Safety Management System
Air Traffic Control Safety

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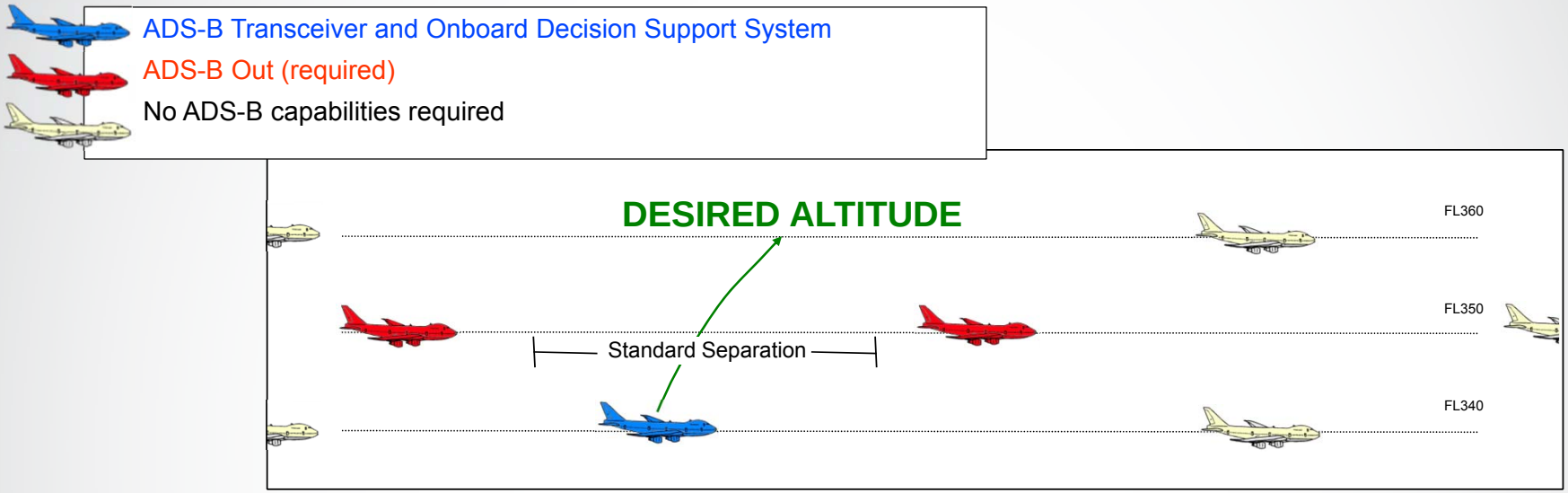
SAFETY MANAGEMENT SYSTEM

- Required by International Civil Aviation Organization (ICAO) and FAA international safety standards
- Began implementation in 2005; approved in 2010

ATO SAFETY MANAGEMENT SYSTEM: WHERE WE'RE GOING

- **Improvement/maturation**:
  - Emphasis on quantifiable data collection/analysis
  - Better monitoring through lower-level indicators of safety risk
  - Incorporation of DO 278 standards
  - Adoption of an international maturity model for assessment
- **Full SMS implementation in other FAA lines of business** (Aviation Safety, Airports, Commercial Space Transportation)
- **Integrated FAA SMS:**
  - FAA-wide hazard tracking system
  - Common taxonomy
  - International harmonization

EXAMPLE: ADS-B IN-TRAIL PROCEDURES (ITP)



NEED → **CHALLENGE** = **OPPORTUNITIES**

Altitude changes required for better fuel economy, winds, and ride quality

The combination of locally dense traffic and large separation minima limits altitude changes

Use airborne ADS-B applications to enable altitude changes otherwise blocked by conventional operations

ADS-B ITP ACCOMPLISHMENTS

- In cooperation with RTCA and the European Organization for Civil Aviation Equipment (EUROCAE):
  - Concept of Operations
  - Operational Performance Assessment
  - Operational Safety Assessment
  - Safety, Performance, and Interoperability Requirements Document
- Collision Risk Analysis
- Collision risk models presented to ICAO Separation and Airspace Safety Panel (SASP) and accepted by the mathematical sub-group
- ITP operation circular approved and forwarded to the ICAO Air Navigation Commission
- ITP procedure to be incorporated in ICAO *Procedures for Air Navigation Services, Air Traffic Management*

ADS-B ITP SAFETY RISK MANAGEMENT DOCUMENT

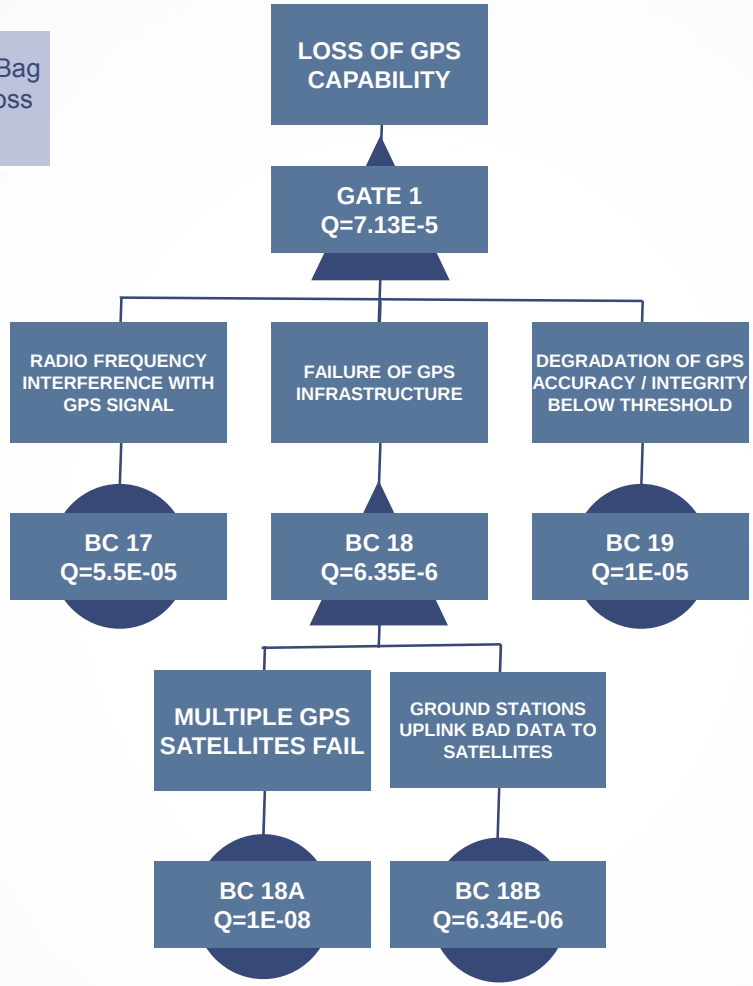
- System hazard analysis
- Collision risk models
- Air traffic controller procedures
- Flight crew procedures
- Operational Safety Risk Management monitoring plan

