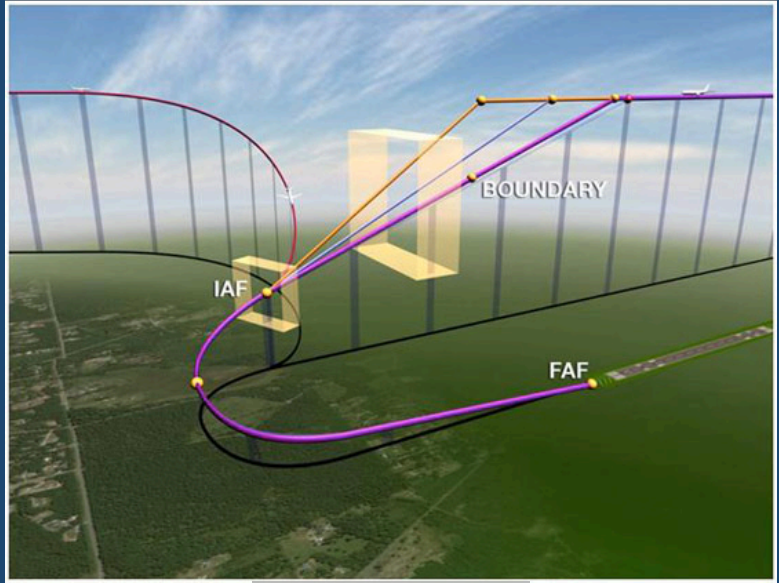


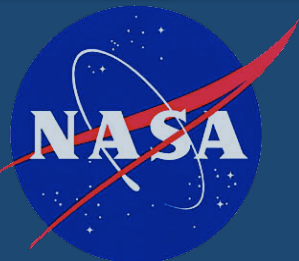
Understanding Current Safety Issues for Trajectory Based Operations

Michael Feary
NASA Ames Research Center

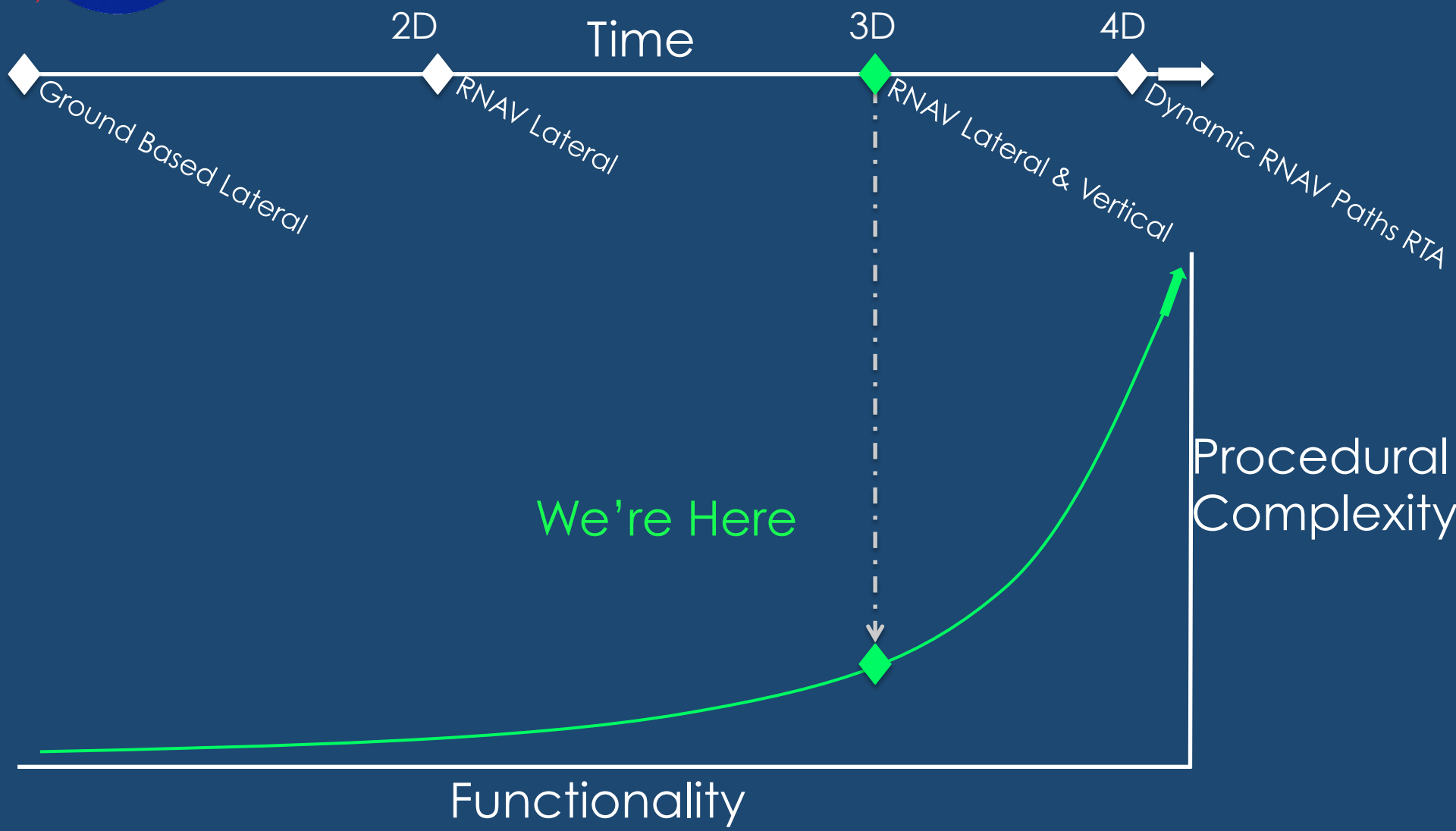
Michael Stewart
San Jose State University Research Foundation

