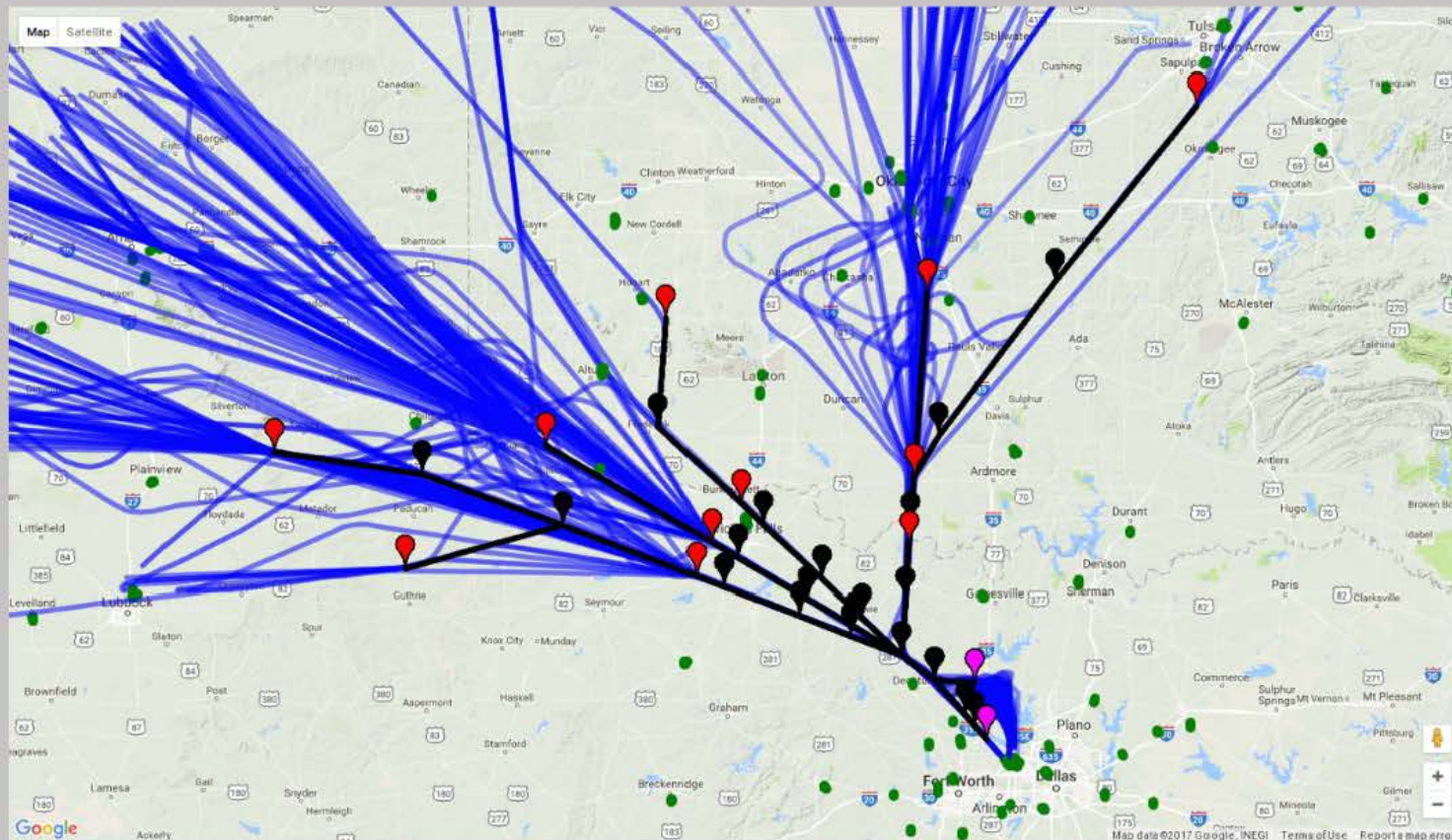


Full-time data source: OASIS and RFLW

Overlay Flights on Routes

-  Entry Waypoint
-  Waypoint in route
-  Exit Waypoint

- Identify route flow
- Determine adherence of lateral flight trajectory with waypoint restrictions
- Characterize lateral adherence (join late/skip/ early exit)



Full Lateral Adherence of VKTRY2 into KDFW

Data Source

Expand Capability

Past

ARTCC radar tracks
(CTAS data)

NOW

TRACON data
(Sherlock2.0)

Longterm

Aircraft sensors
(FOQA-type)

Procedural Characteristics

- Waypoint type, window size
- Speed Restrictions
- Altitude Restrictions
- Route name (e.g., transition)
- Slope-degree angles
- Leg type (e.g., track to fix)

Environmental Variables

- Wind (tailwind component)
- Temperature (Rapid Refresh NOAA)

