Normal Operations Safety Survey (NOSS) and Threat and Error Management (TEM) – SAM Implementation Awareness Webinar

Chris Henry, Ph.D.
NOSS Collaborative
www.nosscollaborative.org
henry@nosscollaborative.org

TEM, LOSA & NOSS: Background & Development

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LOSA Collaborative Airlines

Aegean	AeroMexico	Air Astana	Air Canada
Air Central	Air France	Air Freight New Zealand	Air Hong Kong
Air Japan	Air Nelson	Air New Zealand	Air Next
Air Nippon	Air Nippon Network	Air Niugini	Air Transat
Alaska Airlines	All Nippon Airways	ANA/JP Express	Asiana Airlines
Atlantic Southeast Airlines	Avianca	Braathens	Cathay Pacific
Chautauqua Airlines	China Airlines	Continental Airlines	Continental Micronesia
Copa Airlines	Delta Air Lines	DHL Air	Dragonair / Cathay Dragon
Emirates	Etihad	ExpressJet	FedEx
Firefly	Frontier Airlines	Hawaiian Airlines	Horizon Air
IndiGo	Japan Airlines	JetBlue	KLM
LACSA	Malaysia Airlines	Mexicana	Mount Cook Airlines
Qatar Airways	Republic Airlines	Royal Air Maroc	Royal Jordanian
Saudia	Shuttle America	SilkAir	Singapore Airlines
Singapore Airlines Cargo	Southwest Airlines	TACA International	TACA Peru
TAP Portugal	Thomas Cook Airlines	Transavia	United Airlines
UPS	Virgin America	Virgin Australia	Volaris
WestJet	Jeju Air	Hong Kong Express	

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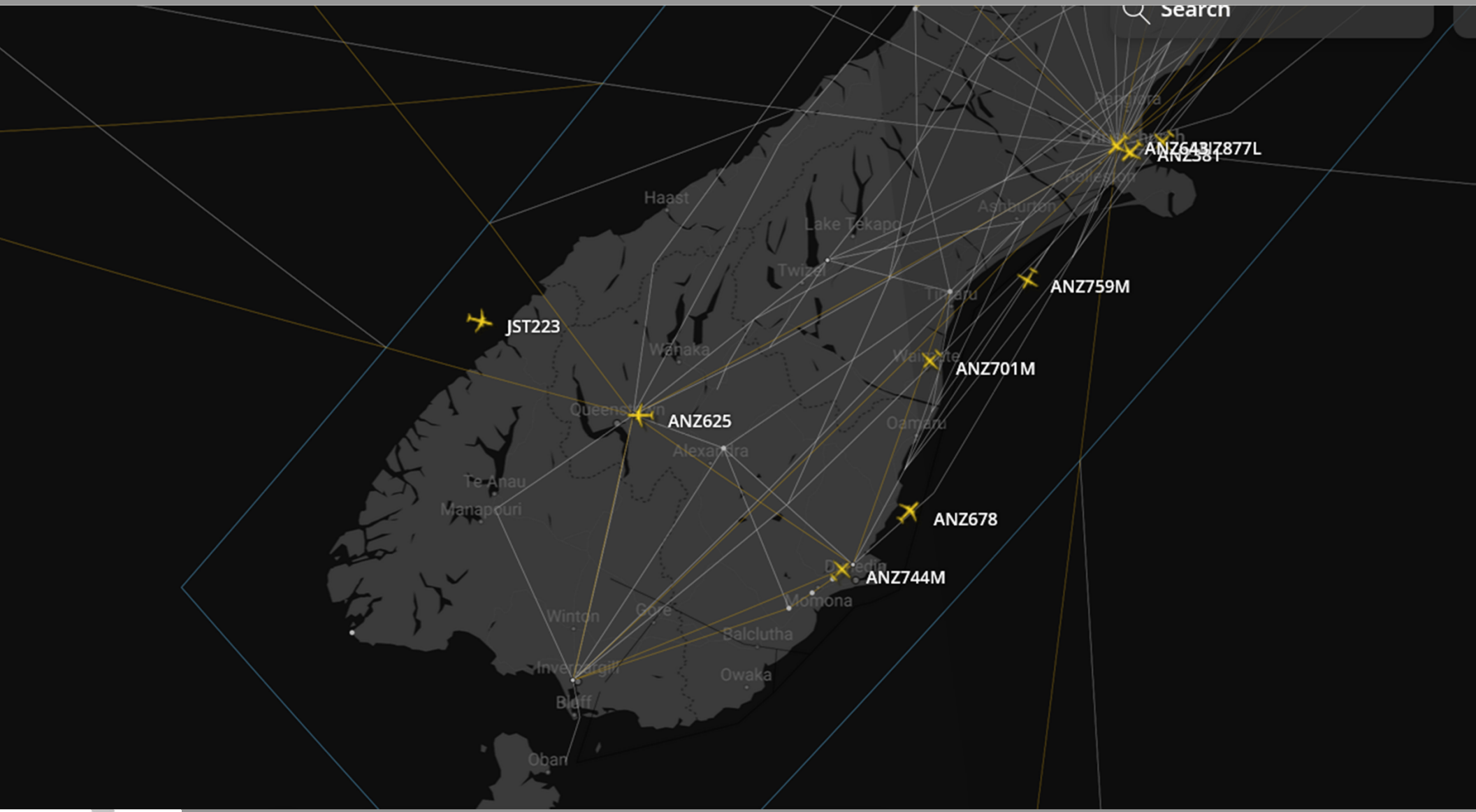
NOSS Activities