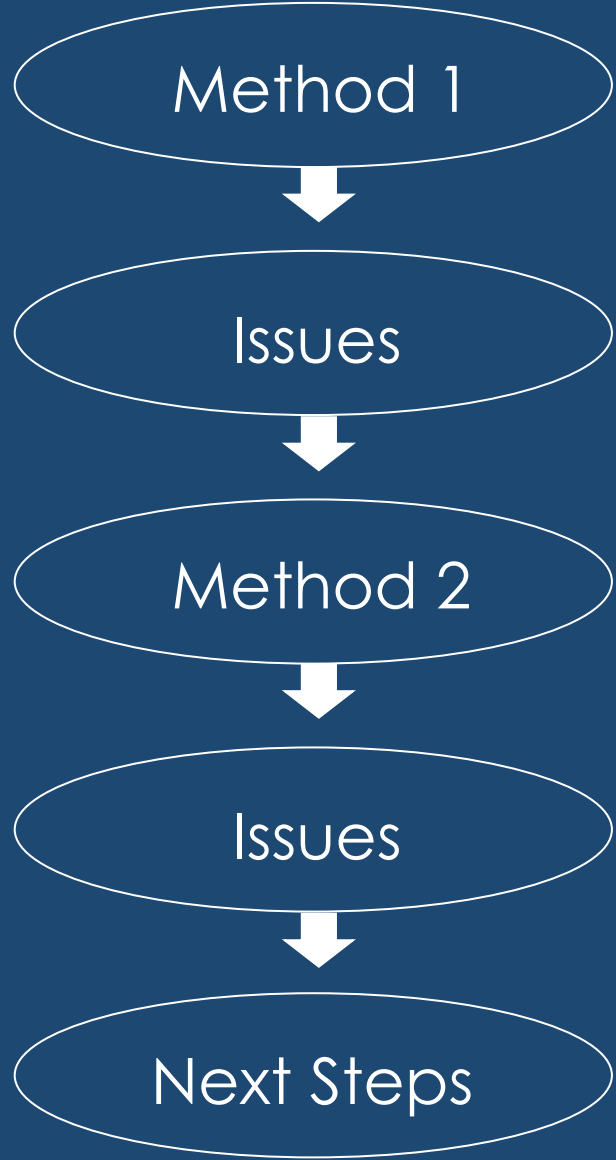
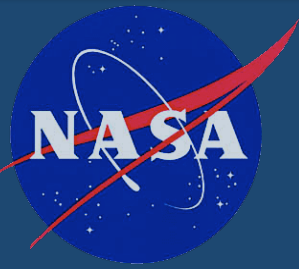


