RNAV STAR Procedural Adherence

Next Steps
- Data Validation
- Regular Updates
- Feedback Mechanism
- Data Analysis

Method

Descriptive Data

Why we looked at OPD STARs
- Operational Efficiency
- Procedural Performance
- Local Area Impact
- Data Quality Assessment
How Procedures Have Changed

No Procedures
Flying was dangerous and not standardized

Instrument Approach Procedures
A method to consistently guarantee safe distance

STARS (conventional)

STARS (RNAV OPD)
Rapid entry/exit, backtrackings, runway-standardization and runway management (FAA 2012)
No Procedures

Flying was dangerous and not standardized
Just north of Chey, Reservoir is about one mile on standard Beacon.

8500 safe at night. Can circle a radius of about 4 miles at this elevation.

Increase to 9200 feet coming from Chey, and 9500 feet from the west. The above altitude will clear anything on the hill.

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)

Noise reduction, fuel savings, route standardization, and flow management. (FAA, 2014)
We're Here
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

- Mixed Equipment Performance
- Weather
- Traffic
Method
Overlay Flights on Routes

- Entry Waypoint
- Waypoint in route
- Exit Waypoint

- Identify route flown
- 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

Past
- ARTCC radar tracks (CTAS data)

NOW
- TRACON data (Sherlock2.0)

Longterm
- Aircraft sensors (FOQA-type)

Expand Capability

Procedural Characteristics
- Waypoint type (window size, speed restrictions)
- Route name (e.g., transition)
- Leg type (e.g., track to fix)

Environmental Variables
- Wind (ballistic 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
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

TRACON data (Sherlock2.0)

Longterm Aircraft sensors (FOQA-type)
Descriptive Data

Assess Levels of Use

Identify Human Intervention
Assess Levels of Use
Houston

- **Skip and Late Entry**: 3.40% (18,107)
- **Skip and Early Exit**: 3.96% (21,082)
- **Early Exit**: 19.91% (106,043)
- **Skip, Late Entry, and Early Exit**: 0.78% (4,151)
- **Late Entry**: 14.17% (75,455)
- **Full Lateral**: 13.50% (71,891)
- **Full Lateral & Vertical**: 9.27% (49,374)
- **No STAR**: 26.09% (138,973)
- **Late Entry and Early Exit**: 5.70% (30,340)
Denver

- No STAR: 48.42% (282,908)
- Early Exit: 20.07% (117,244)
- Skip, Late Entry, and Early Exit: 4.57% (26,674)
- Skip and Late Entry: 0.92% (5,349)
- Skip and Early Exit: 15.45% (90,251)
- Full Lateral: 0.33% (1,944)
- Full Lateral & Vertical: 0.32% (1,888)
- Late Entry: 1.67% (9,775)
- Late Entry and Early Exit: 10.72% (62,648)
Identify Human Intervention
Waypoint: VASHN

Magnitude of Excursion (ft) (bin)

Count of Waypoint

-1900 -1700 -1500 -1300 -1100 -900 -700 -500 -300 -100 100 300 500 700 900 1100 1300
Waypoint: JOBEE

Magnitude of Excursion (ft) (bin)
Excursion Percentage
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