RNAV STAR Procedural Adherence
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How Procedures Have Changed

Next Steps
Data Visualization-Segregate

Method

Descriptive Data

Why we looked at OPD STARs
How Procedures Have Changed

No Procedures
Flying was dangerous and not standardized

Instrument Approach Procedures
A method to consistently guarantee descent distance

STARS (conventional)

STARS (RNAV OPD)
Route introduction: Standard, non-standard, and RNAV standard and runway management. FAA 2014
No Procedures

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

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

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

OK in wet weather.
STARs (conventional)
Standardized Routing & Terrain Clearance
STARs (RNAV OPD)

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
- Weather
- Mixed Equipment Performance
- 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)

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 (baliwind 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

Expand Capability
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
Descriptive Data

Assess Levels of Use

Identify Human Intervention
Assess Levels of Use
Memphis

- LATE ENTRY AND EARLY EXIT: 7.13%, 18,170
- FULL LATERAL: 24.40%, 62,194
- FULL LATERAL & VERTICAL: 18.99%, 48,409
- EARLY EXIT: 19.70%, 50,212
- No STAR: 20.52%, 52,291
- SKIP: 6.54%, 16,681
- SKIP AND LATE ENTRY: 3.15%, 8,033
- SKIP, LATE ENTRY, AND EARLY EXIT: 0.37%, 951
- SKIP, LATE ENTRY, AND EARLY EXIT: 0.51%, 1,307
Houston

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

Excursion below restriction

AT or Below

AT or Above

Window
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

- **Next Steps**
  - Data visualization gap analysis
  - Implementation plan
  - Monitoring and feedback
- **Method**
- **Data Source**
- **Descriptive Data**
- **Why we looked at OPD STARs**