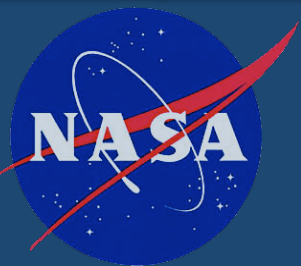
2025-2035



Motivation for Research



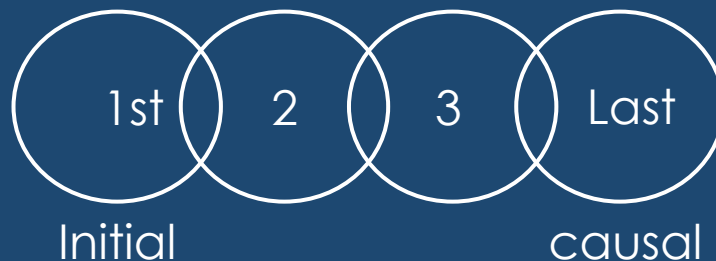




Method 1: ASRS Analysis

- Descend Via RNAV STARs
- ≈400 ASRS reports reviewed
- Deviation trends were categorized

Chains of events were coded by Initial and causal factor



Motivation For Research

Method 1 ASRS

Issues

ATC Intervention

Automation

Procedure Design

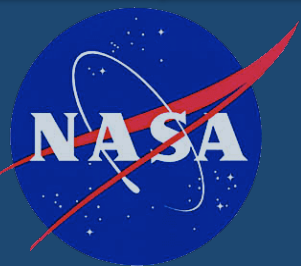
Charting

Method 2 Workshop

Standardization in Design

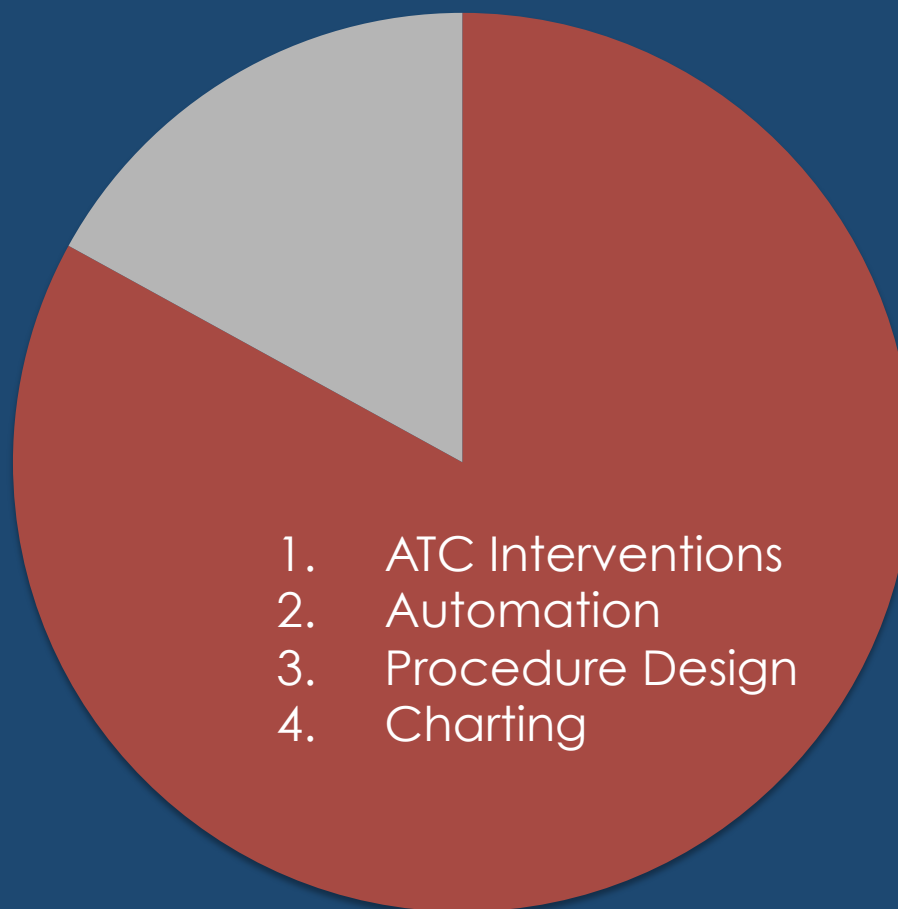
Unchecked Complexity

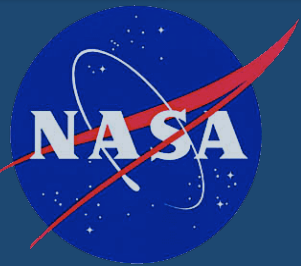
Summary & Next Steps



Issues from ASRS Analysis

More than 80% of Deviations in 4 Categories





ASRS Issue #1

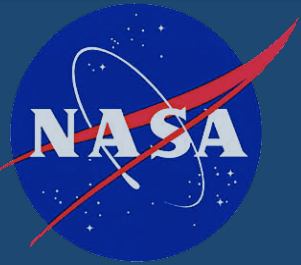
ATC Interventions

- Runway and Approach changes during the STAR triggered issues.

“Several approach clearance changes.....
expect Runway 35R RNAV RNPZ but mistakenly entered Runway 34R.
After a TA alert.....”

- Altering charted restrictions
 - Changes physics of procedure

“ATC specialists must not have any idea of the level of disruption the constantly changing speeds impose on the flight crew during **arrival**. In my opinion they truly need increased awareness of the destabilizing affect these speed changes have on a safe flight.”



ASRS Issue #2 Automation

- FMS Entry errors

“late runway change as they approached HONIE on the WARRR RNAV STAR to ATL, the flight crew was unable to program it in a timely fashion and a modest track deviation Occurred”

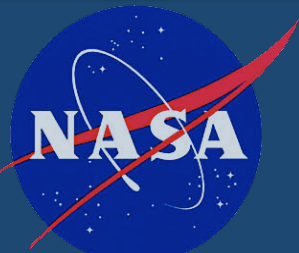
- AUTO Flight Expectations

“We noticed we might be high by KIKKR and put full speed brakes out and kicked off the autopilot, the VNAV Path showed us on the descent path but we were high by up to about 1,000 foot”

- Mismatched Capability

“We went 500 FT below the charted altitude crossing ARGAL...”

The altitude deviation occurred because the Captain put in a rate of descent that would allow us to cross the last fix [as required] versus the intermediate fixes.”



