RNAV STAR Procedural Adherence
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Next Steps
Data Visualization
Graph任せ
Method

Descriptive Data

How Procedures Have Changed

Why we looked at OPD STARs

Data Source
How Procedures Have Changed

No Procedures
Flying was dangerous and not standardized

Instrument Approach Procedures
A method to consistently guarantee clearance distance

STARS (conventional)

STARS (RNAV OPD)
Rule reduction, faster speeds, more standardization and runway management (FAA 200x)
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)

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

Functionality

Procedural Complexity
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
(FOOA-type)

Expand Capability

Procedural Characteristics
- Waypoint type, window size
- Speed Restrictions
- Altitude Restrictions
- Route name (e.g., Transition)
- Slope-degrees angles
- Leg type (e.g., track to fix)

Environmental Variables
- Wind (full wind component)
- Temperature/Pressure (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)

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

Longterm Aircraft sensors (FOQA-type)
Descriptive Data

Assess Levels of Use

Identify Human Intervention
Assess Levels of Use
Memphis

LATE ENTRY AND EARLY EXIT
7.13%
18,170

SKIP AND LATE ENTRY
0.37%
951

SKIP AND EARLY EXIT
3.15%
8,033

SKIP, LATE ENTRY, AND EARLY EXIT
0.51%
1,307

EARLY EXIT
19.70%
50,212

No STAR
20.52%
52,291

FULL LATERAL
18.99%
48,409

FULL LATERAL & VERTICAL
24.40%
62,194

LATE ENTRY
11.86%
30,229
Denver

- No STAR: 48.42% (282,908)
- Early Exit: 20.07% (117,244)
- Late Entry: 15.45% (90,251)
- Skip: 3.14% (18,347)
- Skip, Late Entry, and Early Exit: 4.57% (26,674)
- Skip and Late Entry: 0.92% (5,349)
- Skip and Early Exit: 1.67% (9,775)
- Full Lateral: 0.33% (1,944)
- Full Lateral & Vertical: 0.32% (1,888)
- Late Entry and Early Exit: 10.72% (62,648)
Identify Human Intervention
Excursion above restriction

Excursion below restriction

Excursion Percentage

AT

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
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