ADS-B ITP OPERATIONAL HAZARDS

NUMBER	HAZARD	INITIAL RISK	PREDICTED RESIDUAL RISK
OH-1	Flight crew performs an ITP operation incorrectly and not compliant with the ITP procedure	4D (Low)	4D (Low)
OH-2	Air traffic control approves an ITP operation that is not compliant with the ITP procedure	4E (Low)	4E (Low)
OH-3	Reference aircraft maneuvers during the ITP operation when not cleared by air traffic control	3D (Low)	3D (Low)
OH-4	ITP or reference aircraft encounters wake turbulence	5A (Low)	5A (Low)
OH-5	Controller overlooks an actual conflict between aircraft because of the additional Conflict Alerts generated by the ITP operations	3D (Low)	3D (Low)
OH-6	Failure of ITP Electronic Flight Bag during ITP maneuver causes loss of situational awareness	5C (Low)	5C (Low)

EXAMPLE: SRM QUANTITATIVE ANALYSIS

OH-6	Failure of ITP Electronic Flight Bag during ITP maneuver causes loss of situational awareness



EXAMPLE: SRM QUANTITATIVE ANALYSIS

NUMBER	DESCRIPTION	COMMENTS	RATIONALE / FREQUENCY PER FLIGHT HOUR
BC 17	Radiofrequency interference with GPS signal	Intentional GPS interference is considered a security issue per SCAP. Wide-area jamming is most likely near a terminal area, which should be covered by terminal radar, unless the radar has also failed.	5.5E-05□RTCA DO-318 ADS B RAD 3.2.1.3 (6):□It is assumed that the likelihood of a GNSS signal-in- space interference event causing a wide-area loss of horizontal position is 5.5E-05 per flight hour, based on historical performance.
BC 18	Failure of the GPS infrastructure	There has not been a total system failure since the start of GPS service in 1994.	18 years = 157,680 hours□Better than 6.34E-06 per hour
BC 18A	Multiple GPS satellites fail		1E-8 per hour likelihood of 2 simultaneous independent satellite failures, per GPS SPS PS
BC 18B	Ground stations uplink bad data to satellites		18 years = 157,680 hours□Better than 6.34E-06 per hour
BC 19	Degradation of GPS accuracy and/or integrity below threshold	The accuracy and integrity of the position reports are below the threshold for surveillance and navigation for many aircraft in a geographic region, but the GPS network is still operational.	GPS SPS PS indicates 1E-5 per hour
ENV 4	All aircraft not equipped with alternative means of navigation	ANDed with GT 1	Q=0.99248, based on 25% non-alternate electronic navigation equipage rate
EVENT 1	Two or more radars unavailable in a region, creating an Environment B ADS-B-only airspace		Q=1.14E-3 per flight hour, based on historical radar performance

CURRENT

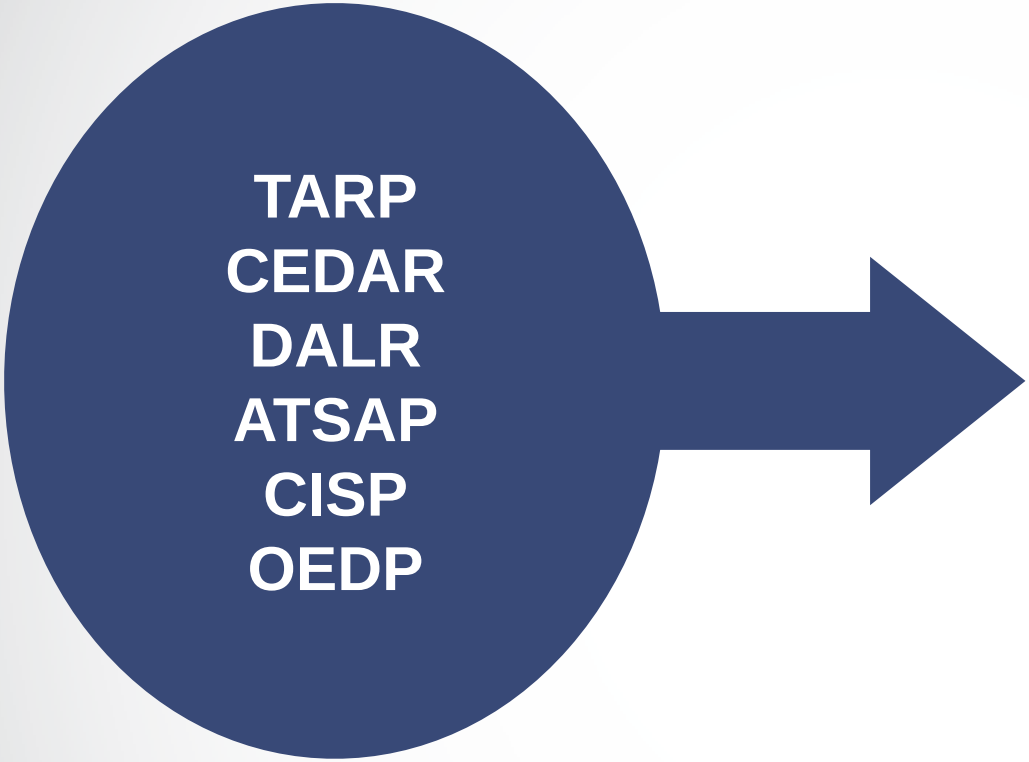
SAFETY MEASURES

2012 – YEAR OF TRANSITION
ESTABLISHING A NEW BASELINE

FROM		TO
Local Reporting	→	National Voluntary Reporting
Minimal Local Electronic Monitoring	→	Automated Electronic Detection
Operational Incident Counts	→	Standardized Risk Analysis
Distance-Based Categorization	→	Application of Risk Matrix
Single Event Mitigation	→	Addressing Systemic Issues (TOP 5)
Categorization Buckets (A, B, C)	→	Identification of High Risk Events
Event Reporting	→	Investigation and ID Causal Factors
A+B Metric	→	Metric on ratio of High Risk Events
Local Mitigation Monitoring	→	National High-Priority Goal on Addressing Risk Mitigation