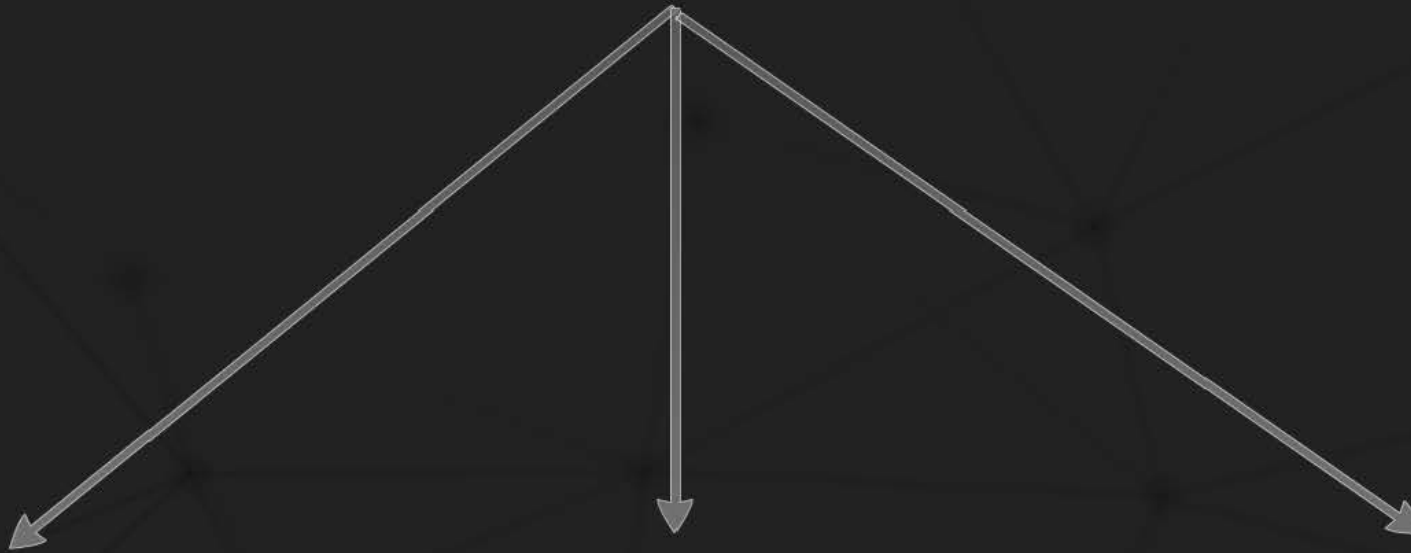
Aircraft Variables

- Type and equipment suffix
- Groundspeed
- Altitude (several samples)
- Rate of descent
- Required slope to next restriction
- #of flights on the arrival

ta)

TRACON data
(Sherlock2.0)

Longterm
Aircraft sensors
(FOQA-type)



Procedural Characteristics

- Waypoint type, window size
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Environmental Variables

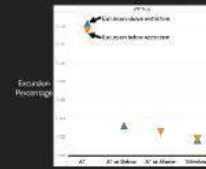
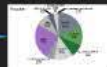
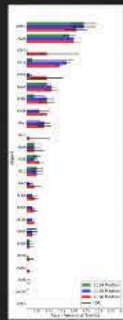
- Wind (tailwind component)
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Aircraft Variables

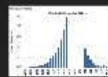
- Type and equipment suffix
- Groundspeed
- Altitude (several samples)
- Rate of descent
- Required slope to next restriction
- #of flights on the arrival

Descriptive Data

Assess Levels of Use

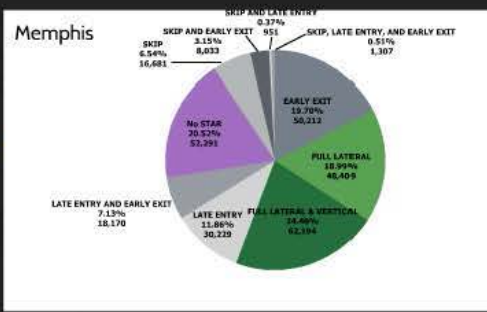
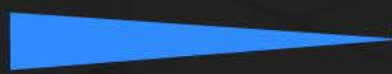
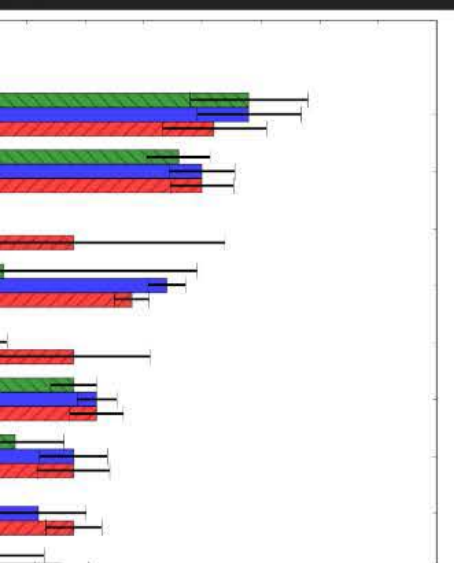


