IFALPA's view on LOSA

Capt. Carlos Arroyo-Landero / IFALPA

Seattle, November 2004

What is IFALPA?

- **The International Federation of Air Line Pilots' Associations**
  - Represents more than 100,000 pilots worldwide
  - 93 member associations
  - 12 Standing Committees (8 technical/4 professional)
  - Permanent observer status at the ICAO Air Navigation Commission

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THE GLOBAL VOICE OF PILOTS

IFALPA's Mission

- The mission of IFALPA is to be the global voice of professional pilots, to promote the highest level of aviation safety world-wide and to provide representation, services and support to its Member Associations.

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Core Functions

- Protect and enhance aviation safety to the highest standard by promoting a single level of safety world-wide.

- Develop common policies and positions and to promote the adoption of such policies by ICAO, regulatory authorities and the State of each Member Association.

- Provide training and education for the benefit of airline pilots and assist in the organizational development of Member Associations.

- Protect, promote and enhance the professional status of the airline pilot.

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IFALPA’s Official Position

- IFALPA fully supports LOSA as a proactive tool for enhancing safety
- LOSA will improve safety, benefiting both pilots and airline management, when properly implemented
- LOSA is effective because its operating characteristics specifically protects the rights of pilots during an Audit
- It is confidential and voluntary and will therefore help to build the trust of pilots
- Further criteria for LOSA and other Auditing systems are being developed

IFALPA's HUMAN PERFORMANCE (HUPER) COMMITTEE, CONSIDERS LOSA A VERY IMPORTANT SAFETY INITIATIVE

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THE GLOBAL VOICE OF PILOTS

Capt. Carlos Arroyo-Landero / IFALPA

Seattle, November 2004

LOSA is an ICAO defined process.

- *ICAO published, Doc 9803, LOSA Manual, in 2002.*
- *Any airline that wants to embark in LOSA can follow the process described in Doc 9803 and complete the safety audit process without any external support.*
- *This has in fact happened: Futura/Spain completed its very successful in-house LOSA during 2003.*
- *A major Canadian airline is in the first steps of launching its in-house LOSA, using Doc 9803 as guidance.*

Some IFALPA Statements

- We stress that IFALPA greatly values the efforts ICAO has gone to, in order to involve us at every level during the implementation of the LOSA program.
- The LOSA program is a strategy aimed to identify and minimize threats to aviation safety. Its core values are directly in line with IFALPA's core mission statement.
- We fully realize that LOSA is an extremely effective and proactive tool to develop countermeasures to human error in aviation.

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More IFALPA Statements

- Our specialist committees are in the process of producing a generalized policy that will cover all auditing systems.
- The aim of the policy will be to put protection measures in place to avoid the results of an audit being used against either pilots or their employers.
- We note that six out of ten of the LOSA operating characteristics target areas that will specifically protect pilots during a LOSA audit and that this should be used as a basis for future systems.

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HUPER has produced a LOSA information sheet

INTERNATIONAL FEDERATION OF AIR LINE PILOTS' ASSOCIATIONS

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THE GLOBAL VOICE OF PILOTS

INFORMATION REGARDING LINE OPERATIONS SAFETY AUDIT (LOSA)

Line Operations Safety Audit or LOSA has been designed as a strategy aimed at developing countermeasures to operational errors. It is used to identify threats to aviation safety, minimize the risks that such threats may generate and implement measures to manage human errors. LOSA is intended to be proactive and identify strengths and weaknesses in the system before they become a threat to safety.

The initial research and project definition was carried out by the University of Texas at Austin and Continental Airlines with funding provided by the Federal Aviation Administration and was endorsed by ICAO in 1999 as the primary tool to develop countermeasures to human error in aviation operations. Although initially developed for the flight deck, the principles of LOSA are now being developed for use in other aviation operational sectors including air traffic control.

In 2002, ICAO produced the LOSA manual, document 9803 which describes the concept behind LOSA, discusses the LOSA methodology and gives advice and guidance to airlines that wish to implement a LOSA programme in their organisation. It also discusses the safety change process that should take place following the implementation of LOSA and gives an example of one operator's experience in starting a LOSA programme.

The manual defines ten LOSA Operating Characteristics of which six are directly related to safeguarding and protecting the pilots that have been observed. To date the LOSA archives contain over 4000 observations from over 3000 flights from operators around the world, and not one has been used to discipline a pilot. It is recognised that the LOSA programme would not be successful without the trust and support of both the pilots and the management concerned and to that end LOSA is a voluntary programme.

LOSA is an ICAO defined process and although there is a commercial organisation (the LOSA Collaborative or TLC) that supports airlines that want to implement a LOSA programme, it is quite possible for any airline to carry out a LOSA programme following the process described in Doc 9803 and complete LOSA without any external support. This has in fact happened as Futura/Spain has completed its very successful in-house LOSA during 2003. Also, a major Canadian airline is in the first steps of launching its in-house LOSA, using Doc 9803 as guidance.

Full details of the LOSA programme can be found in the ICAO LOSA manual Doc 9803 or for more information on LOSA contact Daniel Maurino at dmaurino@icao.int

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Policy writing

- Human Performance and Industrial committees put together a working group to write the Auditing policy together
- HUPER approved it during it's last meeting in Yokohama, Japan
- Industrial will review it during it's November meeting in Dublin

Conference

- If all goes well, at our annual conference in Cape Town, next April, Auditing policy will be accepted and it will become part of IFALPA Policy .

Let's sum up

- We feel it is essential to consider the legal, regulatory and contractual framework in which LOSA will take place to insure that all parties are able to fully participate and realize maximum benefit from the LOSA process.
- The recent Resolution passed by the ICAO Assembly is the necessary first step to the formulation of such protections.

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What’s in the future ?

- IFALPA will to continue to participate together with ICAO, in aviation safety related efforts, such as LOSA

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Thank You !