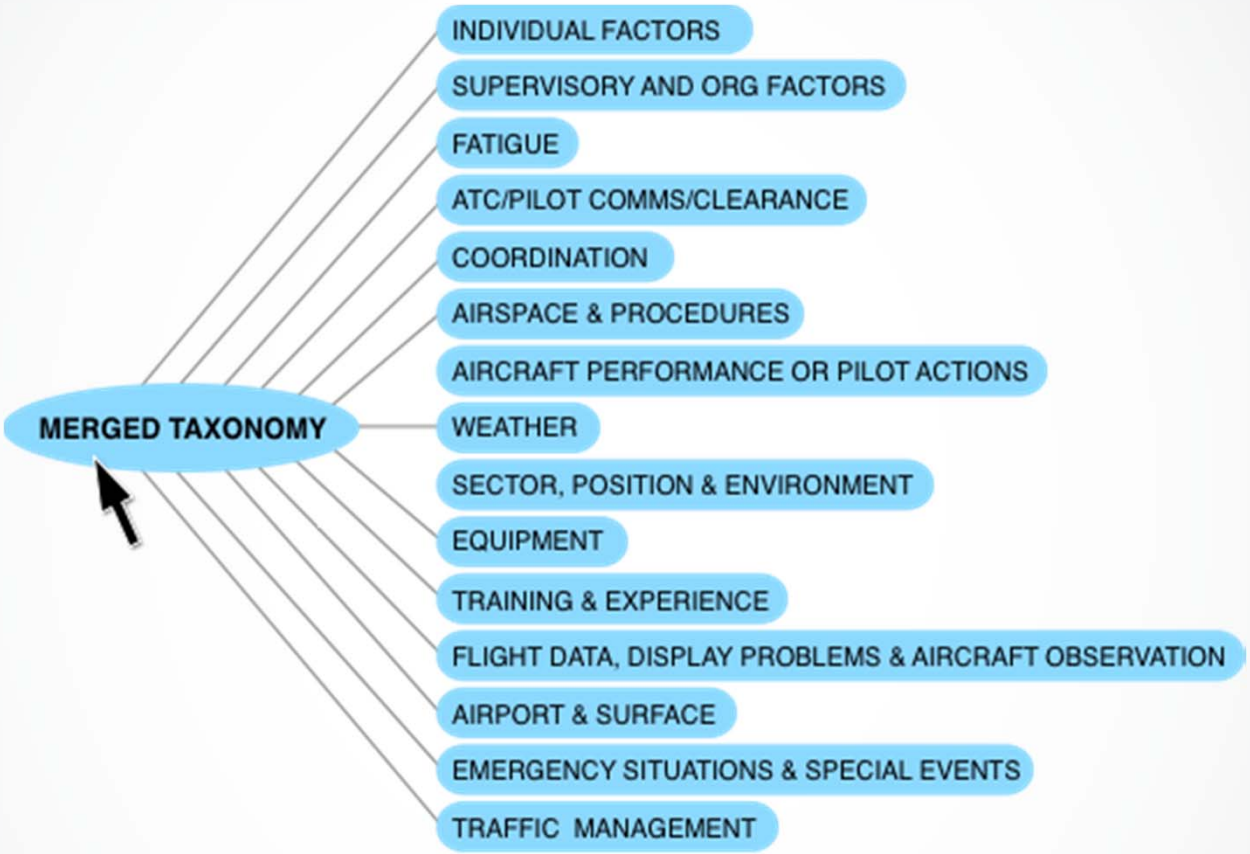
RESULT: A nearly 300% increase in reported incidents

