Strategies for Identifying Resilient Behavior In Aviation

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System-Wide Safety

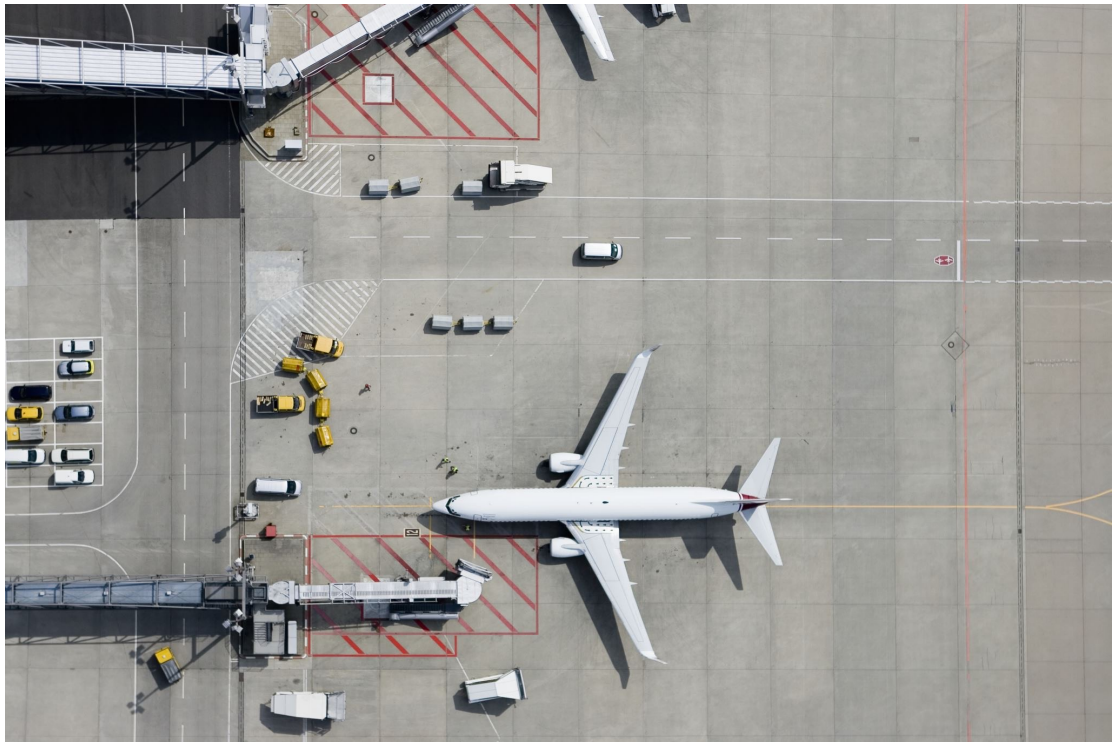
Outline

- Capturing evidence of Positive Deviations or modes of Human Intervention:
  - Countermeasures (tactical)
  - Modifications (strategic)
- Assess Positive Deviations:
  - Determine if changes to the system or organization needs to be made.
- Leveraging a Variety of Data Sources:
  - Numerical
  - Textual
- Case Studies:
  - RNAV Vertical Clearance Exception
  - Wake Turbulence Response

Human Vs Organizational Resilience

Organizations may have resilient actors

- Capturing the behaviors of the resilient actors can reveal systemic issues in the system or organization that are being addressed by the operators.
- Organizations can learn from their resilient performers.
- This can lead to changes that makes the organization as a whole more resilient that can benefit everyone.



Positive Deviance

- **Positive Deviations**
  - Identified by capturing departures from work imagined
  - Result in mission success
  - When challenges or pressures are present.
- **Study Outcomes Under Similar Conditions**
  - Compare outcomes of positive deviations vs those that did not deviate.
    - What makes them perform differently?
    - Can the deviation be quantified?