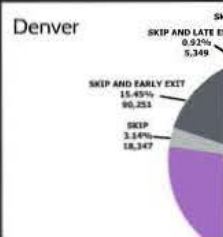
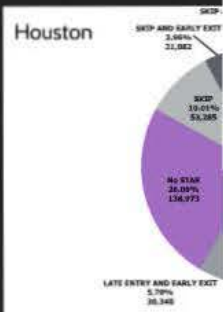
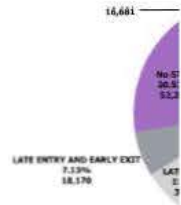
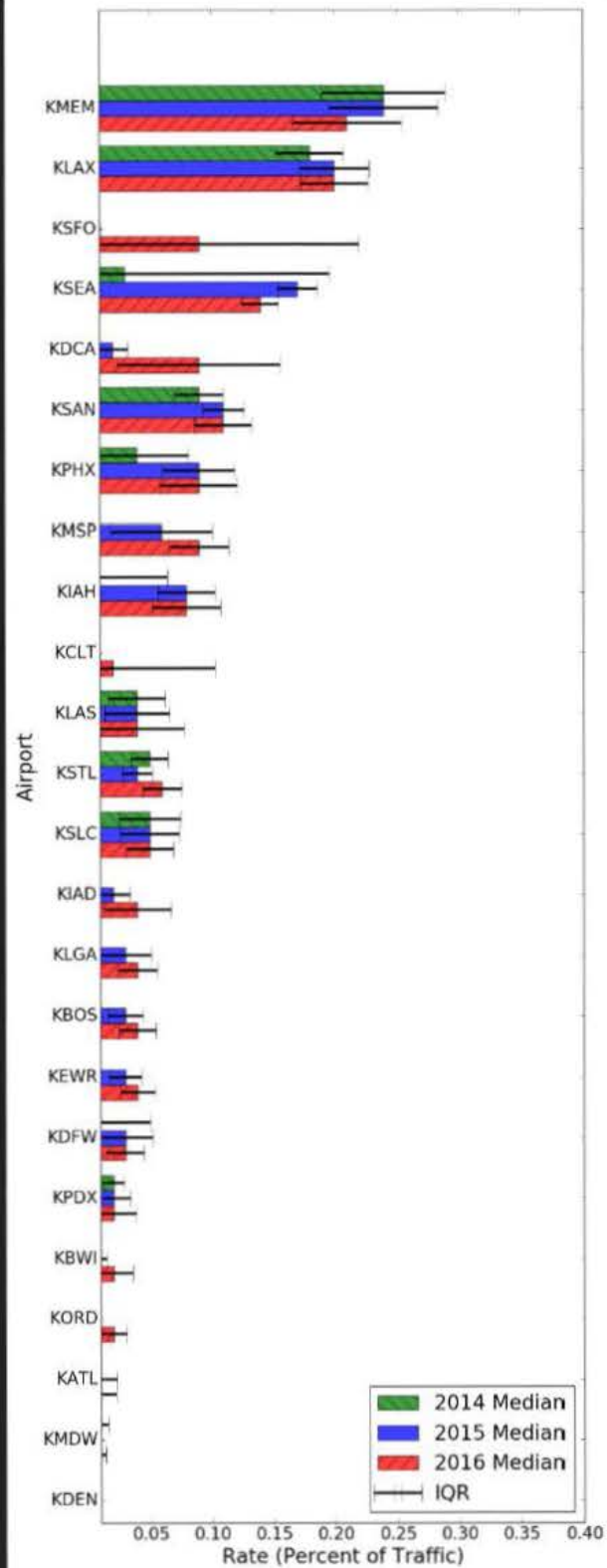
Identify Human Intervention