- ICAO Publications
  - Circular 314 – *Threat and Error Management (TEM) in Air Traffic Control*
  - Document 9910 – *The Normal Operations Safety Survey (NOSS)*
- NOSS Archive – 6,000+ observations from the following countries
  - Australia
  - New Zealand
  - Canada
  - United States of America
  - South Korea
  - South Africa
  - Thailand
  - Dubai
  - Ireland
  - Italy
  - New ANSPs are planning in Middle East, Africa, Asia and Europe

NOSS Activities

NOSS Activities



NOSS COLLABORATIVE

NOSS Activities

NOSS Activities

NOSS COLLABORATIVE

NOSS Activities

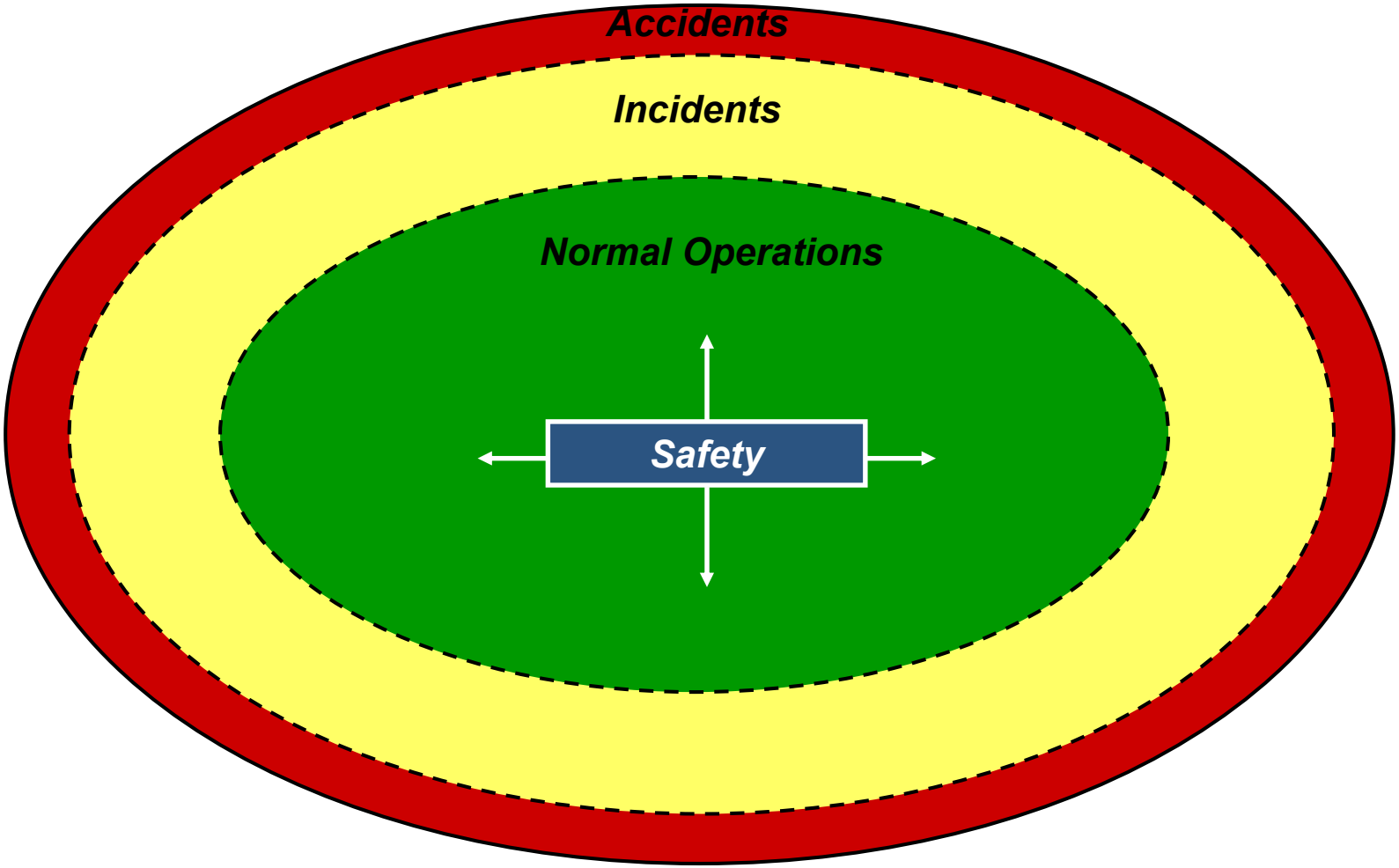
What is NOSS?

- Proactive (Predictive) safety data collection tool
- Over-the-shoulder observations during normal shifts
- An evaluation of the system, not the controller