Conceptual Diagram



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Identifying Two Different Resilient Behaviors:

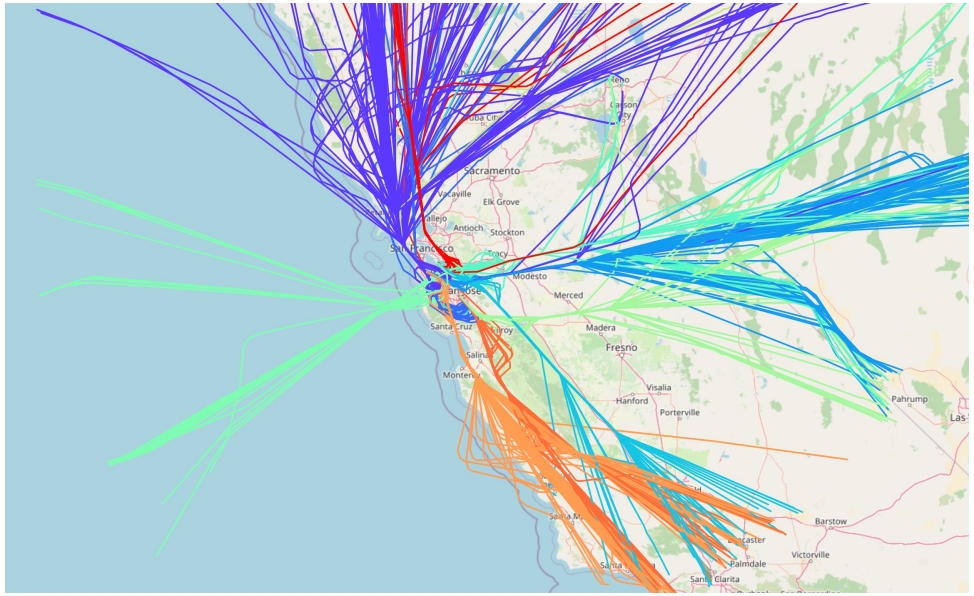
1. Countermeasures:
   - Tactical positive deviations to resolve a pressure/threat or conflict.
   - Positive deviations rely upon prior experience and training to resolve in the moment.

2. Modifications:
   - Strategic positive deviations from a planned operation.
   - Continual implementation of a positive deviations from established procedure.
   - Solution may be derived from experiencing repeated countermeasures being implemented.

Resilient performance indicators

Data Sources:

1. Aircraft centric data: Flight Operational Quality Assurance (FOQA)
   - Can be leveraged to determine how the aircraft was flown.
2. Surveillance data such as ADS-B or radar track data.
   - Reveals how multiple aircraft interact within the context of air traffic patterns.
3. Text reports and narratives from NASA's Aviation Safety Reporting System (ASRS) or Aviation Safety Action Program (ASAP)
   - Captures the context of the operations and why a specific safety event happens.
   - Other rich text narratives: Learning Improvement Team (LIT) or Line Operations Safety Audit (LOSA)





Approach: Event-Report Initiated

Narrative Analysis:

- Extract corrective measure strategies from safety reports or observer-based narratives.
- Characterize how they would manifest themselves in other data sources.

ASRS Report 1. *"SOCAL Approach Control cleared our flight for the ILS 24R via the CRCUS transition. We were **following a B787-9**. To help increase the space between our airplanes the Los Angeles Center **Controller instructed** us to **slow to 250 KIAS** while on the ANJLL4 arrival which **we complied** with. Looking at our TCAS display, I estimated the **787 was approximately 5 miles** ahead of us. SOCAL approach appropriately **cautioned us for wake turbulence** since we were following the heavy 787. Our flight was **normal until we reached CRCUS waypoint** where we **encountered the 787's wake**".*

Detect Events in Numerical Data

- Fusing multiple data sources together.
- Monitor the response and outcome.
- Can lead to geographical hot spots of interest.