A NEW APPROACH TO RISK ANALYSIS



10x MORE DATA OVER LAST 3 YEARS

RISK ANALYSIS PROCESS: CAUSAL FACTORS

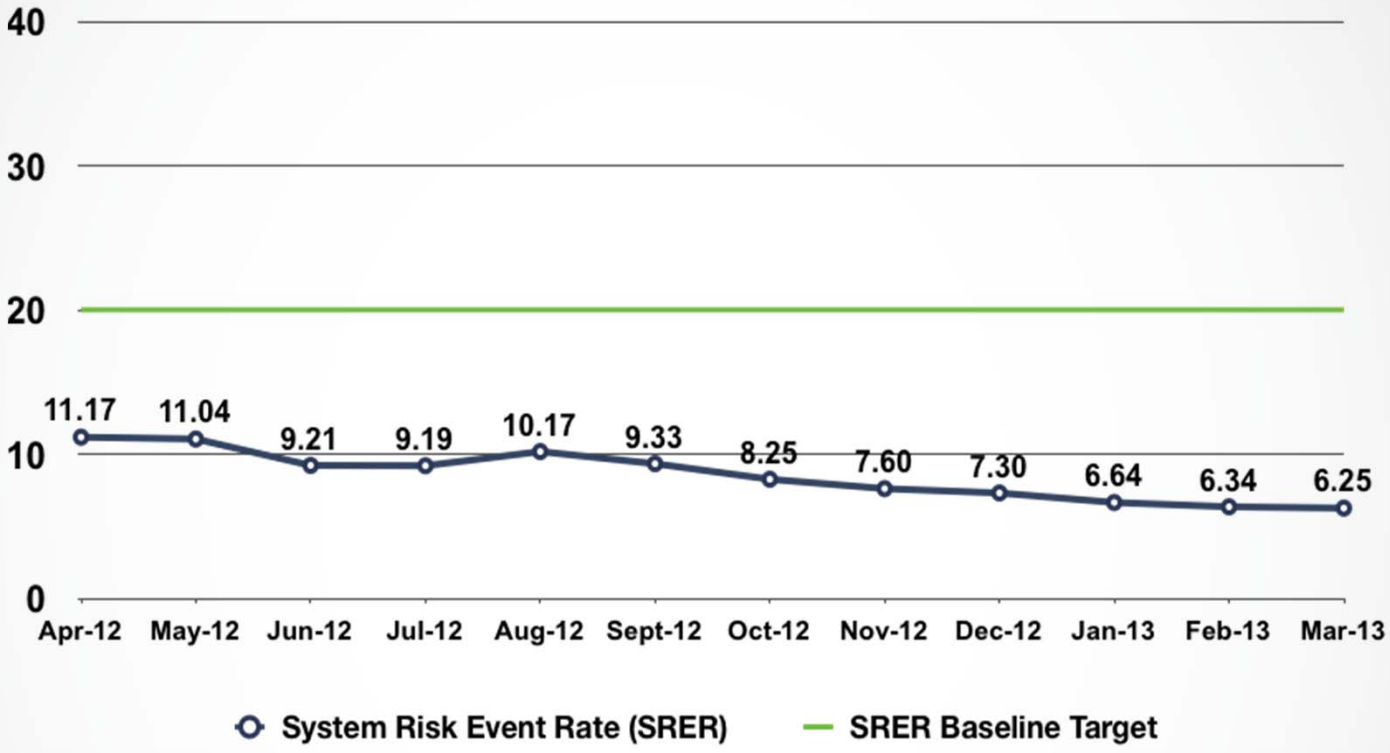


PROACTIVE OCCURRENCE REPORTING

APRIL 2012 - MARCH 2013	
Total Volume Air Traffic Operations	130,437,567
Mandatory/Electronic Occurrences for Review	206,943
Processed Mandatory/Electronic Occurrences	205,596
Validated Losses of Separation	5,918
Risk Analysis Events	1,860
High-risk Events	37
Losses per Volume	0.00004537

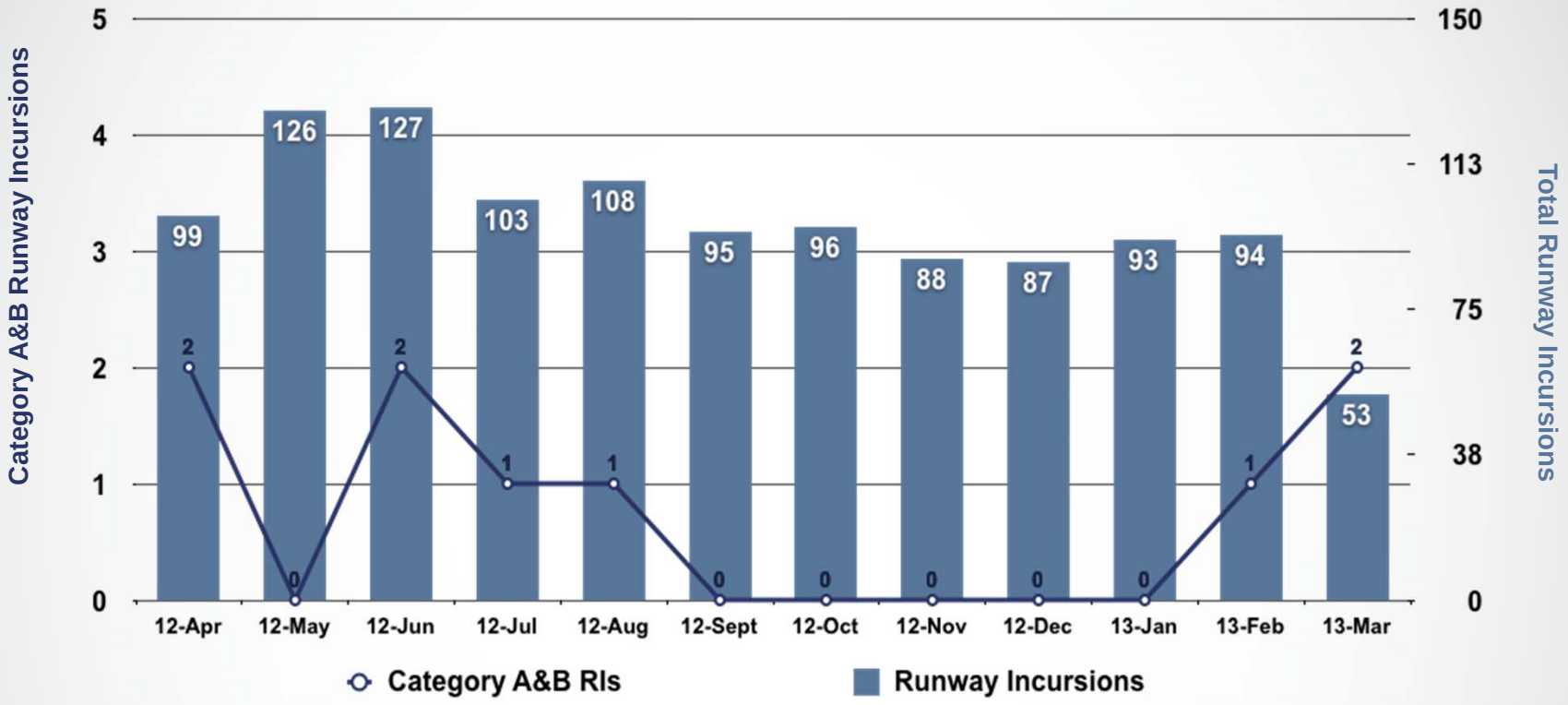
Note: Most validated losses have multiple record entries for each loss identified. Data is for a rolling period beginning February 2012.