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FRONTIER

Line Operations Safety Audit

Second ICAO-IATA LOSA & TEM Conference
Seattle, USA
November 3 – 4, 2004

Captain David L. Bair

Director, Flight Operations Safety


FRONTIER
Airline Today
34 Airbus 319
7 Airbus 318
6 Boeing 737-300
48 Total Aircraft
550 Total Pilots

FRONTIER

Fleet Growth and Transition

April 2004 to April 2005 – 40% Growth

April 2005 – All Airbus Fleet

2008 – 62 Total Airbus

Flight Operations Safety

Boeing LOSA 2002

Lessons Learned

Flight Operations Safety

Airbus LOSA 2005

Flight Operations Safety

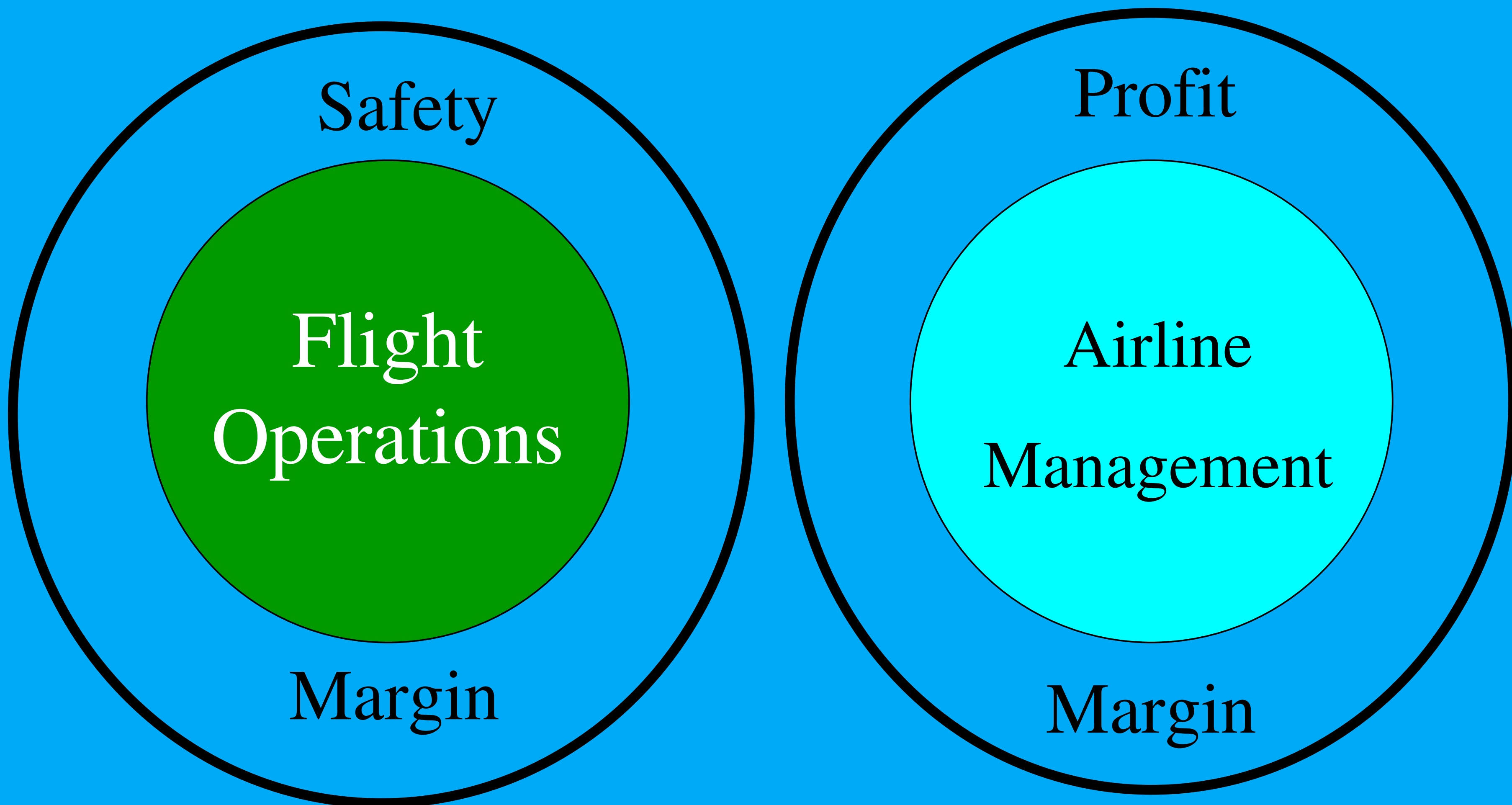
Philosophy of Safety

Philosophy of Flight Operations
Safety

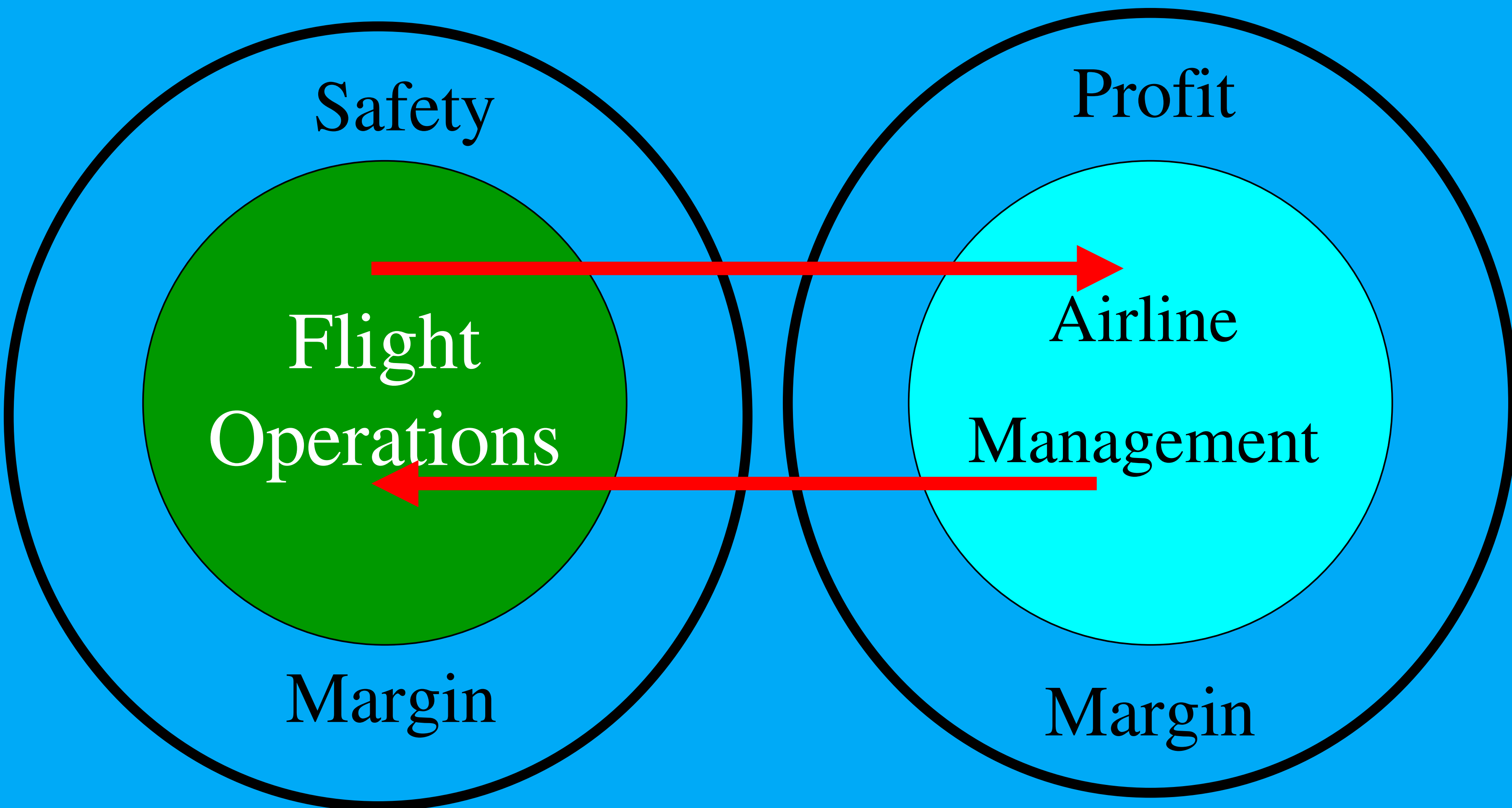
Flight Operations

Airline Management

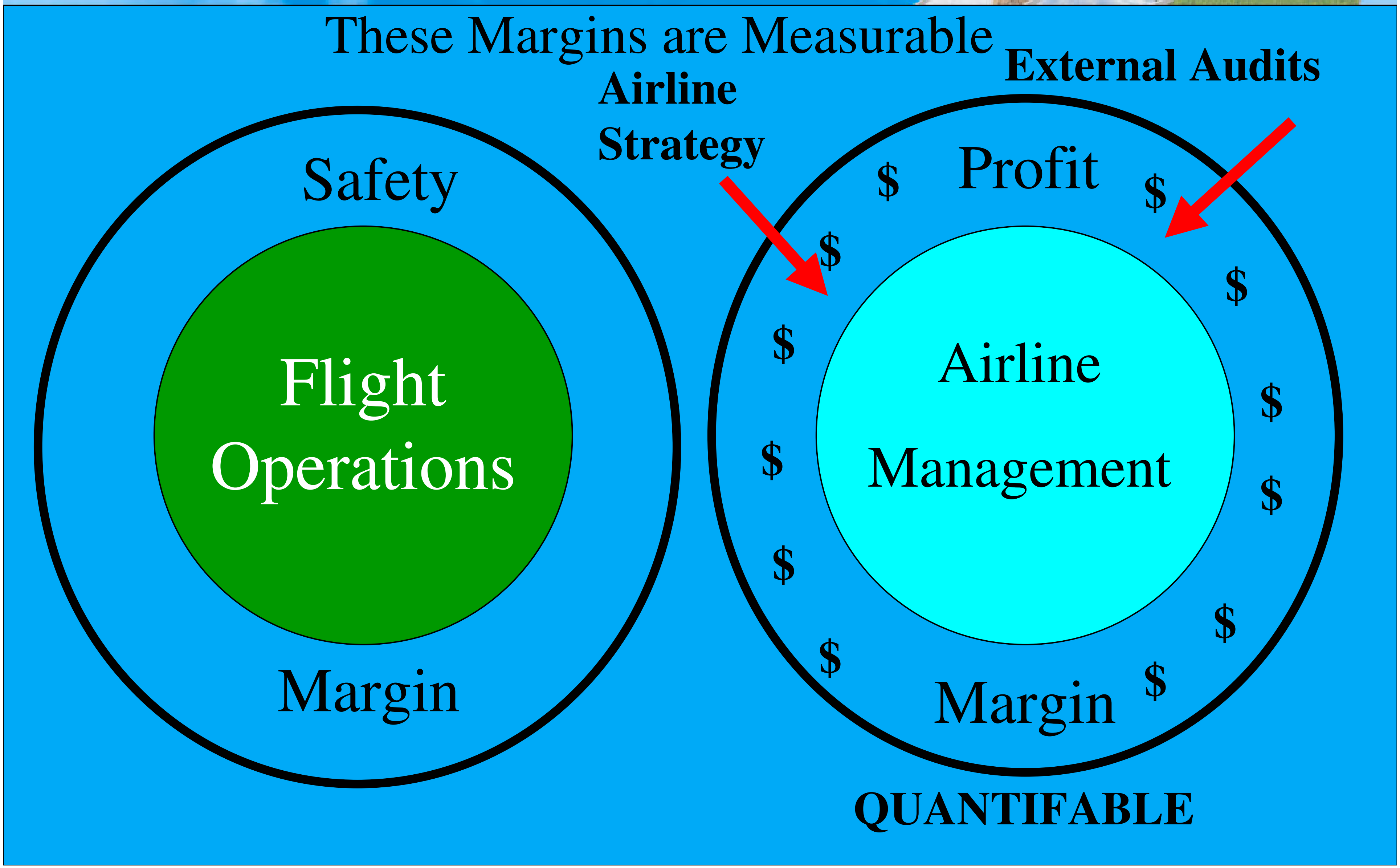
Philosophy of Flight Operations
Safety



Philosophy of Flight Operations
Safety



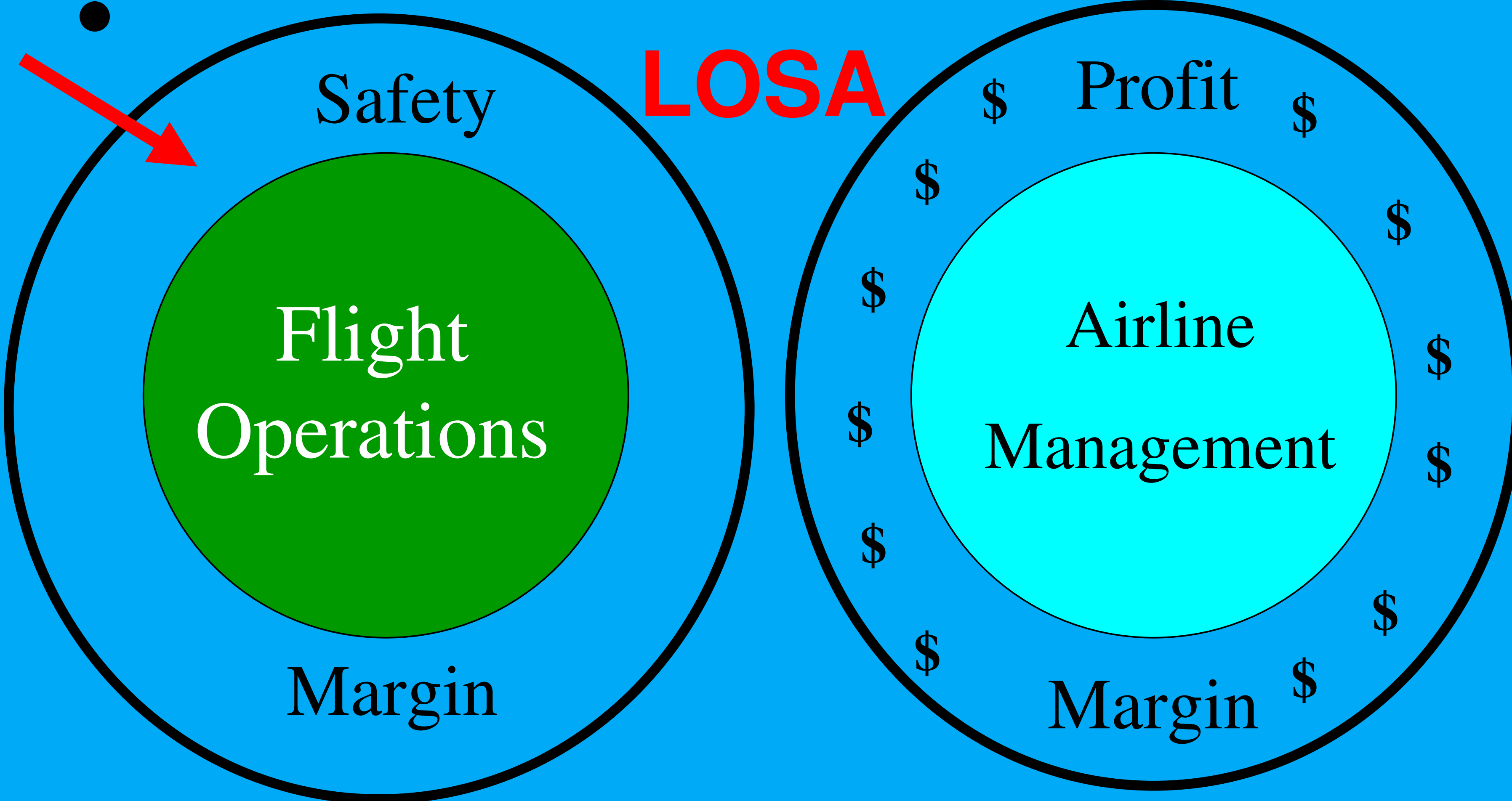
Philosophy of Flight Operations
Safety



Philosophy of Flight Operations
Safety

?

How should we measure?



QUANTIFABLE

Philosophy of Flight Operations
Safety

What kinds of things affect the operating safety margin?

Philosophy of Flight Operations
Safety

What kinds of things affect the operating safety margin?

Errors in:

Decisions

Proficiency

Procedural

Communications

Intentional

Non-Compliance

Philosophy of Flight Operations
Safety

What kinds of things affect the operating safety margin?