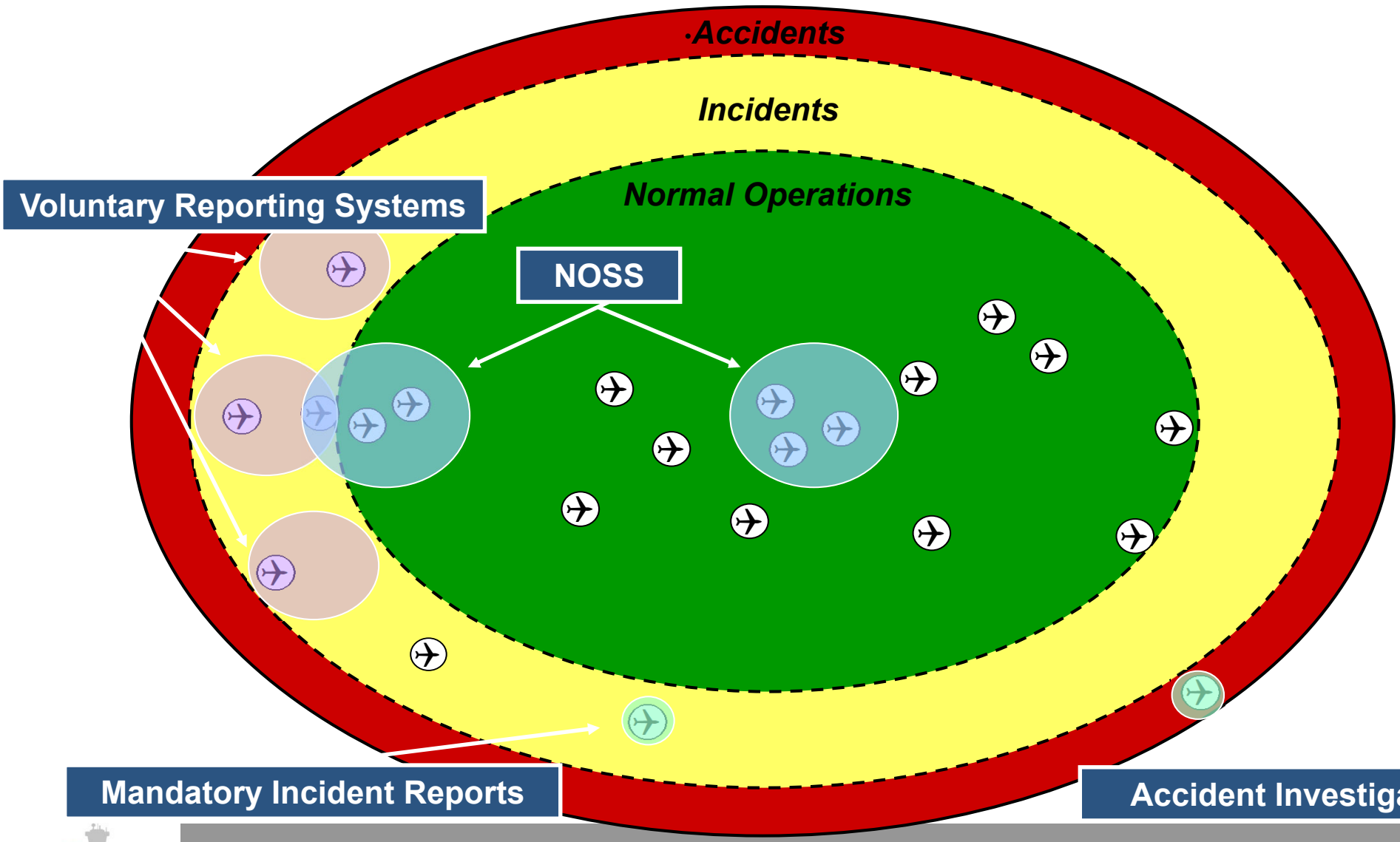
- Primary data – Threat and Error Management, which includes:
  1. Documenting operational complexities and how controllers and the ATC system manage / are impacted by them
  2. Capturing work-as-done: operational drift, work-arounds, shortcuts, performance variation, violations, mistakes

- Based on data, not opinions
- Provides data on *strengths* and *weaknesses*
- Analogous to getting blood-work done by the doctor – it's a diagnostic

Aviation Safety Envelope



Safety Data Coverage



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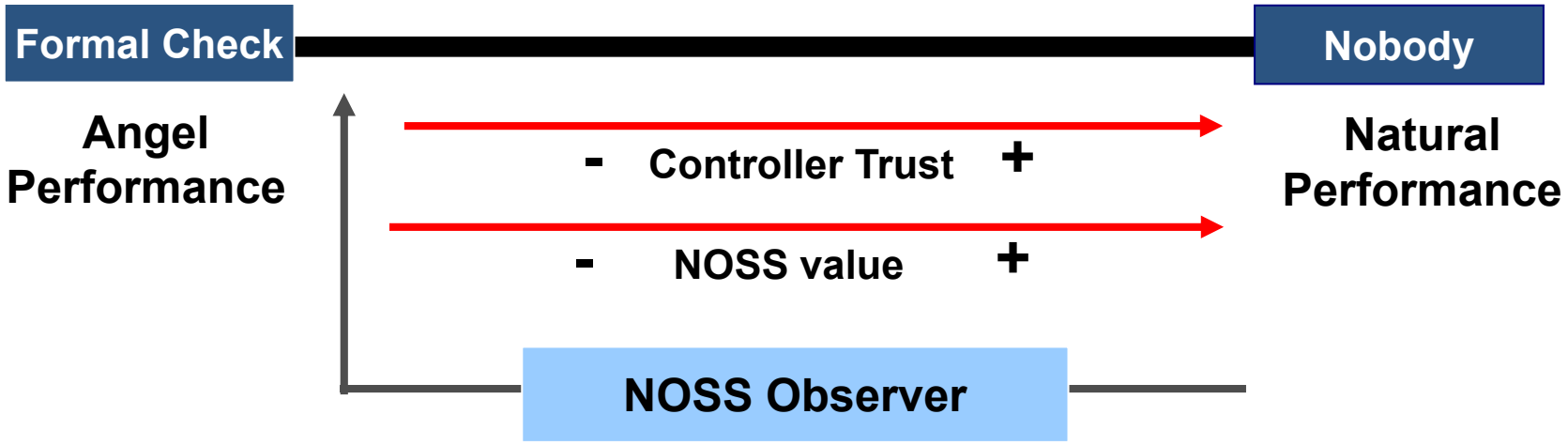
NOSS Success Factors

- NOSS success is dependent upon methodology and execution



Low controller trust = Low quality data because there will be no differentiation between NOSS and proficiency checks

NOSS: The Ten Characteristics

1. Over-the-shoulder observations during normal shifts
2. Anonymous, confidential, and non-punitive data collection
3. Joint management / association support
4. Voluntary Participation
5. Trusted and trained observers
6. Trusted and secure data collection site
7. Systematic data collection instrument
8. Data verification process
9. Data-derived targets for safety enhancement
10. Feedback results to controllers