SYSTEM RISK EVENT DATA

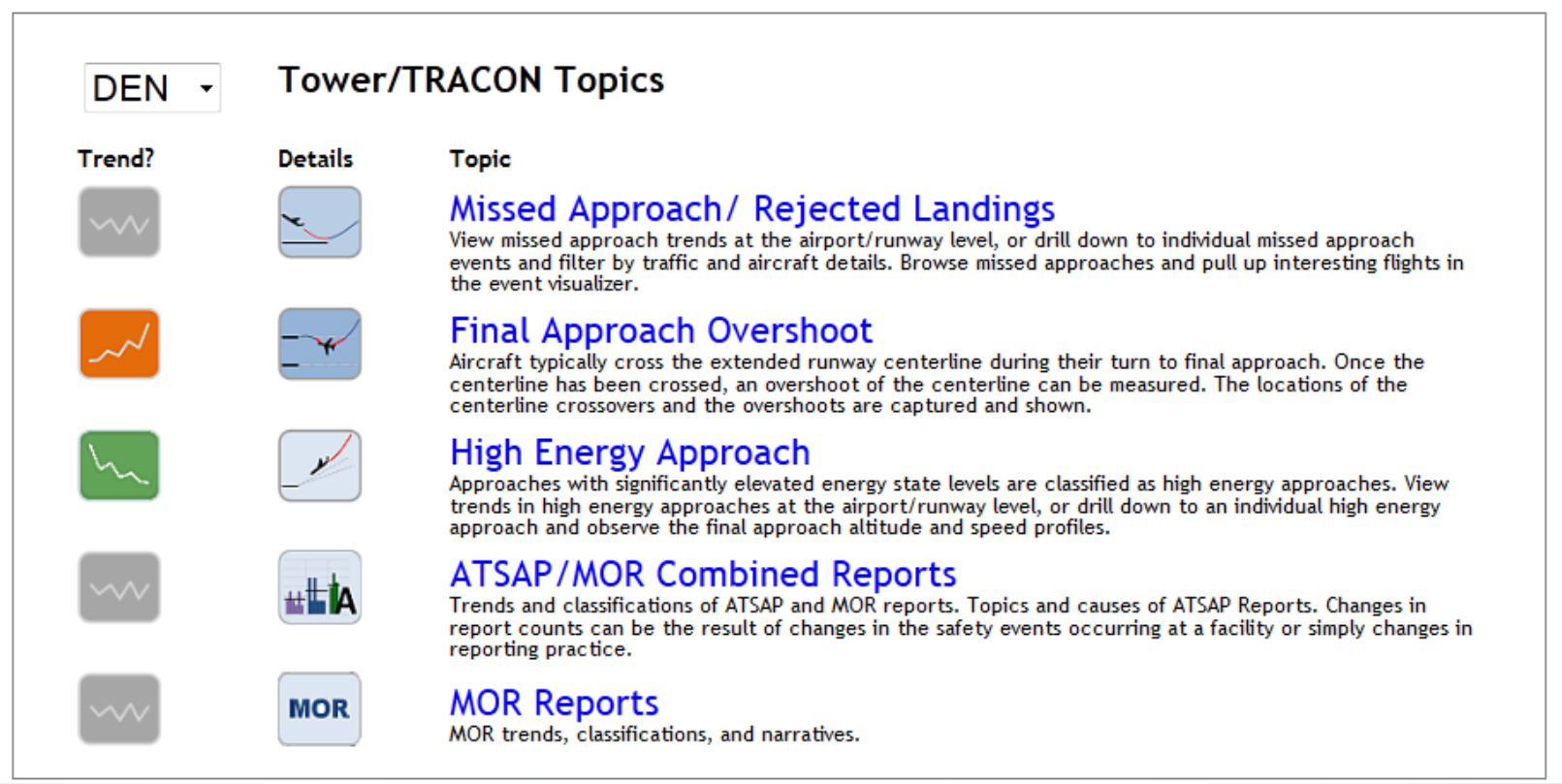


12-Month Rolling Rate
# of High-risk RAEs / Total # of Validated Losses

RUNWAY INCURSIONS



SAFETY DATA PORTAL: METRICS



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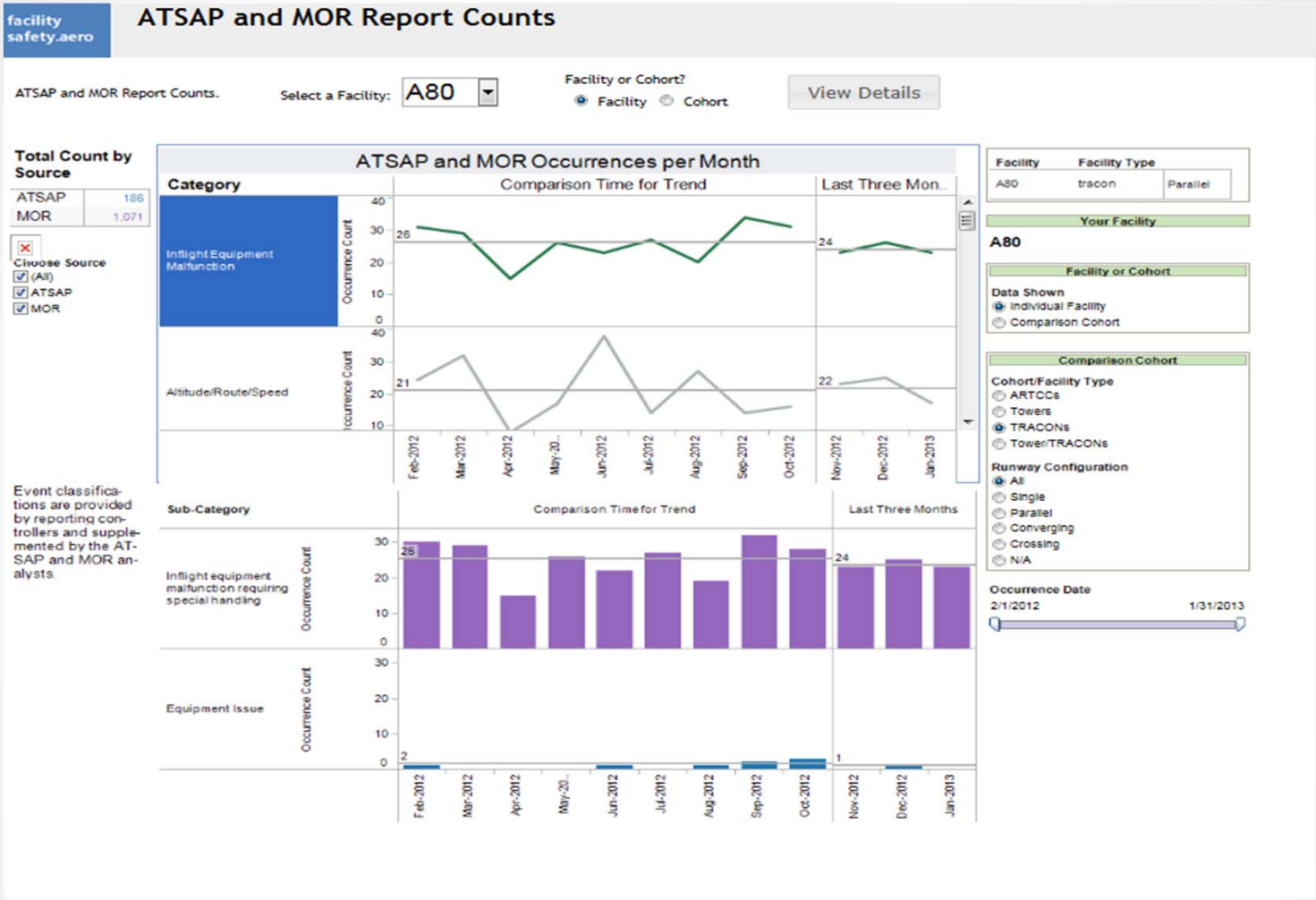