Errors in:

Decisions

Proficiency

Procedural

Communications

Intentional

Non-Compliance

Threats:

Weather

ATC

Terrain

A/C Systems

Mechanicals

Cabin Events

Dispatch Events

Airport Conditions

Philosophy of Flight Operations
Safety

What kinds of things affect the operating safety margin?

Errors in:

In Flight Operations are Observable, Predictable, and……………

Inevitable!

Threats:

Are Observable and Measurable as External Influences to the Safety Margin.

Philosophy of Flight Operations
Safety

Also, Undesired Aircraft States - UAS

Aircraft path – Course and Altitude

Aircraft Systems

Speed too High

Speed too Slow

Long Landing

Hard Landing

Runway/Taxiway Incursion

Abrupt Aircraft Control

Incorrect Configurations

Wrong runway

Wrong airport

Unstable Approach

Severe Weather Penetration

Philosophy of Flight Operations
Safety

LOSA can measure possible precursors to accidents.

Philosophy of Flight Operations
Safety

The Cost of Not Measuring Flight Operations Risk…..?

Trauma – The ultimate Undesired Aircraft State

- Difficult to define carrier's expense:
  - Accident scene, rescue, recovery/ salvage
  - Family Assistance/litigation (negligence)
  - Loss of hull & its use
  - Increased staffing
  - External Safety Audit(s)
  - Reduced bookings/loads/yields
  - Reduced stock value
  - Lowered image/financial rating/growth
  - Management Distraction (20% of Mgt. Time for 1 yr.)