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NOSS Operating Characteristics

1. Over-the-shoulder observations during normal shifts
   - No observations of controllers who are undergoing training / checks
   - “Fly on the Wall” principle
2. Anonymous, confidential, and non-punitive data collection
   - No names, operating initials, employee numbers, dates, experience, or other identifying information
   - Data used for safety purposes only – no punitive actions
   - Observers' identity is known only by the NOSS Collaborative

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NOSS Operating Characteristics

3. Voluntary Participation
   - Controllers have the right to refuse observation
4. Joint management /controller association support
5. Trusted and Trained Observers
   - Trust and Credibility
     - Trust is essential
     - Diversity of observers increases buy-in
   - Training
     - Two-day classroom training: Theoretical background, observation protocols
     - Two-day field training: Practice and feedback

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NOSS Operating Characteristics

6. Systematic data collection instrument
   - Based on TEM; limits judgments

7. Trusted and secure data collection site
   - Controllers, observers and management must be comfortable with the data collection site

8. Data verification process
   - TEM data checked to ensure coding accuracy and consistency with SOP
   - Data analysis does not begin until verification has been completed

NOSS Operating Characteristics

9. Data-derived targets for safety enhancement
   - Examination of TEM data and the context provided in the narratives
   - Initial NOSS, safety change process, follow-up NOSS
10. Feedback results to controllers
   - Results summarized for controllers
   - Information on how organization intends to respond to the data

NOSS Defined

- The 10 characteristics that differentiate NOSS (LOSA) from other methodologies have been endorsed by the:
  - Federal Aviation Administration
  - International Civil Aviation Organization
  - International Air Transport Association
  - International Federation of Airline Pilots' Associations'
  - International Federation of Air Traffic Controllers' Associations'
  - The NOSS Collaborative
  - The LOSA Collaborative
  - US Airline Pilots Association
  - University of Texas

- **NOSS must have all ten characteristics, otherwise it is not NOSS**

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What are we looking for? - Threat and Error Management (TEM)

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TEM Terminology for ATC

- Threats: Events or errors that occur beyond the influence of the air traffic controller, increase operational complexity, and which must be managed to maintain the margins of safety

- Errors: Actions or inactions by the air traffic controller that lead to deviations from organisational or controller intentions or expectations
  - Translation: Slips, lapses, violations, shortcuts, work-arounds, mistakes – It is all information (data)

- Undesired States: Operational conditions where an unintended traffic situation results in a reduction in margins of safety
  - Translation: the transitional state between normal and abnormal operations (incidents)

Threat codes – Internal threats

Internal Threats			
Equipment / Workspace Threats		**Other controller / Flight Data**	**Operational Performance Threats**
Maintenance	Visitors	Communication Transfer Issue	Procedure
Radios	Poor Sight Lines	NS. Phraseology by other controller	Flow Control Issue
Hotlines / Landlines	Lighting	Incomplete Readback by Other Controller	Non-Standard Level
Traffic / Radar Display Issue	Chart/Manual Error	Communication difficulty with other ATC	Non-Dedicated RWY Usage
Surveillance Coverage	Windows (dirty, etc)	Comm. channel used by other controller	Change in duty RWY / Mode of operations
Frequency Coverage	Automated Handoff Failure	Controller System Input	Diversions
Screen Clutter	Flight plan -ATS system incongruence	Coordination Issue	Sequencing Issue
Unserviceable Equipment	Equipment Failure (fails during observation)	Strip Issue	Combined / De-combined Positions
Data Incongruence between ATS systems	Information not updated	Controller-to- controller interaction	Transponder limitation
Software / Equipment Issue		Supervisory Issue	Block Altitude
False System Alert	Data link problem	Flight Plan Error - Controller	Increasing Traffic Load / Complexity
Equipment Checks	Workstation layout	Unspecified Controller Threat	Ground Stop
Noise - People	Temperature	Incorrect Readback by Other Controller	Test Flight
Noise – Equipment/Maintenance	Other Equipment/Workspace Threat	Updated information not provided	Holding
Difficult to Access Materials/Information		Flight Information Service Issue	ELT
			Towing (disruptive to operations)
			New procedure / equipment
			Noise abatement
		Other Controller Operational Threat	
		Non-Operational Conversation	

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Threat codes – Airborne threats

Airborne Threats		
Aircraft Pilot Issus	**Pilot Communication**	**General Traffic Characteristics**
Radar identification issue	Incomplete Readback - Pilot	Traffic Mix
Heading Deviation	Non-Standard Phraseology - Pilot	Military Activity
Speed Deviation	Language Difficulty - Pilot	Parachute Activity
Altitude Deviation	Pilot failure to respond to call	Pop-Up flight
Routing Deviation	Frequency Congestion / Calls stepped on	Formation Flight
A/C Slow to Comply with Instruction	Blocked Frequency	Survey Flight
Aircraft Equipment Issue	Pilot Communication Difficulty	Training Flight
Pilot unable to Comply w/ Instruction	Pilot Use of Incomplete/Incorrect Call Sign	Hot Air Balloon
Closing Speeds / Overtake	A/C answering call for another A/C	Similar Call Signs
Aircraft Priority / Emergency	Incorrect Readback - Pilot	MET Balloon Release
Airline Procedure / Operating Practice	No radio contact	Special VFR
Non-Standard A/C Profile	Pilot on Wrong Frequency	Flight Check
RWY Occupied Longer Than Expected		SAR Action
Pilot Taxi Error		Aerial refueling
Pilot Transponder Issue		Unknown VFR
Pilot Estimate Error		Glider Flight
Operating without required regulatory approvals (RVSM, etc)		Test Flight
Other (Misc.) Pilot Error	Other Pilot Communication Threat	Remotely piloted aircraft activity / UAV
Pilot Request		Surveillance flight
Flight plan issue – pilot/airline		Wake turbulence event (separation standards met)
Fuel Issue		Flight planned against flow
Position Report Issue		Atypical aircraft type (for airport, operators etc)
SID Deviation		Priority flight / VIP
STAR Deviation		Cloud seeding
Unexpected missed approach		Special requirements flight
Aircraft not ready at threshold		Other Traffic Threat
Circuit spacing issue		
Circuit deviation		
Rejected takeoff		
Pilot provides wrong information		
Pushback error		
Illuminated stop bar crossed		
Late change of pilot intentions		
Rate of Climb / Descent		
Unauthorized entry into AOR		
Taxi speed		
Exceeds clearance limit		
Other Pilot/AC performance threat		