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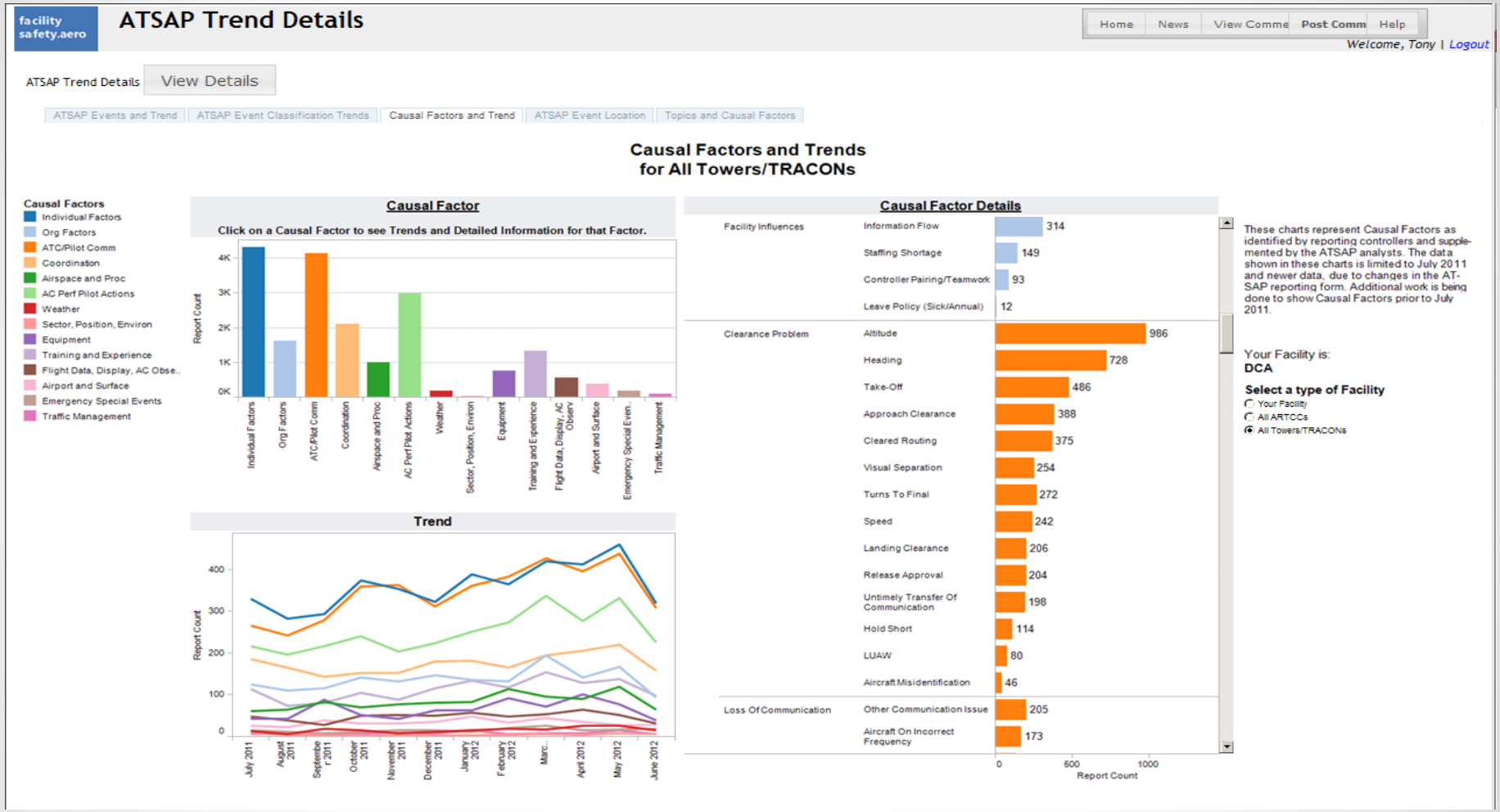

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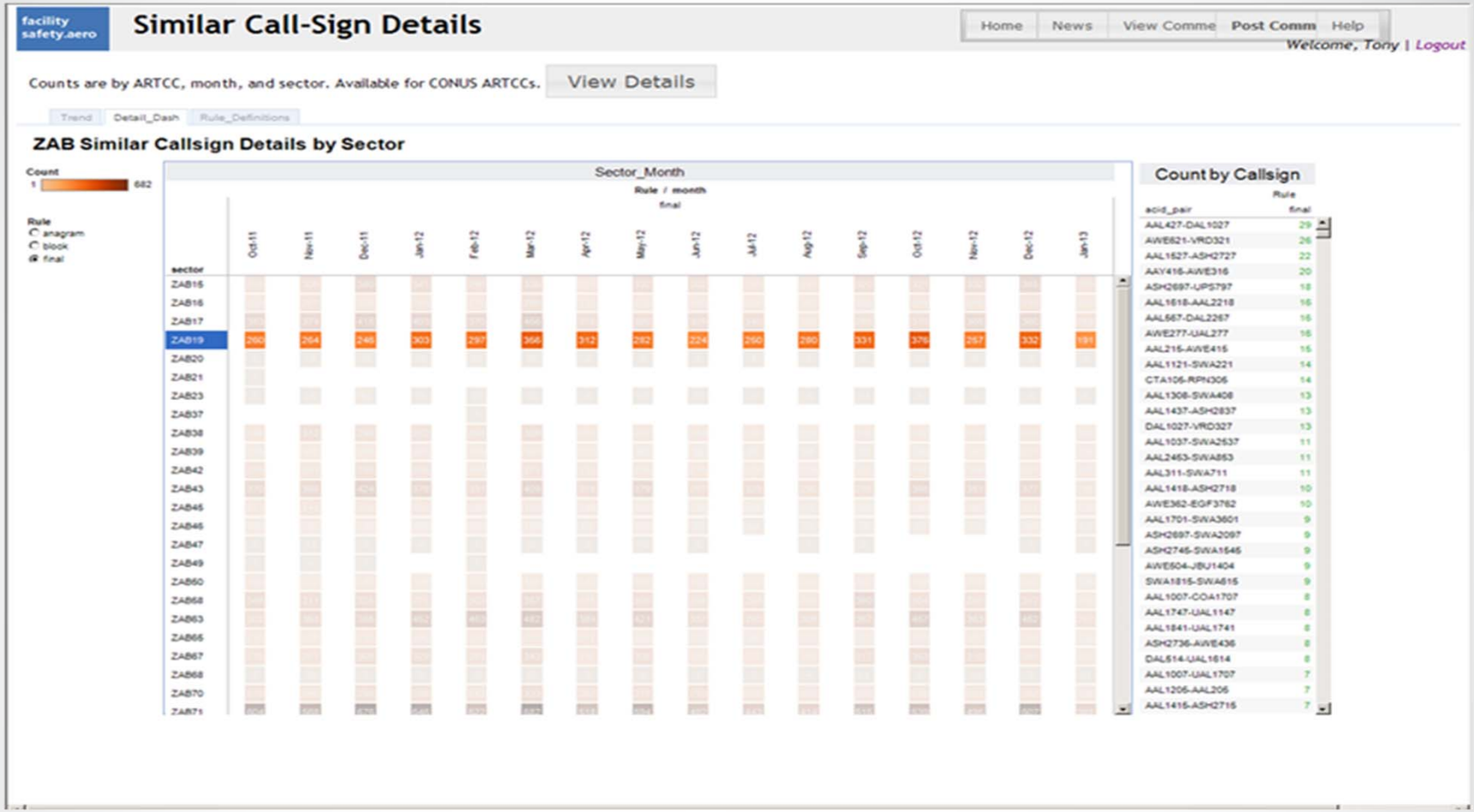