- Possible "trauma" expense (Wide-body) = $1Bil

FRONTIER

Frontier Airlines LOSA 2002

All Boeing 737-200/300
125 flights
99 different flight crews
27 different airports

FRONTIER

Observer Training

One day of standards calibration – Check Airman

Two days of observer training – LOSA Collaborative

One day of round trip observations

One day of re-calibration training – LOSA Collaborative

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Observer Assignments

Assigned to 10 to 12 legs by city pairs
Given 6 weeks to complete their observations
About 2 hours per flight leg to record the observation
No other duties during the observation period!

FRONTIER

Final Report and Corrective Actions

Now the work begins!!

Target teams for areas of enhancement

Six months to define the corrective action

Six to nine more months to implement changes

FRONTIER

Corrective Actions

Define Stabilized Approach Policy
Implement No-Fault Go-around Policy
Complete Re-Write of the Boeing FOM
Teach T&EM in Every CRM Class Including All Check Airmen

FRONTIER

Corrective Actions

Implement two phased Command Leadership Training to all new upgrade and transitioning captains. Currently now only for new upgrades.

FRONTIER

Documentation

Retained all working documents on file.

Retained all permanent documents chronologically labeled “History of Documents”.

Recorded all Corrective Actions and Policy and Procedural changes for later reference.