ASRS Issue #3 Procedure Design

SC-2, 30 APR 2015 to 28 MAY 2015

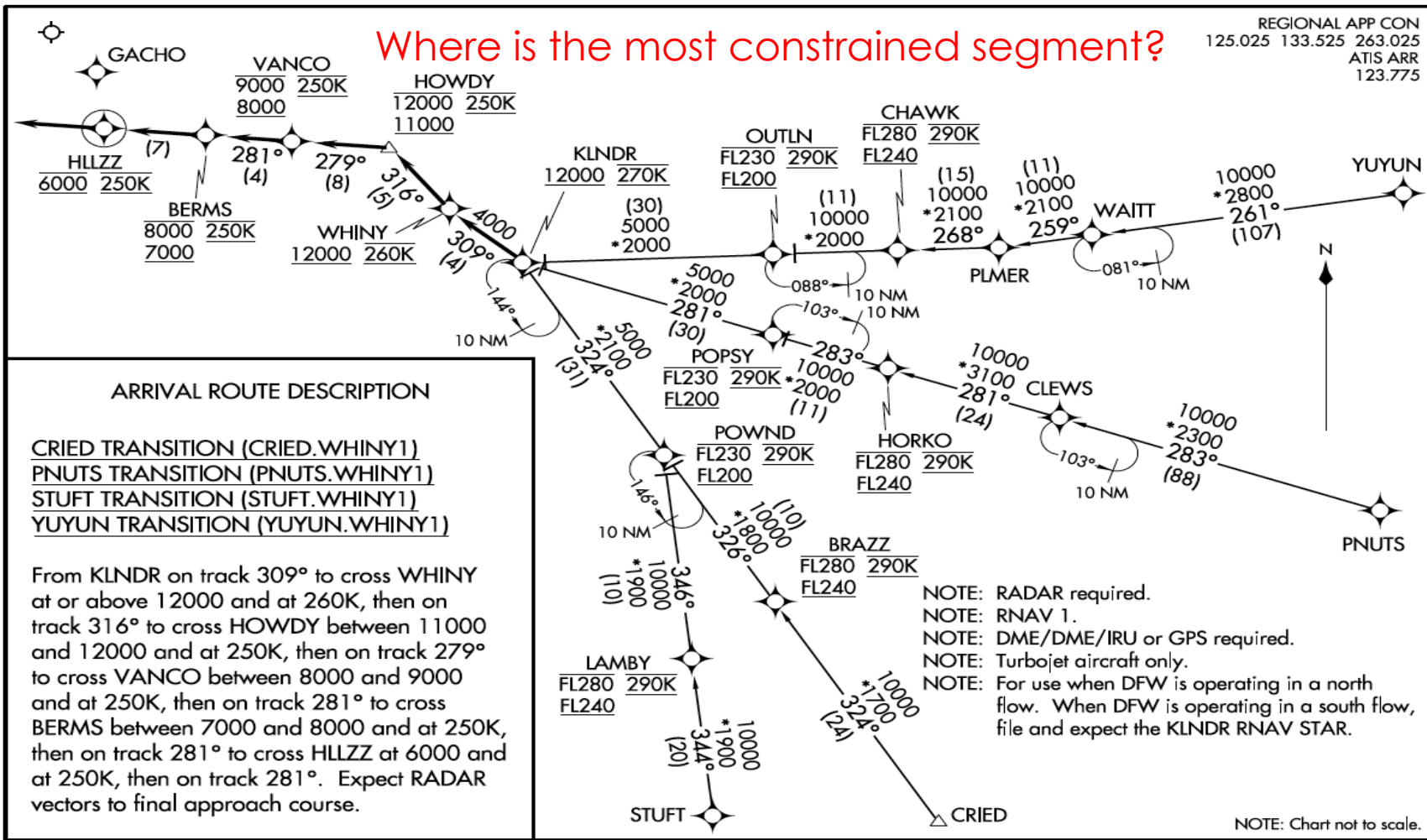
Where is the most constrained segment?

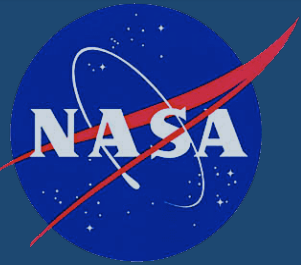
WHINY ONE ARRIVAL (RNAV)
(KLNDR.WHINY1) 14289

(KLNDR.WHINY1) 14289
ST-6039 (FAA)