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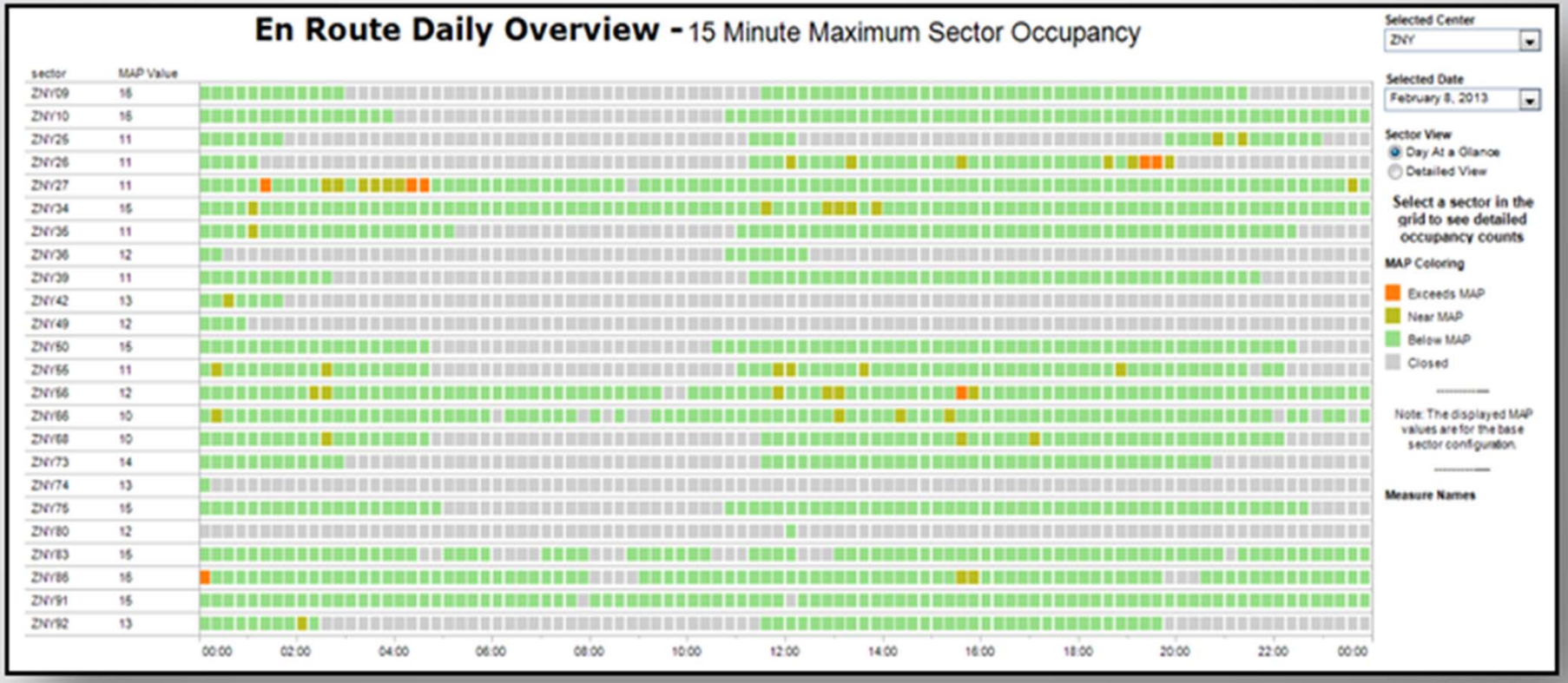