FRONTIER

Airbus LOSA 2005

Observer Training remains the same
Conduct of the Audit remains the same
Schedule 140 flights
Collect data over 6 week period

FRONTIER

Airbus LOSA 2005 – Changes from LOSA 2002

Get Flight Operations Managers Involved

Director of Training/Standards

Chief Pilot and Fleet Manager

New Line and Simulator Check Forms

All Check Airman and Instructors

FRONTIER

Airbus LOSA 2005 – Changes from LOSA 2002

- Check airmen attend observer training
- Teach T&EM to check airmen during 6 week data collection period
- Check airmen chair the Target Teams for Airline Enhancements
- Line and Simulator Checks will include T&EM


Thank you

The Boeing Perspective: LOSA and the Value of Collaboration

R. Curtis Graeber, Ph.D.

Boeing Commercial Airplanes
Seattle, Washington, USA

2nd ICAO-IATA LOSA & TEM Conference
Seattle, WA
3-4 November 2004

Today's Topics

- Boeing's Safety Approach
- Boeing-TLC Collaboration
- The Value of Collaboration
- Leveraging Our Safety Tools
- Boeing's use of LOSA data

Boeing's Safety Approach

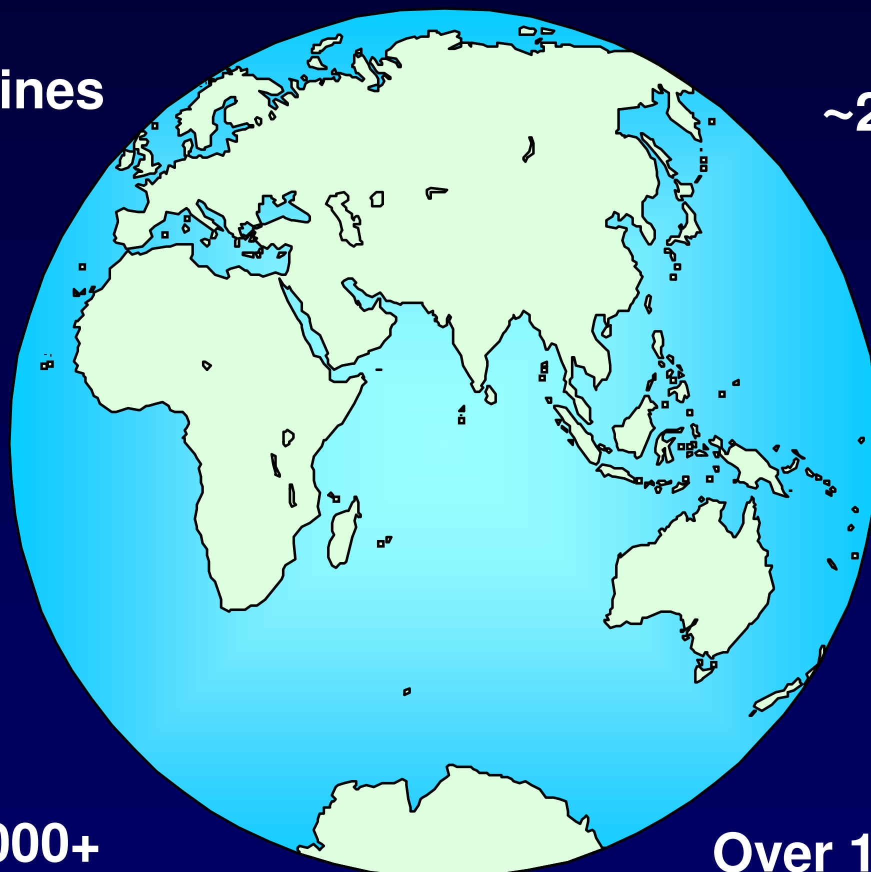
- Be proactive
- Investigate accidents and incidents
- Learn from the experience of our customers
- Continuously improve the Airplane Life Cycle process
- Seek Global Involvement
  – Airlines
  – Manufacturers
  – Regulatory agencies
  – Safety and flight crew organizations

Because the Aviation System is Complex, All Parts of Industry Must Work Together

~800 airlines

~200 languages

1,350 major airports



Over 200 countries

150,000+ flight crew

Over 14,000 airplanes (Western built)

Boeing's Safety Approach: HF Research

- Rely on data to drive safety related decisions
- Conduct and support internal safety research
- Share mutually beneficial data and results

Boeing's Safety Approach: HF Research

- Collaborate globally on external research
  - NASA, FAA, NLR
  - Madrid BRTE
  - Customer airlines
  - Universities (Illinois, Ohio State, Cranfield, Massey, etc.)
  - University of Texas HF Project/The LOSA Collaborative
- Create safety tools to support SMS at airlines
  - Flight Operations Support Program (FOSP)
  - Procedural Event Analysis Tool (PEAT)
  - Maintenance & Ramp Error Decision Aids (MEDA, REDA)
  - Cabin Procedure Investigation Tool (CPIT)
  - *Line Operations Safety Audits (LOSA)*