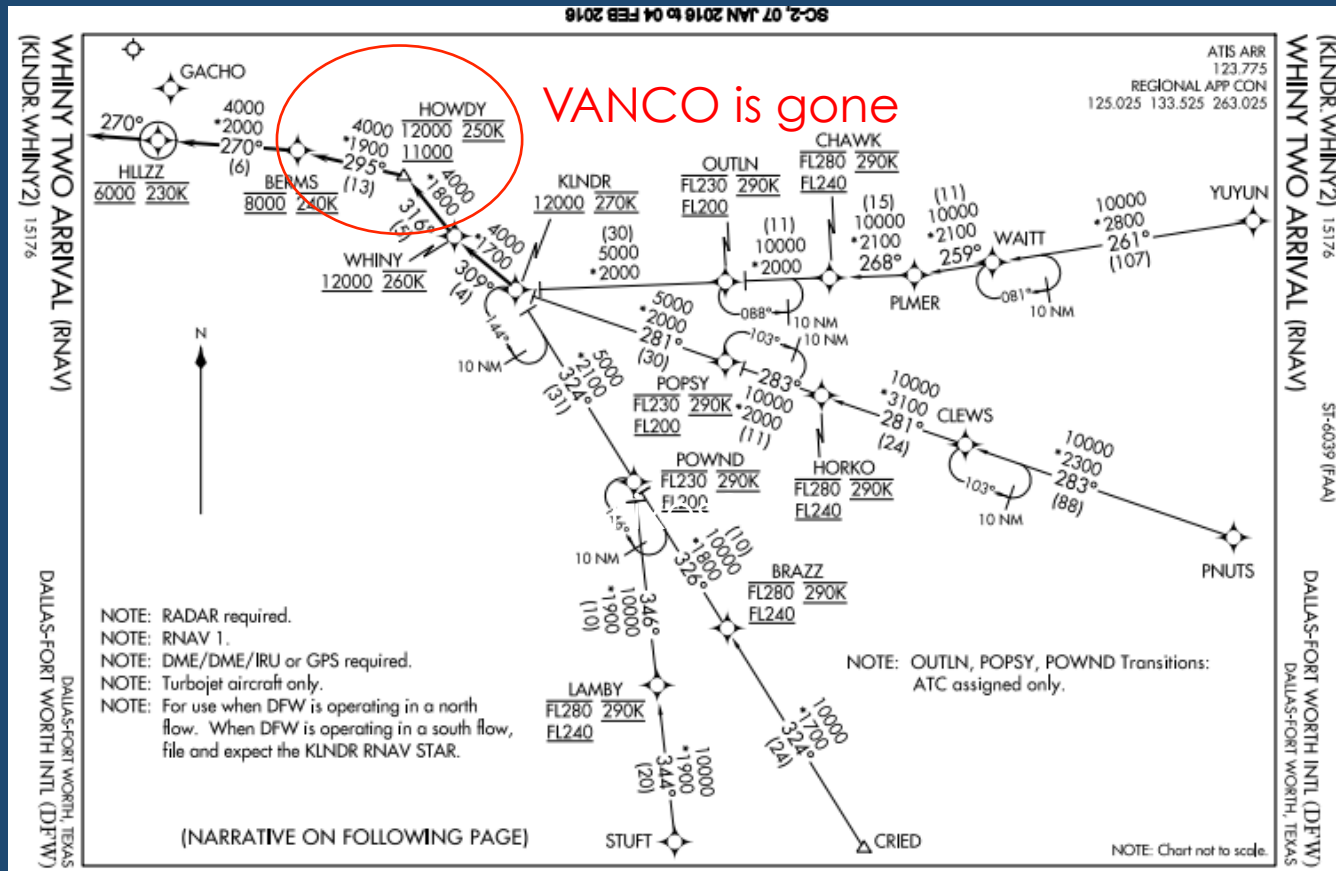
DALLAS-FORT WORTH, TEXAS
DALLAS-FORT WORTH INTL (DFW)

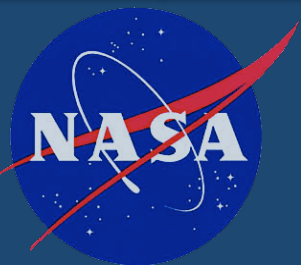
DALLAS-FORT WORTH INTL (DFW)
DALLAS-FORT WORTH, TEXAS