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External Threats

Air Traffic Service Provider External Threats					
Airport Layout & Airspace Infrastructure/ Design		**Ground Operators**		**Foreign Service Providers**	
301	Ground Construction	401	Wrong –Frequency - Ground Operator	341	Ext ATSP - NS Phraseology
302	Runway Contamination	402	Similar Callsigns - Ground Operator	342	Ext ATSP - Readback Error
303	RWY/TWY Configuration	403	Wrong Callsign - Ground Operator	343	Ext ATSP - Comm Difficulty
304	Insufficient / Poor Signage	404	Phraseology - Ground Operator	344	Ext ATSP - Comm Channel
305	Taxiway Closure	405	Slow to comply Ground Operator	345	Ext ATSP - Controller System Input
306	Airport Layout	406	Communication difficulty Ground Operator	346	Ext ATSP - Equipment Issue
307	Animal Activity	407	Maneuvering error Ground Operator	347	Ext ATSP - Coordination Issue
308	Taxiway unavailable	408	Incorrect readback - Ground Operator	348	Ext ATSP - A/C Transfer Issue
309	Vehicle working on RWY	409	Incomplete readback - Ground Operator	349	Ext ATSP - Flight Plan Error
310	RWY Closure	410	Position report - Ground Operator	350	Ext ATSP - Unspecified Controller Threat
311	Closures not properly marked	411	Ground emergency - Ground Operator	351	Ext ATSP - Restriction
312	FOD	412	Not in contact with ATC - Ground Operator	352	Ext ATSP – Coord with wrong sector
313	Airport operator procedure	413	Equipment issue - Ground Operator	353	Ext ATSP – Handoff issue
319	Other Airport Threats	414	Did not report - Ground Operator	354	Ext ATSP - Procedure
321	Airspace Design	415	Did not respond to call - Ground Operator	359	Other Ext ATSP Threats
322	Restricted Airspace	416	Procedure – Ground Operator		
323	STAR/SID Design	417	Illuminated stop bar crossed – Ground Operator		
339	Other Airspace Threats	419	Other ground operator threat		

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Weather / Geographical threats

Environmental Threats			
Weather Threats		**Geographical Environment**	
361	Thunderstorms w/ Turbulence	379	Other weather threat
362	Turbulence (only)	381	Sun/Glare (natural light)
363	Icing	382	Terrain
364	Wind Shear	384	Smoke causing reduced visibility
365	Winds	385	Volcanic activity
366	Visibility		
367	Cloudbase		
369	Low Altimeters		
379	Other weather threats		

Errors

Position Relief Errors	
Incomplete Briefing	No Briefing
Checklist not used	Wrong information given during briefing
Did Not Open Position	Other Briefing Error

Communication Errors	
Full readback not obtained	Wrong language used (multi lingual environment)
Incorrect readback given	Communication not established
Incorrect readback not challenged	Did not address unanswered call
Wrong call sign used	Wrong RWY specified
Non-standard phraseology	RWY not specified
Missed call	CPDLC issue
A/C Type omitted in initial call	Rate of speech
Call sign Omission/Truncation	Amount of information in single transmission
Clipped call	Control instruction and frequency change during same transmission
No station ID on initial contact	Hearback error
Full Readback Not Given	Other Communication Error

Equipment / Automation / FDPS Errors	
Strip / FDE marked too early	Computer input error (e.g. finger trouble)
Strip /FDE marked too late	Display range selection
Strip / FDE moved too early	Data tag / important information not visible
Strip / FDE moved too late	Flight plan not updated
Wrong strip / FDE moved / marked	Communication system manipulation
Deadwood	Aerodrome lighting issue
Strip / FDE not annotated (non-standard event/operation, etc)	Stop bar / device manipulation
Strip / FDE not forwarded	Recommended automation not utilized
Required action not indicated on strip / FDE	Screen display error
No strip/FDE on display	Alert suppression error
Display out of sequence	Other equipment / automation / strip error
Blocking strip / display utilization	

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Procedural Errors

Procedural Errors	
Non-Operational Conversation	Did not pass information (traffic, terrain, etc)
Did not issue preferential routing	Incomplete / Incorrect info given during coordination
Did not scan Taxiway	Position report issue
Did not monitor takeoff/landing	Handoff error
Visual separation with A/C not on frequency	Wrong information passed to aircraft
Non-Standard Allocation of Duties	Point out issue
Information not Updated	Flow times not met
Inadequate priority given to emergency AC/vehicle	Electronic (non-operational) distraction
Failure to act on AC/vehicle Deviation	Inappropriate application of intersection departure
Estimate Error	Did not address RWY/TWY issue
SAR Response	
Late coordination	Non-standard level for non-operational reason
No Coordination	Flight plan error
Coordination with wrong sector	Task prioritization error
Insufficient conflict check	Route issuance issue
No / incomplete visual scan of RWY	Did not report problem
No / late response to alarms	Aircraft release/validation error (no auto's in effect)
Recorded line not used	Inappropriate transfer of responsibility (i.e. IFR to VFR)
Insufficient monitoring	Auto release error
No level verification	RWY Selection
Aircraft Identification Issue	Wrong separation standard applied
Response to pilot request	Checklist error (non-briefing)
Response to controller request	Reasons for Vectoring not Given
Radar services not terminated	Other Procedural Error