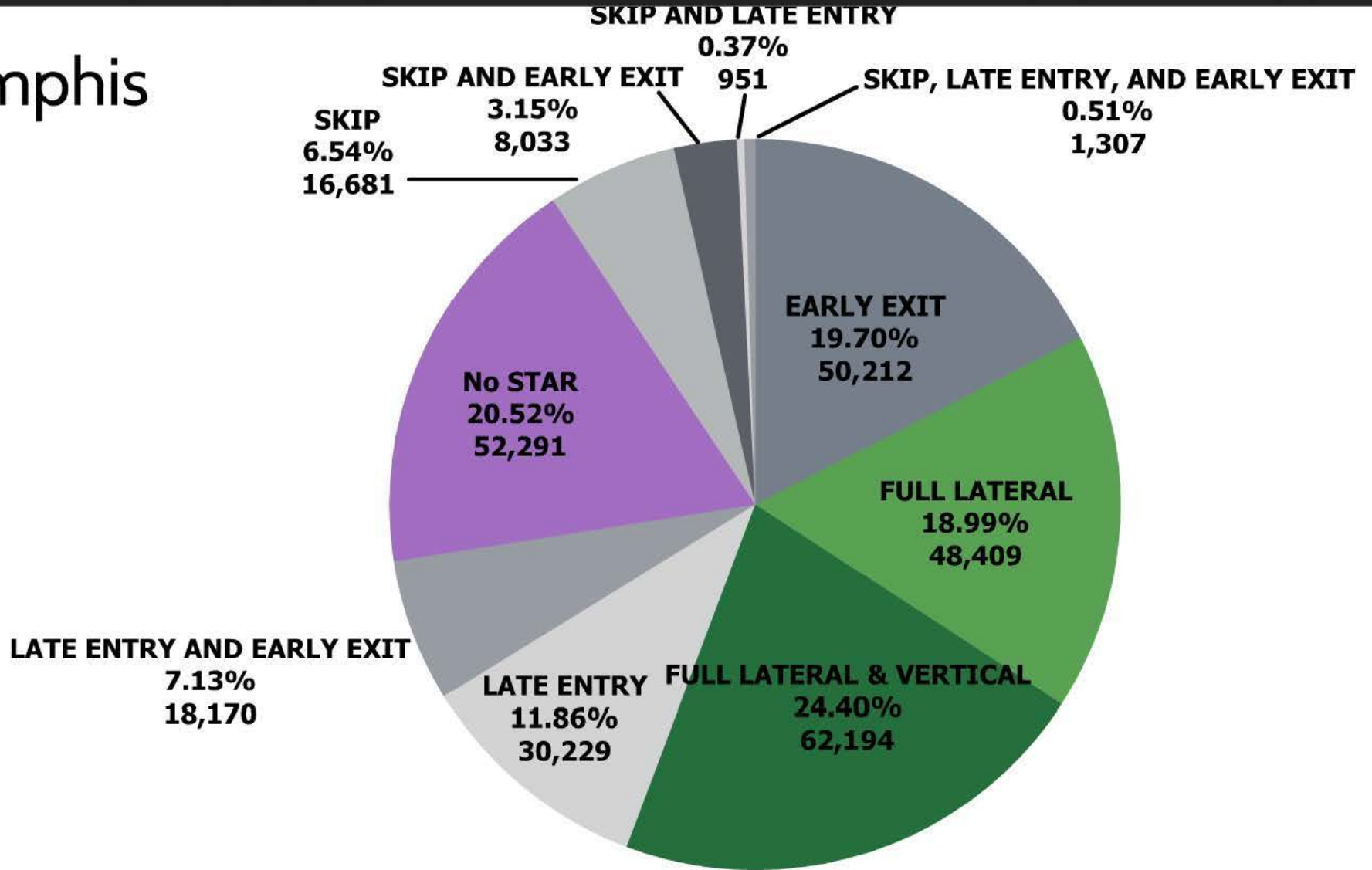
Da

Assess Levels of Use

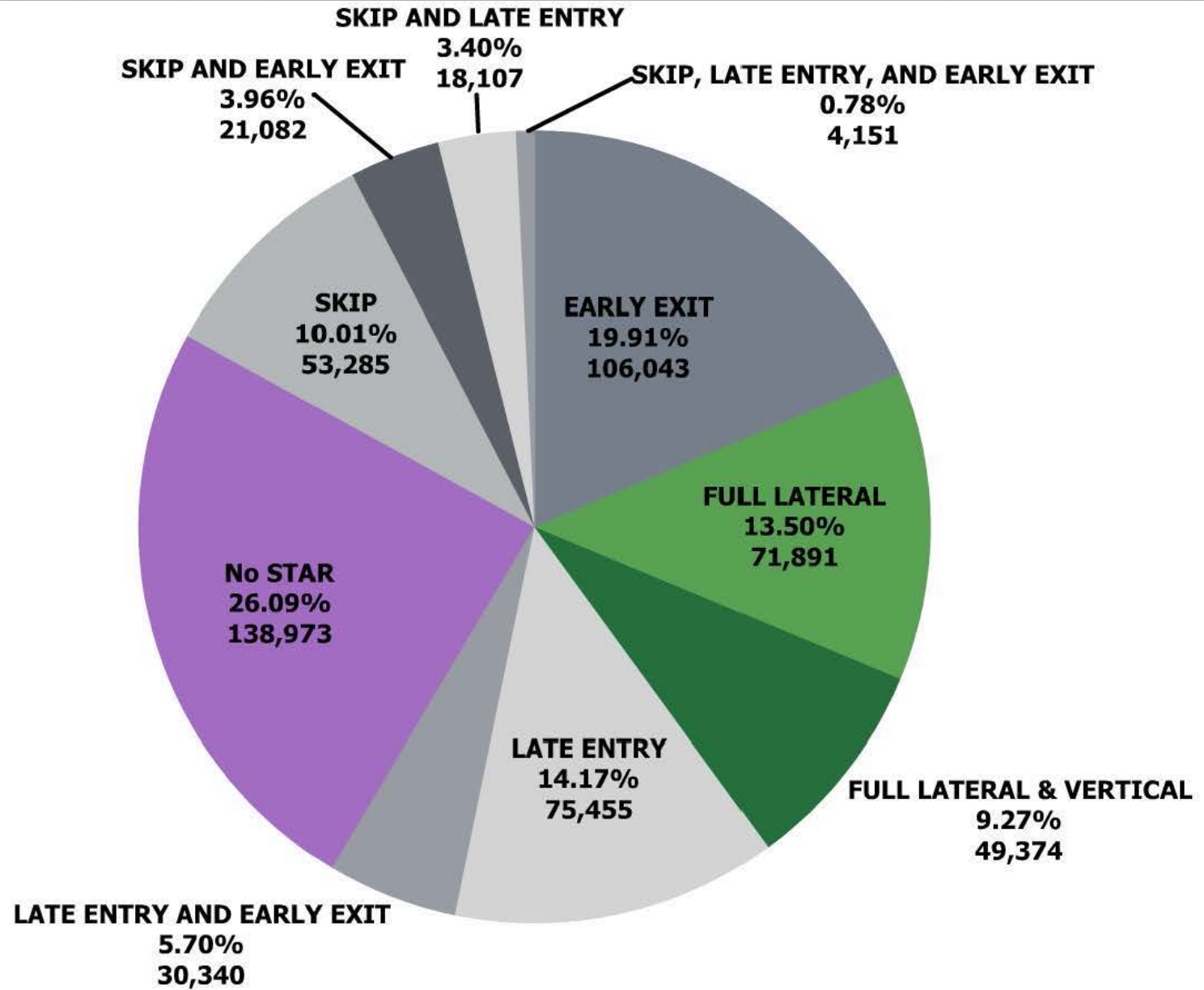