TLC – Boeing Collaboration Agreement

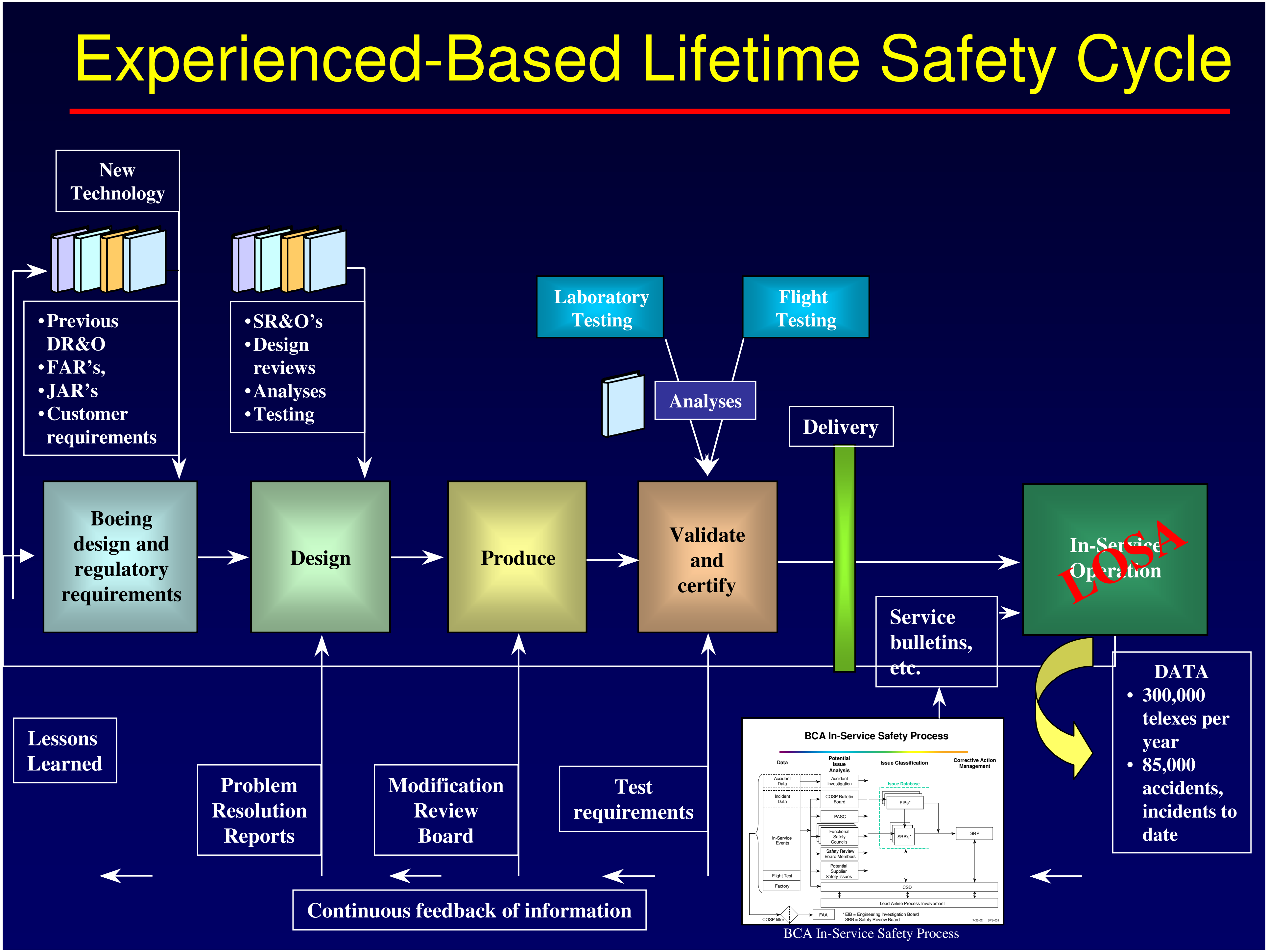
- Agreement signed May 2002
- A mutually valuable research partnership
- Boeing is assisting TLC in improving LOSA (data collection software)
- Opportunity for TLC to provide customers with a two-way channel of communication between them and Boeing

The Value of Collaboration

- TLC
  - Gains manufacturer’s perspective and expertise in promoting global aviation safety
  - Intellectual scientific and expert technical support
  - Detailed design knowledge
  - Ability to compare results across other databases
  - Increased opportunity to benefit all airlines
  - Economic and Manpower Resources
- Boeing
- Airlines

The Value of Collaboration

- TLC .... Value ⎤
- Boeing
  - Access to information about crew errors during normal operations (ARCHIE)
  - Insights about how crews recover from errors
  - Invaluable, objective insight into the design and operation of our products
  - Synergistic research partnership
- Airlines


Experienced-Based Lifetime Safety Cycle
New Technology
•Previous DR&O
•FAR's,
•JAR's
•Customer requirements
•SR&O's
•Design reviews
•Analyses
•Testing
Laboratory Testing
Flight Testing
Analyses
Delivery
Boeing design and regulatory requirements
Design
Produce
Validate and certify
In-Service Operation
LOSA
Service bulletins, etc.
DATA
• 300,000 telexes per year
• 85,000 accidents, incidents to date
Lessons Learned
Problem Resolution Reports
Modification Review Board
Test requirements
Continuous feedback of information
BCA In-Service Safety Process
BCA In-Service Safety Process

The Value of Collaboration

- TLC .... Value ⎫
- Boeing .... Value ⎫
- Airlines
  - Availability of manufacturer's perspective
  - Invaluable research partnership
  - Convergent Validity
  - Safety Related Products
    - Airplane design
    - Procedure evaluation and development
    - Safety and training guidance

BOEING

The Value of Collaboration

- TLC .... Value
- Boeing .... Value
- Airlines .... Value

The Value of Collaboration is

Enhanced Safety!

Improving the Human Interface

Some Potential Data Sources:

- Accidents
- Incidents (ASAP)
- FDM/FOQA
- LOSA

Accident Data

- Example: NTSB, AIB, etc.
- Extraordinary detail about single events
- Can be a high value data source when applicable
- Very dependent upon expertise and processes of the investigating authority
- Poor comparability and usually too few worldwide to understand HF issues
- Always too late!

Incident Data

- ASRS, CHIRP, ASAP, STEADES
- Key factors frequently identified
- Incidents can support precursor search
- Level of detail varies
- Participant recollection can be suspect
- Extremely high value data source to corroborate other data