Proficiency	Pressure	Description	Goal	Outcome	Description
countermeasure	ATC/ Traffic	Asked ATC for 1 mile offset to avoid wake	Avoid wake turb	Success	No wake was observed
countermeasure	ATC/ Traffic	Asked ATC to slow for additional spacing for heavy	Avoid wake turb	Failure	Hit wake

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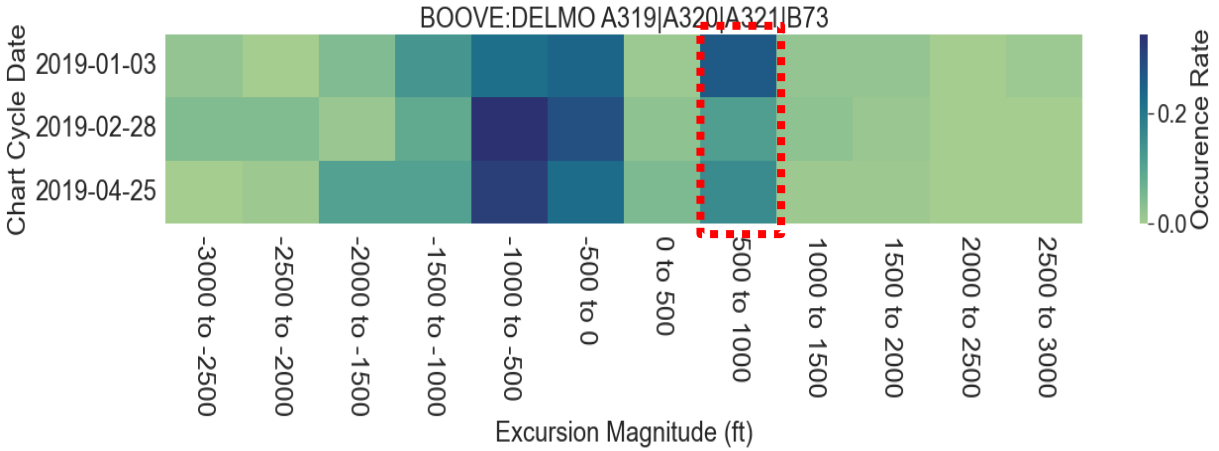
Approach: Numerically Initiated

Numerical Analysis:

- Find instances of non-adherence
- This may be evidence of strategic modifications not codified into procedures.

Search ASRS for reported events:

- Provides context of why
- May be due to unachievable procedural vertical profiles or conflicts.
- Describes how pilots and controllers are handling these events.



ASRS Report 1. *"During the BOOVE4 arrival into DFW. We were descending out of 11400 just prior to DELMO for 11000. Approach advised us of traffic at our 1 o'clock climbing. Seconds after, we had a traffic advisory from the TCAS that immediately changed to an RA with a climb advisory.* ***Traffic alerts from ATC and TCAS into DFW occur on almost every arrival and departure.***"