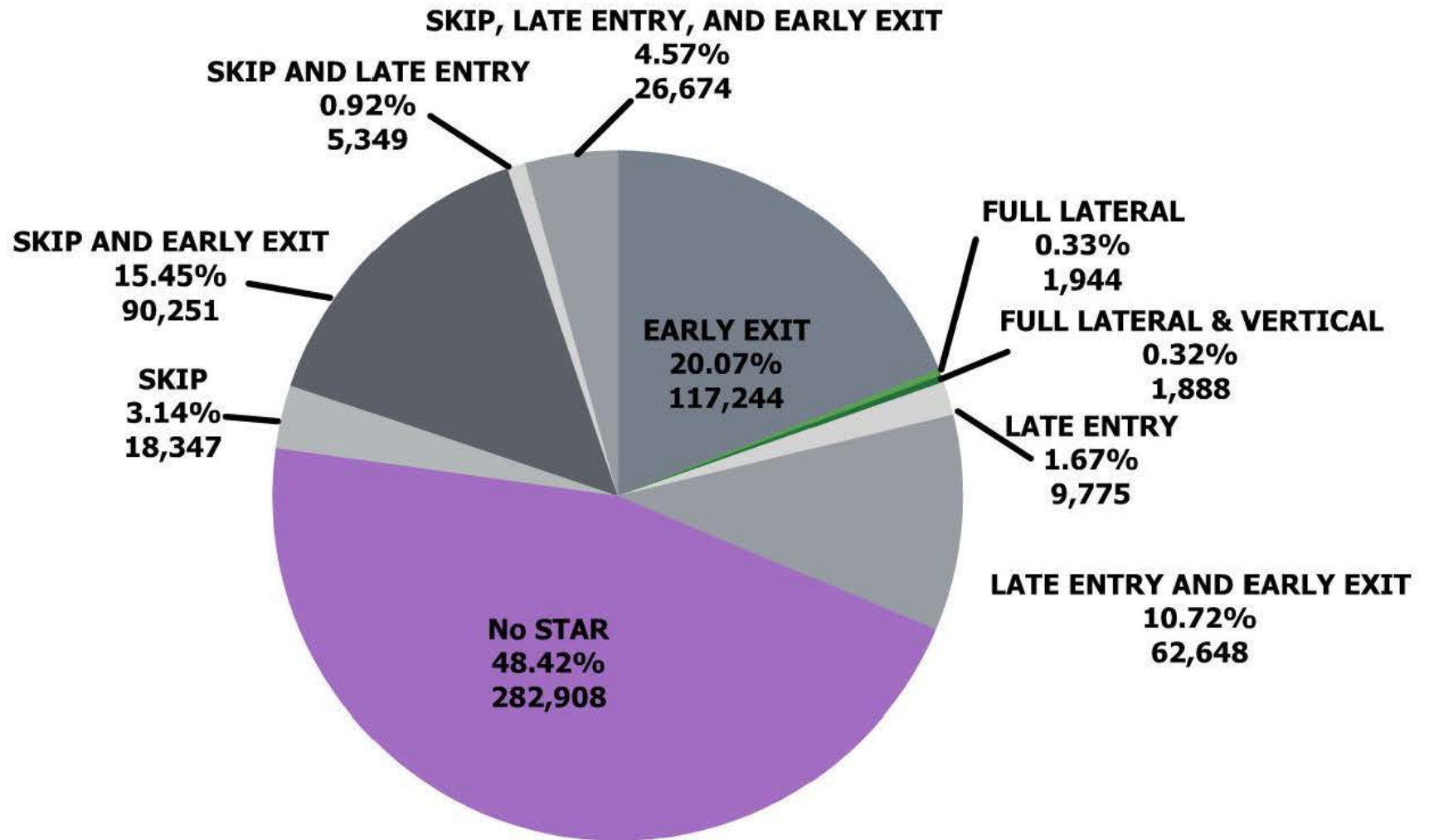
Memphis

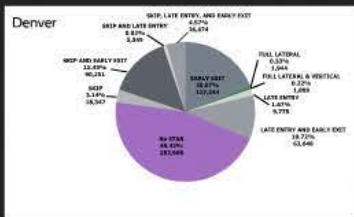


Houston

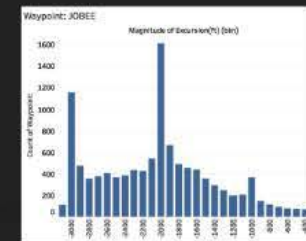
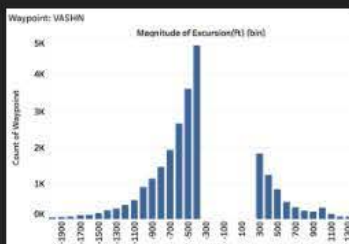