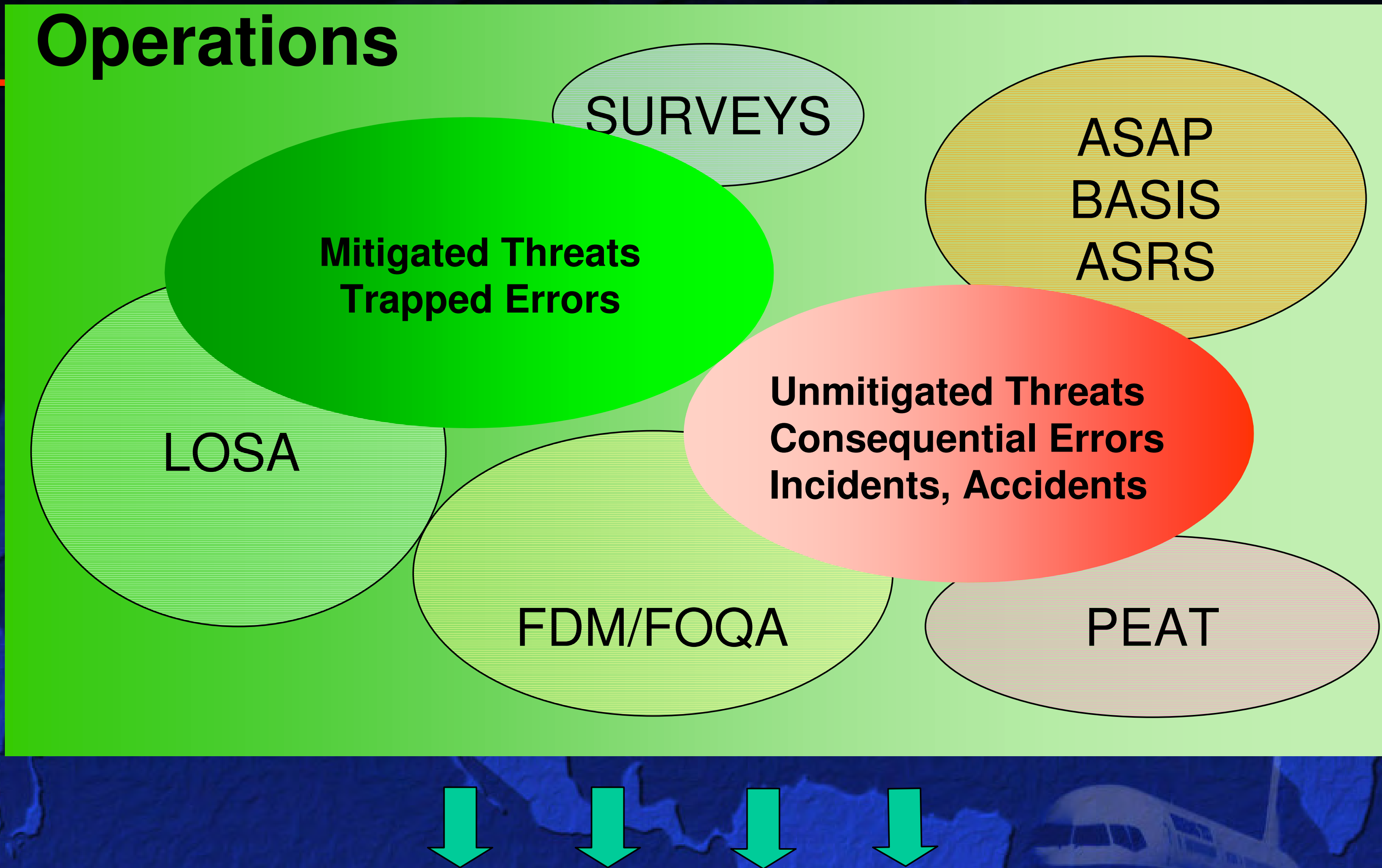
FDM/FOQA Data

- Proprietary and closely protected by operators
- Very detailed objective outcome data
- Uniquely suited for multi-flight statistical analysis
- Limited in scope
- Understanding “Why” requires information about context and crew actions

LOSA Data

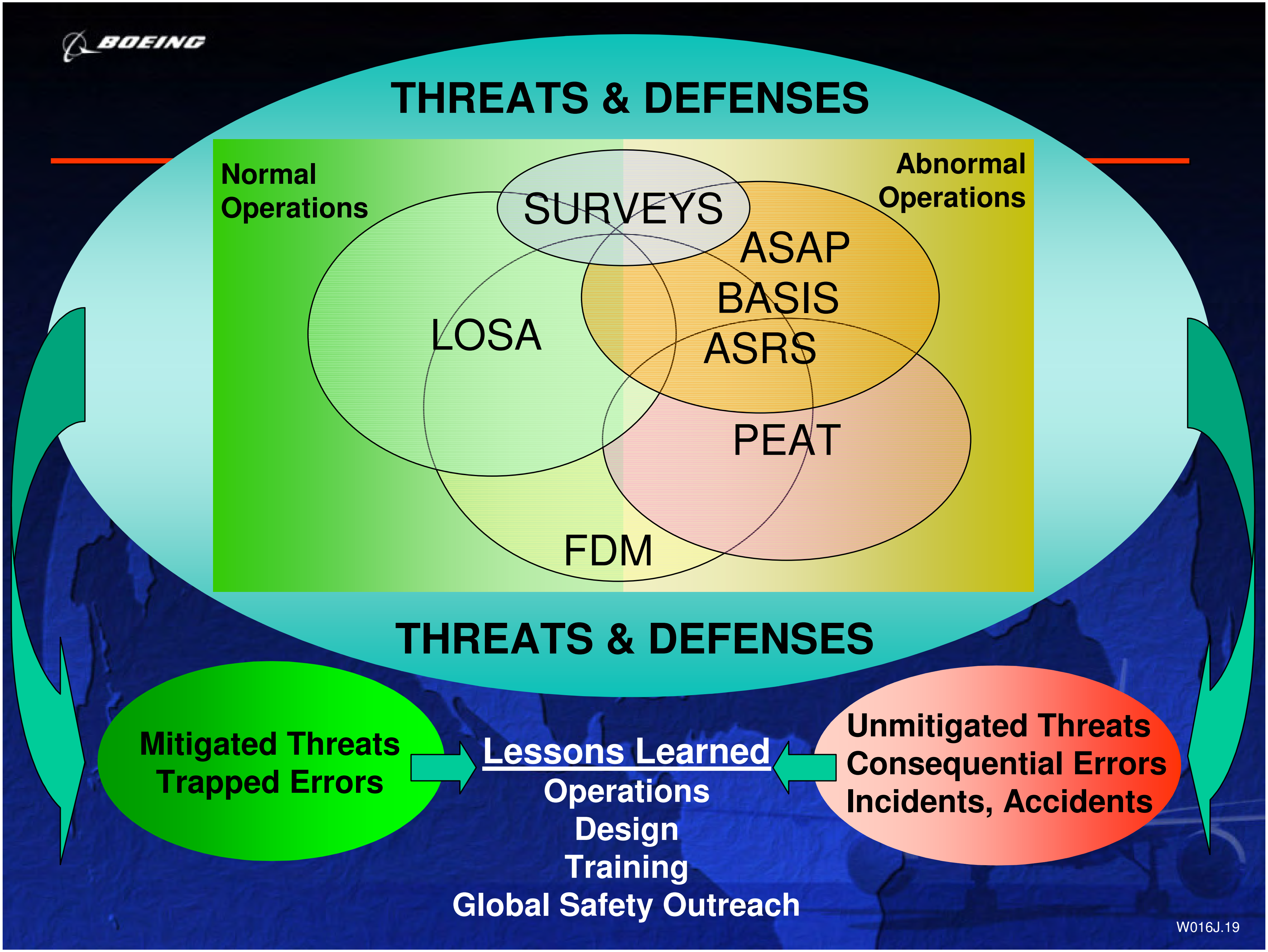
- Structured format that captures
  - Facts and events
  - Background that puts facts & events in context
- Provides more than single flight context
- Can provide better detail than incident reports
- Greater accuracy than anecdotal analysis
- Can support rate of occurrence analysis
- Reveals how crews successfully manage errors
- Enables focused observations on issues of interest