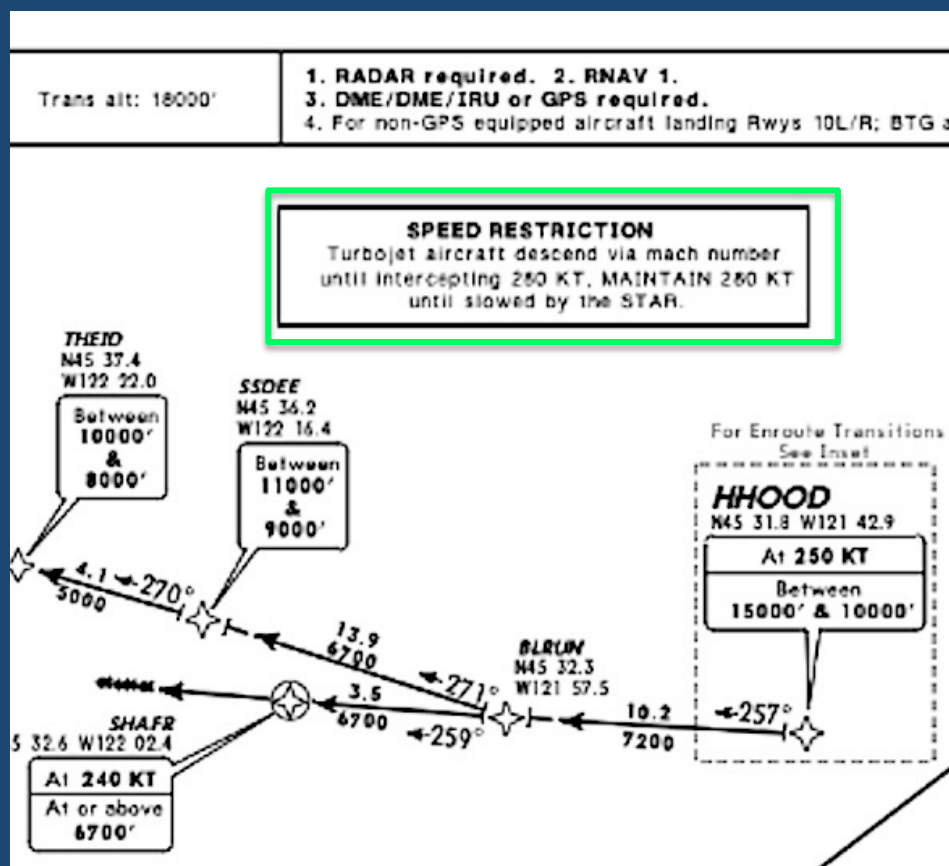
ASRS Issue #3 Procedure Design

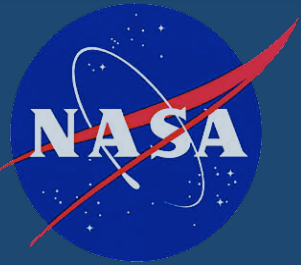




ASRS Issue #4: Charting

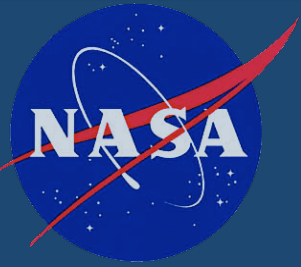
Missed Notes





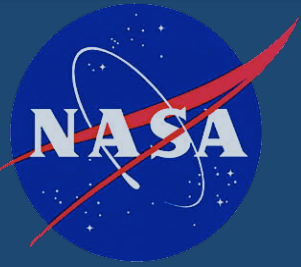
Method 2: 2015 Workshop

- Held at NASA Ames Moffett Field, CA
 1. To learn about design and issues
 2. To provide a forum and start dialog
- Attended by
 - FAA Safety, Airline Reps, NASA personnel.
- Presentations:
 - Non-VNAV airline operational concerns
 - Weather effects
 - Design problems in Boston
 - Complexity



Standardization In Design

- No requirement to include stakeholders in design process
 - Might miss valuable feedback or knowledge
 - Might not have the authority to make needed changes (e.g., airspace)
- No method to catalog fixes
 - Actionable fixes not available to others
- Aero modeling is not comprehensive
 - Flyability limits are unknown

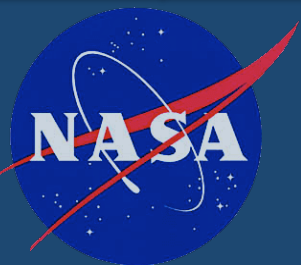


Summary & Next Steps

Deviations from 4 major categories

1. ATC Intervention
2. Automation
3. Procedure Design
4. Charting

- Are there other Categories? We need a larger pool of data. FOQA + ASAP = better picture



Summary & Next Steps

Design methods are not standardized leading to inconsistent results.

- Create a repository and forum for design problems, lessons learned, and best practices.

Increases in STAR implementation & functionality might be related to deviation occurrence rates.

- Need to know how often deviations occur- ATC data could possibly inform more accurately.