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Aircraft instruction Errors

Aircraft Instruction Errors	
Frequency change error	Sequence spacing error
Late descent	Takeoff clearance error
Late RWY Change	STAR clearance error
Altitude Instruction Error	SID clearance error
Speed Instruction Error	Aircraft not sent around / re-positioned
Altimeter instruction error	Line-up instruction error
Heading Instruction Error	Transponder instruction error
Hold Instruction Error	Clearance limit not established
Clearance Instruction Error	Pushback error
Taxi Instruction Error	Approach instruction error
	Other Aircraft Instruction Error

Outline of NOSS Process

Outline of NOSS Process

1. Planning: Scoping project, education, observer selection
   - ANSP resource requirements – NOSS project coordinator or steering committee part time to serve as liaison and guide decision making
   - NOSS Collaborative: Provide guidance

2. Observer training: Classroom training & 1st observations, and observer "coaching sessions"
   - ANSP resource requirements – Make observers available for 3-4 days for training, initial observations & training session
   - NOSS Collaborative: Conducts observer training & observer coaching sessions

3. Data collection
   - ANSP resource requirements: Observer availability for 3-5 shifts over a 2-3 month period
   - NOSS Collaborative: Collate data, monitor observation quality and progress, provide regular feedback to observers & project manager about progress, build database, review and prepare data for data verification

Outline of NOSS Process

4. Data verification: Quality control process, vet the data, address grey areas, etc
   - ANSP resource requirements: Provide operational experts to review data (1-3 days); just show up
   - NOSS Collaborative: Facilitate data verification, make changes to database

5. Data analysis & report production:
   - ANSP resource requirements: Nil
   - NOSS Collaborative: Analyze data and produce report; detailed summary of trends and issues identified in the data using a mixed quantitative and qualitative approach; de-identified comparisons to comparable NOSS Archive Units

6. Report delivery & safety change process
   - ANSP resource requirements: Units / ANSPs are in full control of the safety change process
   - NOSS Collaborative: Provide the NOSS Report and Raw Data; provide insight into what other Units / ANSPs have done; provide support to ANSP

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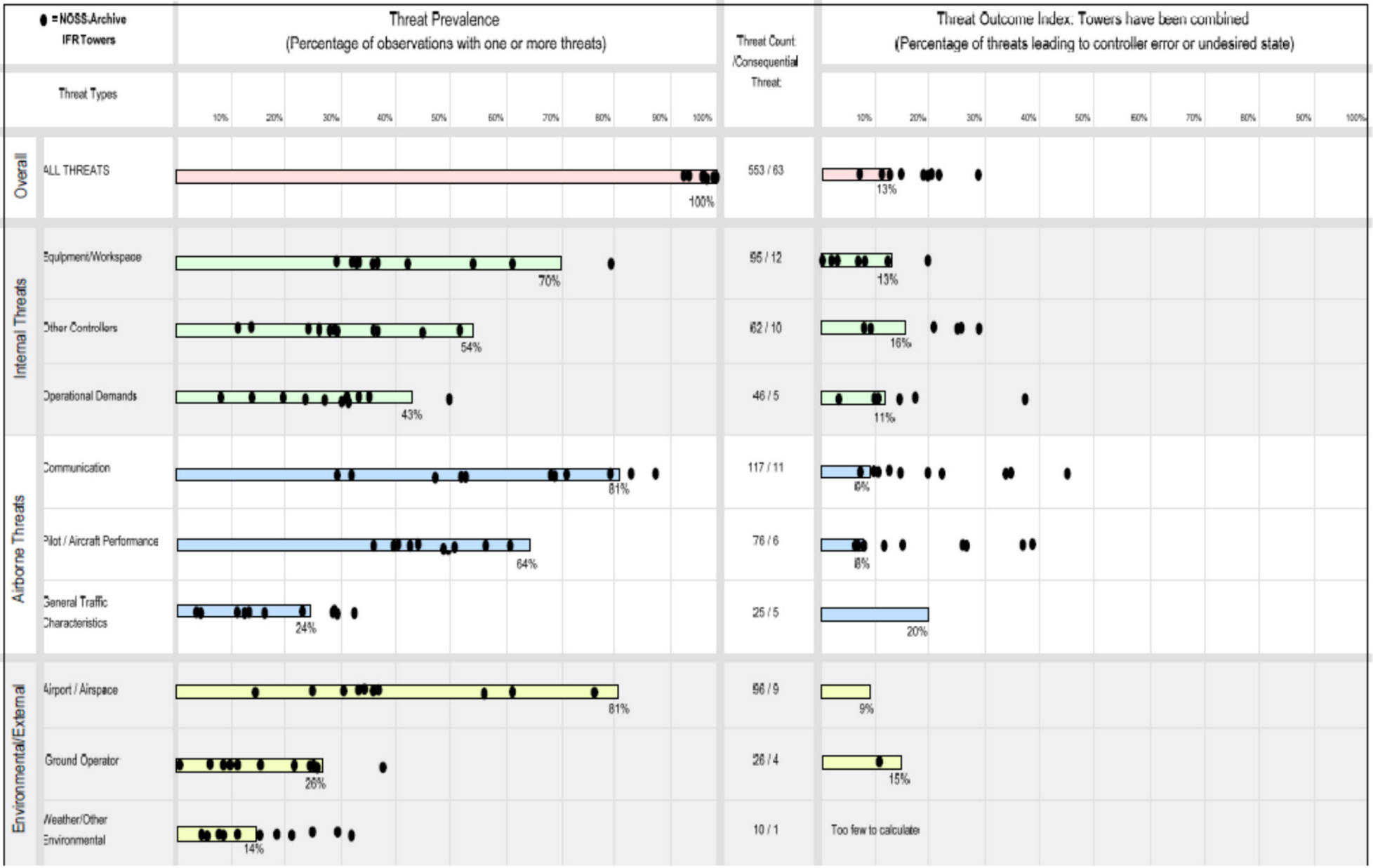
What sort of information does NOSS provide?