Denver

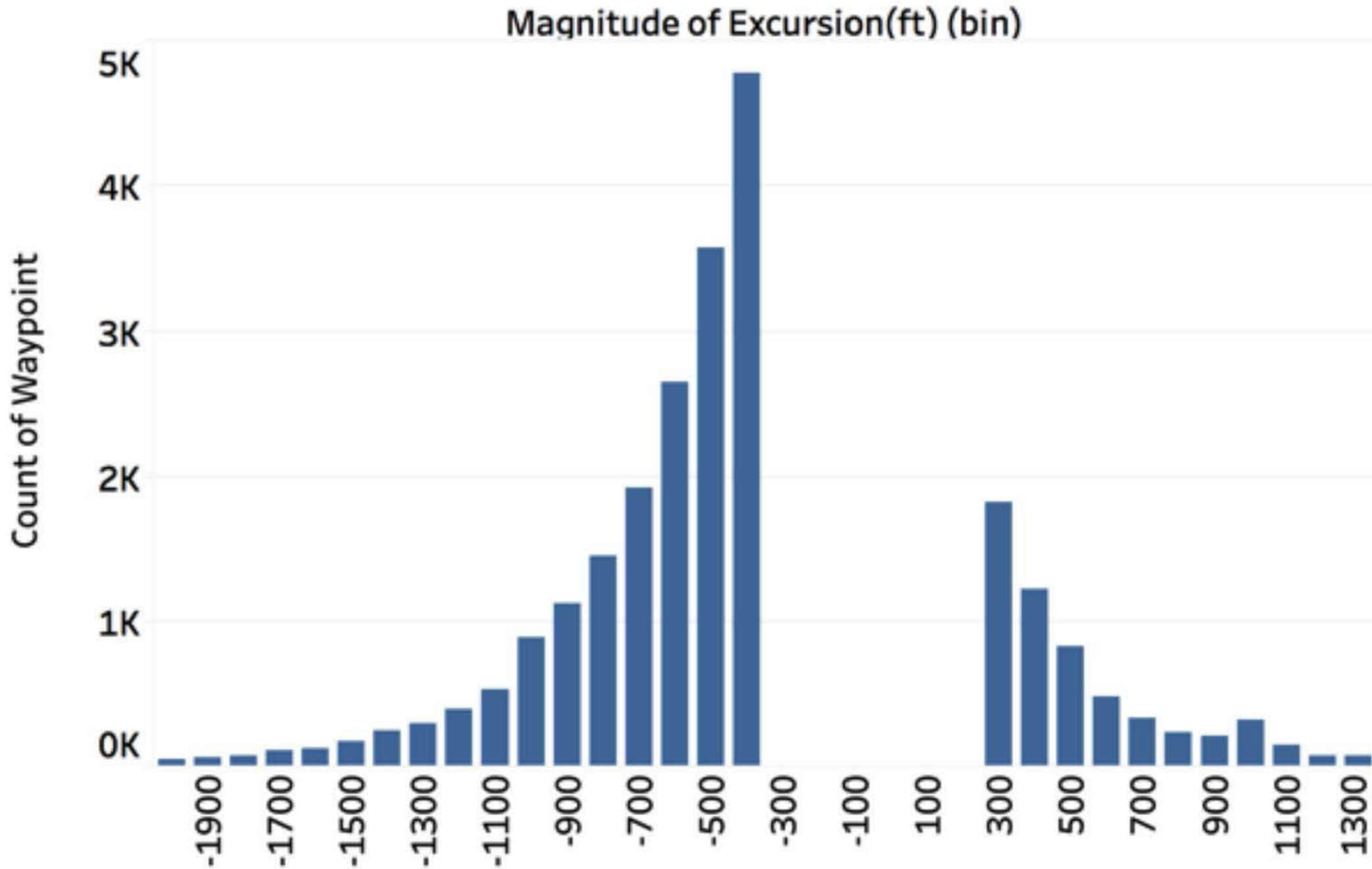




Identify Human Intervention

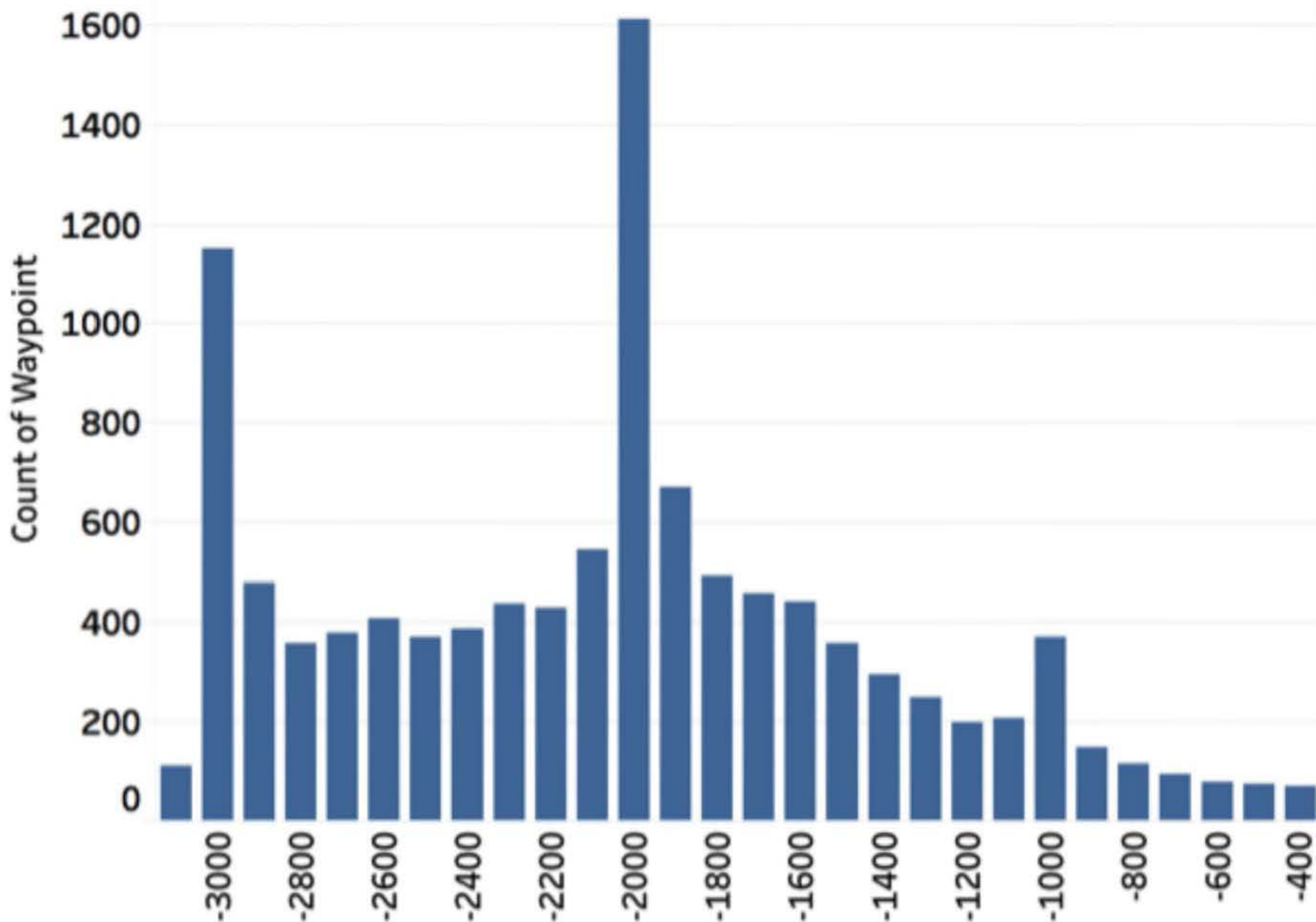


Waypoint: VASHN



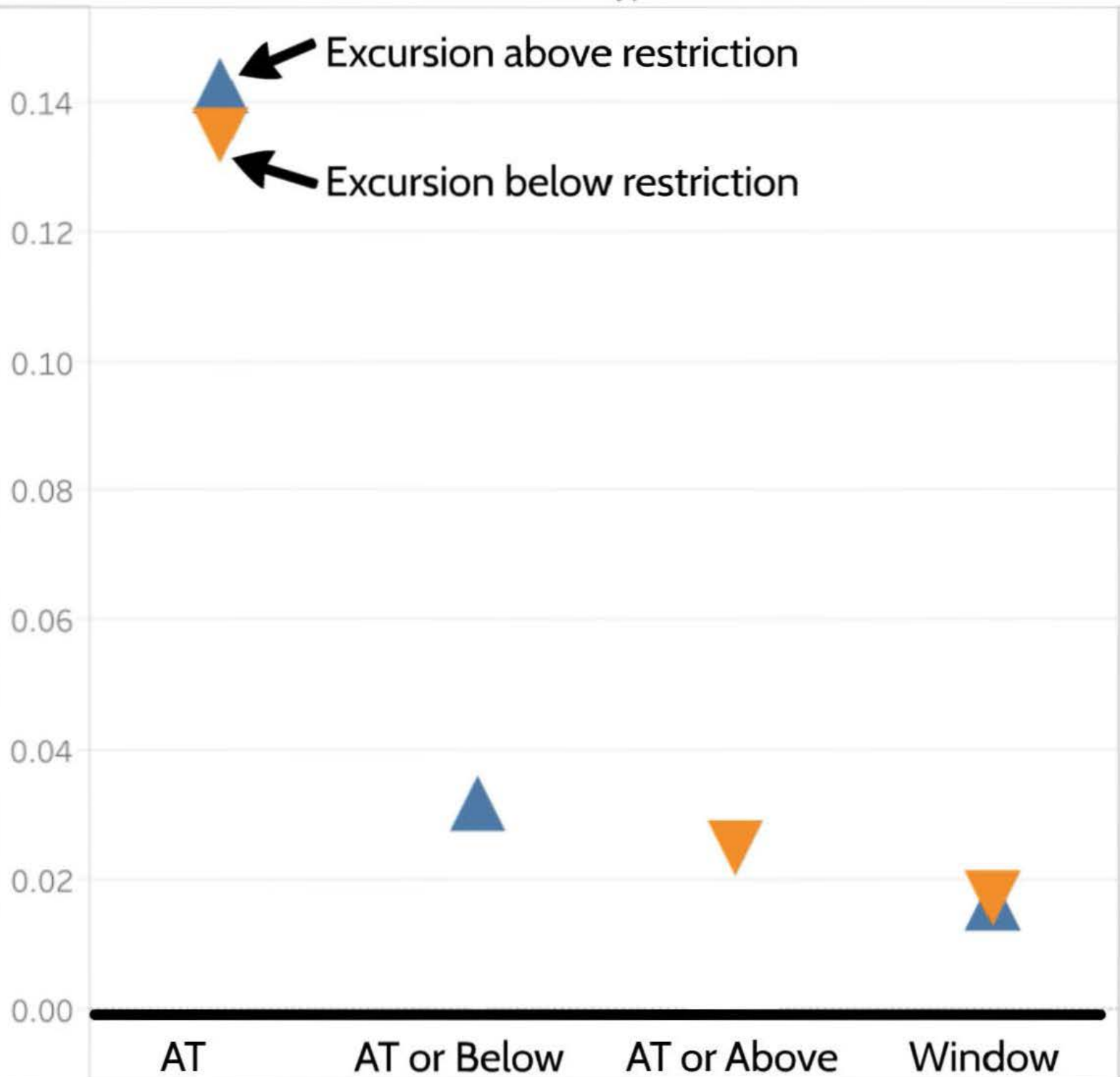
Waypoint: JOBEE

Magnitude of Excursion(ft) (bin)



Excursion
Percentage

WP Type



Next Steps

Data Visualization & synthesis

Monitor trends

Observe efficacy of mitigation strategies

Observe factors that influence degradation

Set acceptability metrics

Decision support for designers

Monitor trends

Observe efficacy of mitigation strategies

Observe factors that influence degradation

Set acceptability metrics

Decision support for designers

RNAV STAR Procedural Adherence