Motivation For
Research

Method 1
ASRS

Issues

ATC
Intervention

Automation

Procedure
Design

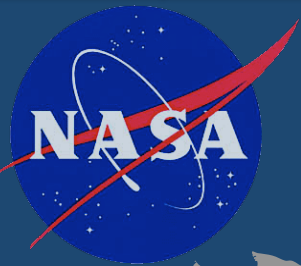
Charting

Method 2
Workshop

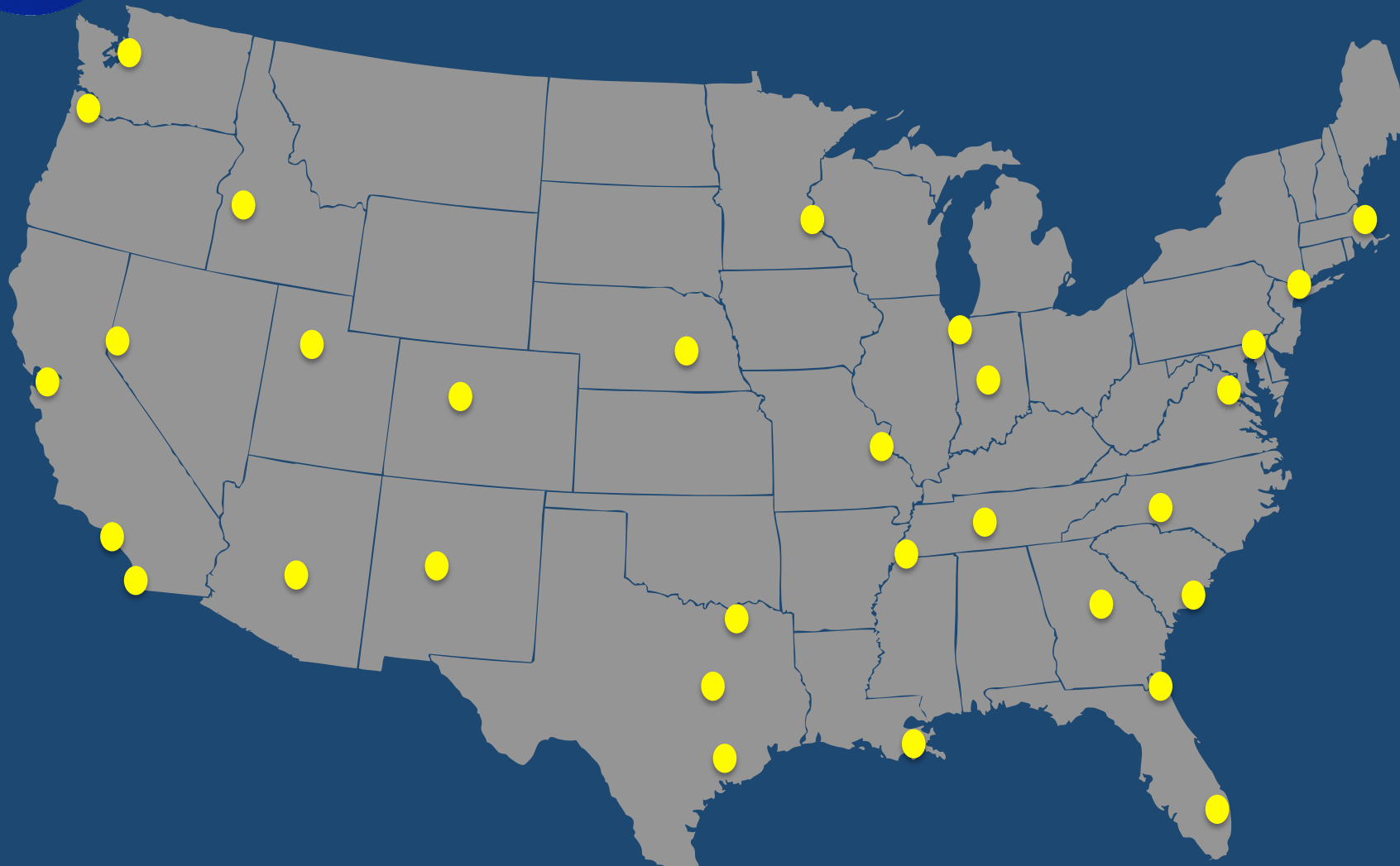
Standardization
in Design

Unchecked
Complexity

Summary &
Next Steps



Unchecked Complexity Poses Future Risks



Motivation For
Research

Method 1
ASRS

Issues

ATC
Intervention

Automation

Procedure
Design

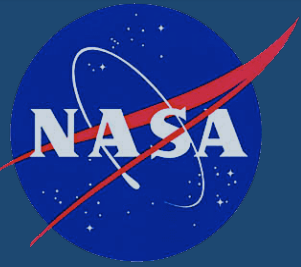
Charting

Method 2
Workshop

Standardization
in Design

Unchecked
Complexity

Summary &
Next Steps



Thank You

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650-604-3156

Michael.j.stewart@nasa.gov