● = NOSS Archive IFR Towers
Threat Prevalence
(Percentage of observations with one or more threats)
Threat Count /Consequential Threat:
Threat Outcome Index: Towers have been combined
(Percentage of threats leading to controller error or undesired state)
Threat Types
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Overall
ALL THREATS
553 / 63
100%
13%
Internal Threats
Equipment/Workspace
95 / 12
70%
13%
Other Controllers
82 / 10
54%
16%
Operational Demands
46 / 5
43%
11%
Airborne Threats
Communication
117 / 11
81%
6%
Pilot / Aircraft Performance
76 / 6
64%
8%
General Traffic Characteristics
25 / 5
24%
20%
Environmental/External
Airport / Airspace
96 / 9
81%
9%
Ground Operator
26 / 4
26%
15%
Weather/Other Environmental
10 / 1
14%
Too few to calculate

A few random findings

Obtaining complete and correct readbacks: XXXXX controllers were more likely to obtain complete and correct readbacks from flight crews than controllers at other NOSS Archive Towers. Despite being exposed to three times more incorrect pilot readbacks than the average NOSS Archive Tower, XXXXX controllers were 2 ½ times more likely to challenge incomplete and incorrect readbacks than peers at comparable NOSS Archive Towers.

Frequency Congestion: Frequency congestion was more likely to be noted at XXXXX than any other NOSS Archive Tower – by a significant margin. Frequency congestion was particularly likely to affect the Ground position. Most threats were adeptly managed – the controller prioritized calls without missing things. This could be viewed both as a vulnerability (frequency congestion) and a strength (controller frequency management).

Pilot Taxi Errors: Pilot taxi errors were twice as likely to be noted at XXXXX than at the typical NOSS Archive Tower – more pilot taxi events were noted than at all but one other NOSS Archive Tower. Pilot taxi errors were spread across operators and most likely to impact the YYY Position – seven (of 11) threats were noted there. There were multiple instances of aircraft mixing up ST (spot 15) and SR (spot 14), and aircraft continuing to taxi beyond the RET (past their clearance) limit.

Mode changes: During half (7 of 14) of the observations that involved mode changes, there was indication of errors being made. These errors were committed by multiple positons within the Tower (and Approach) and tended to involve changes not being made to the automation and not issuing frequency changes to VFRs.

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A few random findings

Re-sectorisations: Threats or errors (excluding incomplete handovers) were observed to be associated with 44% of re-sectorisations. Coordinator inputs (controller system input threats) and frequency assignments were the biggest contributors. There were three instances apiece of aircraft jurisdiction and frequency assignments not going to the appropriate sector. All instances were corrected prior to having an adverse impact on operations. There were also two incomplete handovers during re-sectorisations – traffic handling and the status of an active TRA were each omitted during one re-sectorisation.

XXXX Aerodrome Operations {Small aerodrome near major aerodrome}: XXXX airport operations were reflected in multiple facets of the TEM data – particularly on the Approach (APP) position. First, procedural threats highlighted ambiguities in the dissemination and depiction of XXXX's activity. Second, coordination for XXXX arrivals was frequent and lengthy – it became the primary source of APPs workload when there were XXXX arrivals. In one instance, the coordinator provided incomplete coordination to APP about a XXXX arrival, which left APP unsure of how to handle their traffic. Finally, XXXX traffic were responsible for the only pilot routing deviations observed during this NOSS.

Monitoring: Controllers were observed to closely monitor aircraft and vehicular movements – they always seemed aware of what traffic was doing and were quick to detect pilot deviations. Controllers were diligent about sighting aircraft before issuing instructions. There were no errors stemming from insufficient monitoring.

How has NOSS data been used?: Case Study - Runway Safety

Vulnerable Runways

- NOSS Findings:
  - Controllers were not always scanning runways prior to issuing takeoff and landing clearances
  - Controllers were not spending enough time monitoring aerodrome movements.
- Why?
- Threats: controllers were encountering threats that led to “heads down” time instead of monitoring aerodrome movements
  - Unnecessary automated messages
  - Flight Data Progress Strip (FDPS) distribution procedures

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What was done?

- Safety Improvements
  - Created a software filter to eliminate unnecessary messages
  - Changed the procedure so the assistant sorts the FDPS instead of the aerodrome controller
  - Reinforce the importance of monitoring aerodrome movements in recurrent training – using incident/accident scenarios in conjunction with NOSS data (it could happen here!)
  - Reinforce the monitoring of aerodrome movements during proficiency checks

Case Study 2: What can we learn from a pattern of errors?

What does a pattern of errors say?

- NOSS Findings:
  - During approximately half the observations on the Local (Tower) position the controller was issued departure headings without coordinating with Departures
  - This was a violation of procedure – it was an error

- OK, what do we do with this information (diagnostic)?

Response

- The pattern of Errors was determined to be a desired workaround:
  - The pattern of errors indicated a safe, efficient workaround
  - An LOA was created to legitimize the departure headings
  - This pattern of errors identified a strength!?!?

Case Study 3

Identifying Threats – The BAY Sector

- Problem: The “BAY” sector had a reputation of being an unstructured and challenging piece of airspace, but there was little data from the SMS to support this reputation
- NOSS data supported the reputation and provided some details
  - More threats, mismanaged threats, errors, and undesired states in Bay than other sectors
  - Traffic conflictions, parachute activity, training aircraft, little airspace for vectoring or solving problems
  - Impartial observers agree, the sector is a mess!