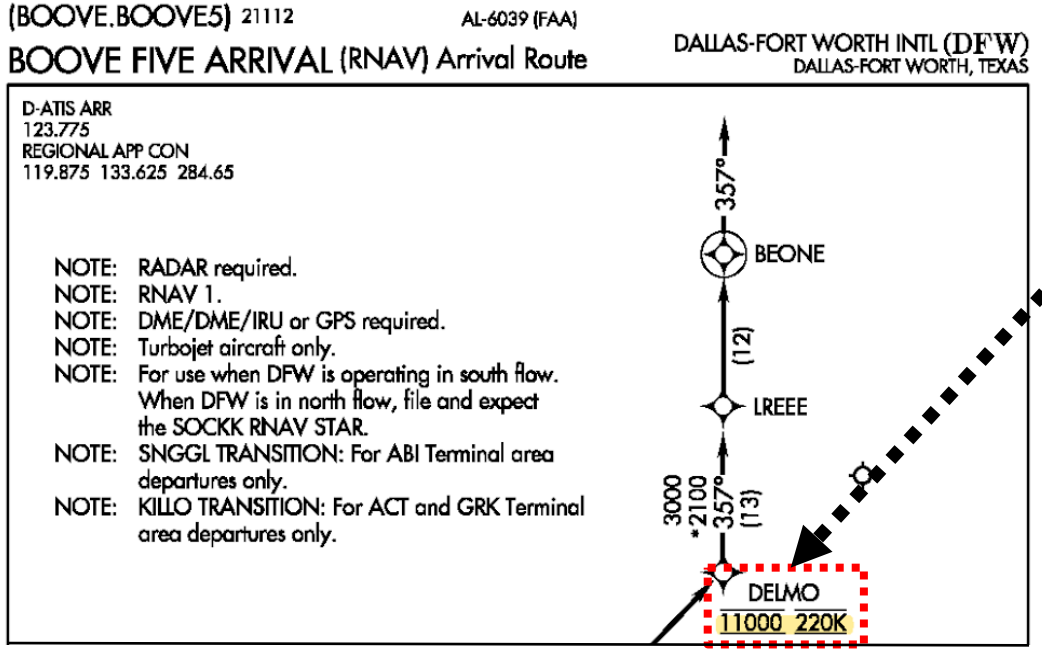
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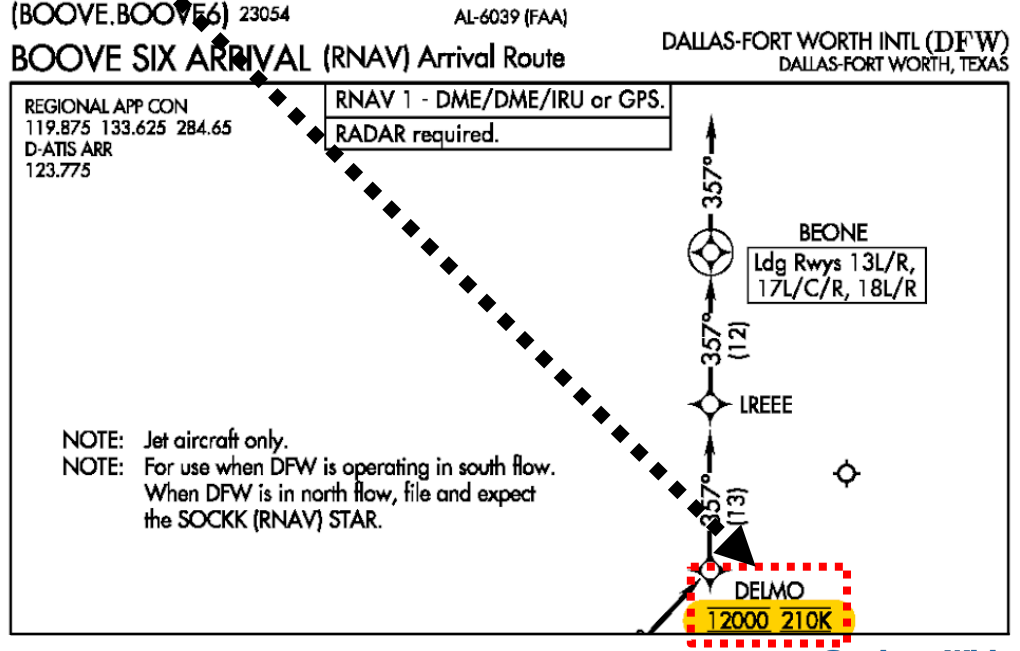
Transitioning away from Modifications

- If the modifications are implemented safely there may be a need to make changes to the system.
- For Example:
  - Changing controller phraseology.
  - Incorporate modification into the procedure.

Change in ATC Phraseology

DESCEND VIA STAR, EXCEPT MAINTAIN TWELVE THOUSAND





Summary

Wealth of Data to Examine

- **Outlining a Strategy:**
  - Where to begin.
  - How to augment with other data sources.
- **Anecdotal Examples:**
  - Different responses to wake turbulence events.
    - Attempt to slow down.
    - Leave the procedure and fly a parallel path abeam to the original.
  - Modifications to DFW Arrival Altitude Restrictions to prevent TCAS-RA's.
    - Altitude restriction modification.
- **Future Work:**
  - Build empirically validated results using real-world data.
  - Help build awareness amongst stakeholders to incorporate into SMS programs.

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Questions?

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