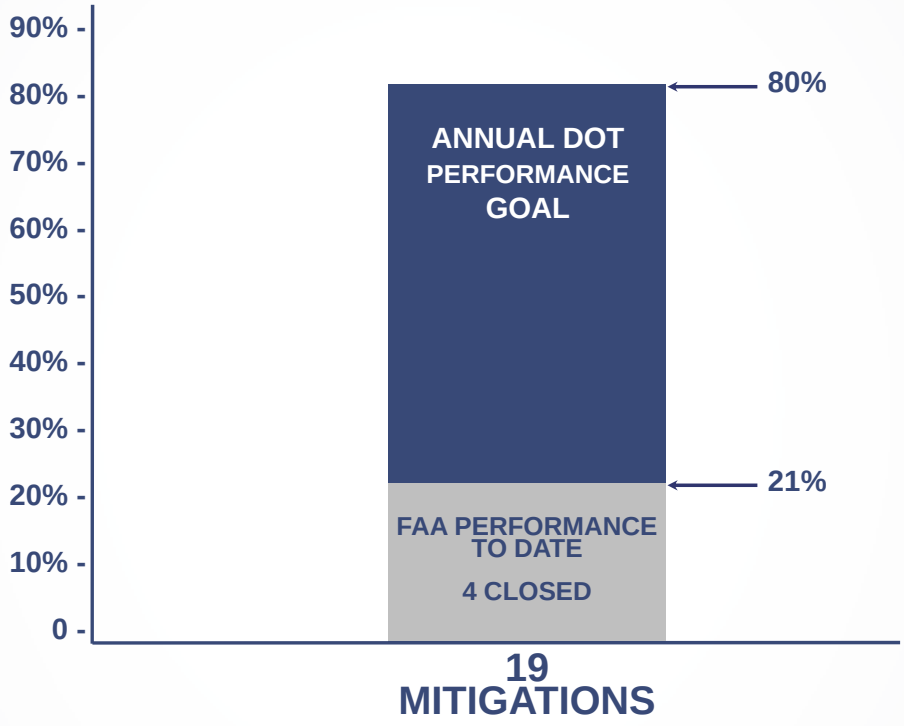
TOP 5

WE MEASURE SUCCESS BY WHAT WE FIX

2013 TOP 5

- RECOVERY
- TRAFFIC ADVISORIES/SAFETY ALERTS
- MONITORING INITIAL DEPARTURE HEADINGS
- SIMILAR SOUNDING CALL SIGNS
- CONFLICTING PROCEDURES

2013 TOP 5


90% -
80% -
70% -
60% -
50% -
40% -
30% -
20% -
10% -
0 -
80%
ANNUAL DOT PERFORMANCE GOAL
21%
FAA PERFORMANCE TO DATE
4 CLOSED
19
MITIGATIONS

RESULTS: VOLUNTARY SAFETY REPORTING

REACTIVE

5,000

APPROXIMATE OPERATIONAL INCIDENTS OVER 3 YEARS

PROACTIVE

63,000

ATSAP REPORTS TO DATE

- **64% OF ELIGIBLE PERSONNEL HAVE FILED REPORT**
- **300-350 REPORTS PER WEEK**

170 CORRECTIONS SINCE PROGRAM INCEPTION

Note: As of FY13-Q2

RESULTS: CONFIDENTIAL INFORMATION SHARING PROGRAM

NEXTGEN

SAFETY PERFORMANCE METRICS

COMMERCIAL CATASTROPHIC ACCIDENT RATE
PER FLIGHT HOUR WITH DIRECT ATM CONTRIBUTION

Official European TLS	US Accident Rate
Operational	Operational
1.55×10^{-8}	0.72×10^{-8}
Design	Design
1×10^{-9}	1×10^{-9}
Through Redundancy	Through Redundancy

How should we value Human Performance in Design Standards?

NEXTGEN TRANSFORMATION

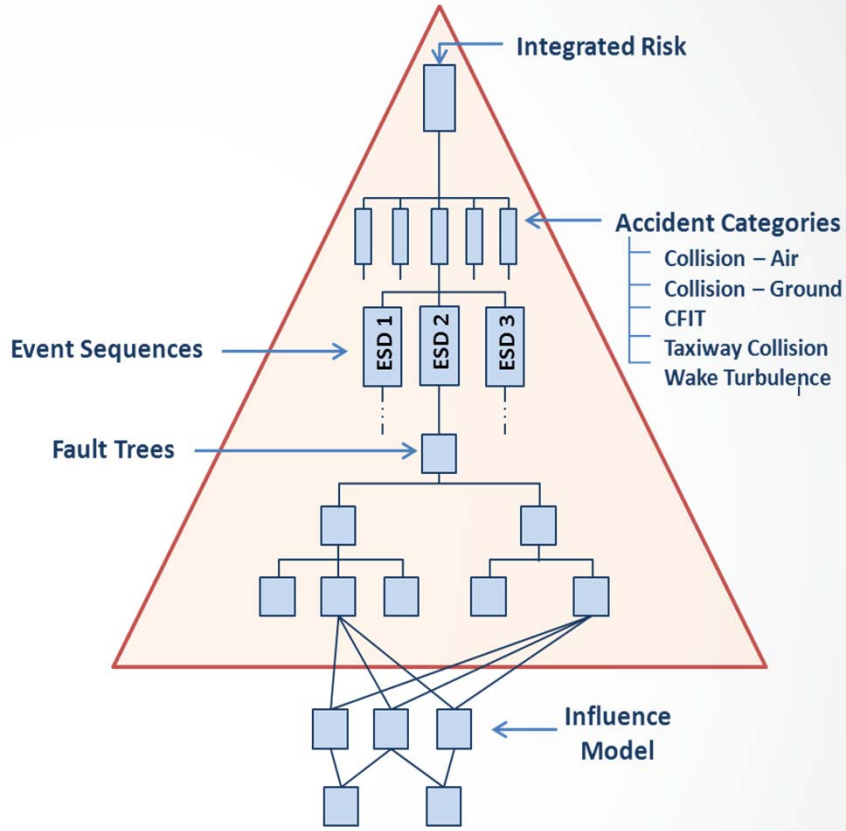
FROM		TO
Ground-based navigation/surveillance	→	Satellite-based navigation/surveillance
Voice radio control	→	Digital data exchange
Disconnected information systems	→	Net-centric information access
Human-centric air traffic control	→	Automation-assisted air traffic management
Fragmented weather forecasting	→	Probabilistic weather decision tools
Limited-visibility airfield parameters	→	Equivalent visual operations
Forensic safety system	→	Prognostic safety system
Inefficient security screening	→	Integrated security risk management
Current aircraft environmental footprint	→	Reduced aircraft environmental footprint

POTENTIAL SAFETY CHALLENGES IN 2020

- Controller situational awareness
- Increased number of alerts/notifications
- Decision support tools
- Propagation of inaccurate information (throughout interrelated NAS)
- Detection/recovery from safety events
- No reduction in existing safety barriers
- Mixed equipage

INTEGRATED SAFETY MANAGEMENT

- Enterprise-focused, risk-based assessments throughout the lifecycle of solution
- Early identification of safety issues
- Integrated safety analyses across vertical, horizontal, and temporal planes
- Hazard and mitigation effectiveness tracking



Integrated Risk Picture - Generalized

Questions?

WWW.FAA.GOV/Go/ATOSafety