Response to Findings

One sector in particular that was previously recognized as being unstructured, and containing a high number of threats was confirmed by the NOSS data to the point that a formal review was initiated. I would have to say it was not NOSS alone that lead to the review, but the factual information it provided gave considerable weight that lead to the final decision. Since the review the sector has undergone some wide ranging changes including improved procedures for controllers working the sector.

-- *Provided by the BAY Manager*

Fixing the shortcomings in BAY sector

- Solutions suggested (and adopted) by staff:
  - An area was dedicated for parachute activity that reduced demands on controllers
  - A circular flow structure was introduced that minimized conflictions and complexity
  - Confines of controlled airspace expanded to give more options/flexibility to controller
- Follow-up NOSSs have indicated that the changes made to the sector were largely successful in reducing complexity.

Other Examples of Informing Airspace Design

- NOSS findings have been used to:
  - Reduce complexity in Vancouver area airspace during a major re-design of the airspace surrounding the city
  - Initiate a major review and re-design of STARs and SIDs (which often conflicted) in Johannesburg
  - Negotiate for enough airspace with the Transportation Ministry and Military for a second, parallel airway on a very busy airway
  - Prioritize the development of STARs for airports that did not yet have STARS
    - Airports with more movements were to receive STARs first.
    - NOSS data showed the impact of not having STARs was greater at some of the airports with fewer movements – so these airports received STARs first.

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Frequently Asked Questions (FAQ)

How can we get controllers to trust NOSS?

But Chris, you don't understand……. Controller's at _____ **do not** like to be observed!

- A story from South Africa

How can we get controllers to trust NOSS?

- The Ten Characteristics (controller protections)

NOSS: The Ten Characteristics

1. Over-the-shoulder observations during normal shifts
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How can we get controllers to trust NOSS?

- The Ten Characteristics (controller protections)
- Understanding the purpose of NOSS (improving operations and the controllers working environment)
- Understanding how NOSS sees operations (assessing the system, not individual controllers)
- Trusted observers (observers should be non-threatening to controllers)
- Controllers, "managers don't understand what it is like to be a controller!" (NOSS helps managers understand operations)

How to choose the best observers?

Unfortunately, there is no list of objective qualifications (e.g., years, experience, human factors expertise, etc.)

Attributes that can indicate a good observer?

- Trusted
- Respected
- ATC experience in similar type of environment
- Open / Flexible thinking; not judgmental
- Interest in safety / operations
- Writing ability
- Years experience has not bee a good predictor of observer success

How can the NOSS process promote safety change?

NOSS provides data that isn't available from other sources and compliments other SMS data, but it can help drive change by creating organizational momentum

- NOSS is "high profile" – executives, senior mgmt., local mgmt., supervisors, controllers are all aware it is happening.
- NOSS is periodic – the report initiates a "safety change process"
- De-identified comparisons the NOSS Archive provide context / motivation

At what levels in the organization can findings be applied?

- Local unit / facility – See the case studies presented earlier & many others
- Beyond the local unit – Some safety improvements may need help from headquarters (airspace design, inter-unit procedures, national procedures, etc.)
- Feeding the SMS – Some ANSPs feed NOSS data into larger databases to monitor trends (NOSS and other SMS data work together)
- Information exchange – with airlines, other ANSPs, airport operators, military, etc.

More ways in which NOSS data has been used

Avenues of Improvement - Summary

- Airspace Re-design
  - NOSS findings used to justify establishment of additional airway (so that northbound & southbound traffic would be segregated)
  - Served as a catalyst to change a piece of highly unstructured and complex piece of airspace that had long been a concern amongst controllers
  - Used to reduce complexity & improve SIDs/STARs in re-design of Vancouver & Johannesburg airspace
- Procedures
  - Provisions for splitting sectors or adding a data position
  - Releasing equipment for maintenance
  - Position relief protocols
  - Letters of Agreement adjusted to reduce need for manual coordination
- Equipment/Workspace
  - HMI/Strip shortcuts taken by controllers identified
  - Noise dampening panels & special lighting to reduce glare
  - Base rates of message anomalies

Avenues of Improvement - Summary

- Training
  - Findings used to enhance refresher or recurrent training
  - Development of specialized training modules
- Information Exchange
  - RWY Safety Teams – changing procedures
  - Problematic SID re-designed after consultation with airline
  - Similar call signs – one airline changed the manner in which they numbered their fights
  - Aircraft operating without proper equipment have been identified and paths to remedy this situation have been implemented
  - ATC providers are exchanging ‘best practices’
- Intangibles – perhaps the most impressive benefit of all!
  - Observers gain a different perspective and greater understanding of operations throughout the facility
  - Training instructors gain new tools to use with their trainees
  - ATC organizations have developed new methods of dealing with predictive safety data
  - Enhanced trust between controllers and managers

Cost / Resources to do NOSS?

Cost depends on several factors

- Internal NOSS vs. External assistance
  - Internal – may reduce external expenses, but greatly increases workload in safety department
  - External – more expensive, but greatly reduces internal workload; faster, more polished product, de-identified comparisons
- Size and scope of NOSS
  - There are some efficiencies to doing NOSS at multiple units in same project (with limits)
  - Number of units / facilities, size of units, similarity of units, number of observations
- Some misleading efforts to lower costs
  - Training only – no data verification or data analysis
  - Applying TEM codes to voice recordings / radar playback
  - Controllers as their own observer / self-observation
  - These might have value, but they aren't NOSS

Chris Henry, Ph.D.
NOSS Collaborative

www.nosscollaborative.org

henry@nosscollaborative.org