Correlation and Convergence



Lessons Learned

Preventative Actions


BOEING
THREATS & DEFENSES
Normal Operations
Abnormal Operations
SURVEYS
ASAP
BASIS
ASRS
LOSA
PEAT
FDM
THREATS & DEFENSES
Mitigated Threats
Trapped Errors
Lessons Learned
Operations
Design
Training
Global Safety Outreach
Unmitigated Threats
Consequential Errors
Incidents, Accidents
W016J.19

Boeing's Use of LOSA Data

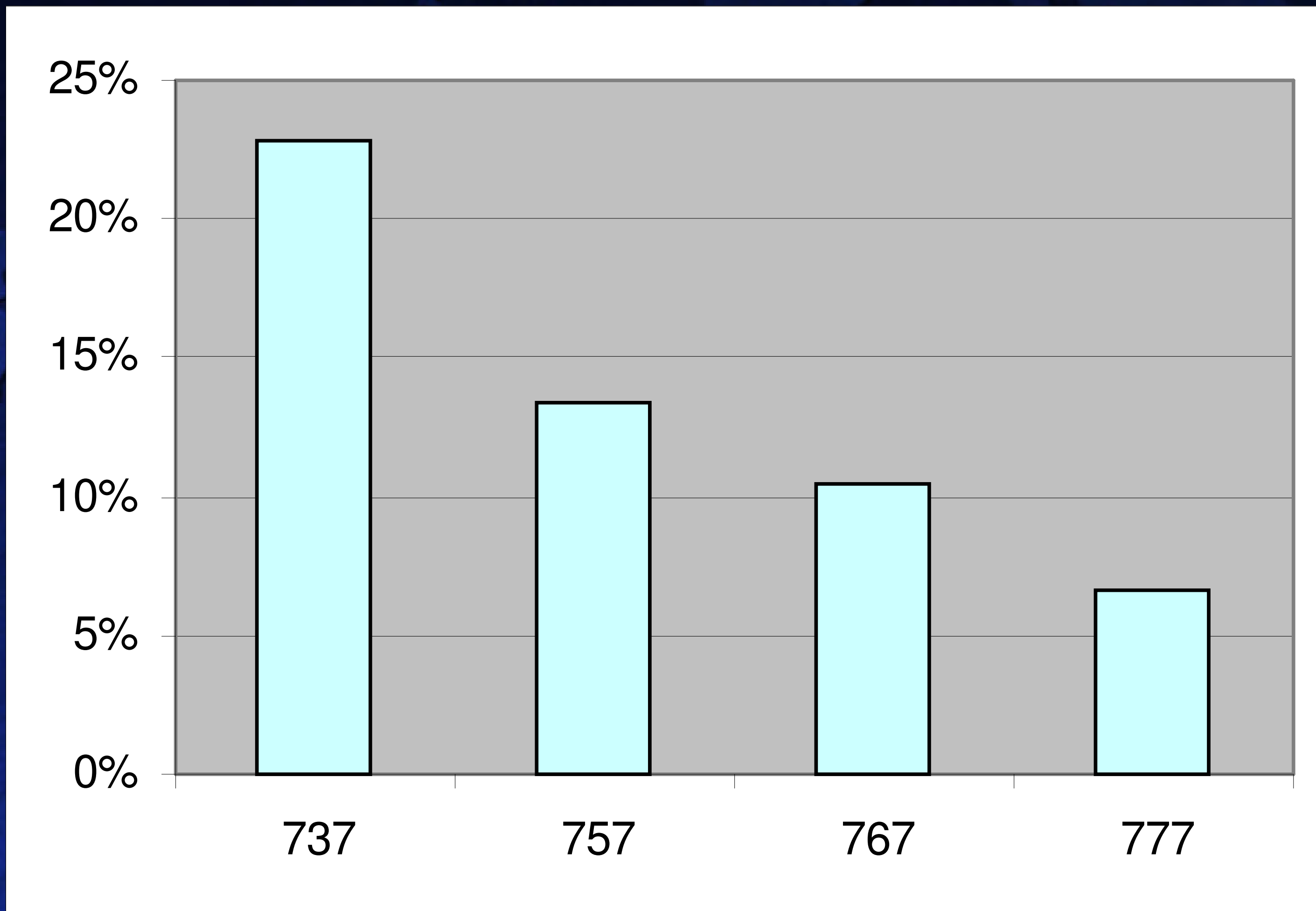
- Search for threats and errors related to our fleet
- Close the loop on design
- Develop capability to correlate results with other databases and gain convergent validity
- Sufficient observations in ARCHIE to find trends and patterns
- Apply and improve latest data mining tools to
  - Enable efficient analysis of narratives
  - Still limited to case-by-case basis

BOEING

An Example: Checklist Errors

- LOSA data confirm our previous reports (Boorman 2001; Holder ‘03, ‘04)
- Value added by LOSA data
  - Provide rates of occurrence
  - Separate occurrences by phases of flight
  - Add context to better understand each error
- Most frequent reasons for checklist errors are:
  - Late checklist
  - Checklist not performed to completion
  - Items on checklist left open
  - Wrong checklist
  - Not knowing which checklist to use (training & proficiency)

Percent of Flights with Checklist Errors



777 Checklist

- We knew electronic checklist could provide a great advancement in safety
- Operator experience confirms we succeeded
- We designed a lot of the traditional checklists problems out (see Boorman, 2001)
- Anecdotal and FOSP information has identified a few potential enhancements
- Seeking more information to focus our enhancement efforts
- LOSA is providing valuable information

Evolution of Checklist Enhancement

Phase 1 – Discovering Errors

- 165 B777 LOSA flights
- 11 of 165 flights had checklist errors (7%)
- 13 checklist errors in 11 flights
- 3 errors reported as intentional
- 1 error led to additional error
- No undesired aircraft states

Phase 2 – Classifying errors

- Omitted checklist
- Forgot checklist
- Did not call for checklist
- Self-initiated checklist
- Checklist performed late or at the wrong time
- Checklist not performed to completion (e.g., open item that gets forgotten)
- Checklist performed from memory

Phase 3 – Learning the Context

- Pilot forgot to ask for checklist
- PNF forgot he left an item open on CKL
- PF did not call for After-Landing CKL
- Landing CKL initiated at 2000 ft (late)
- Late completion of landing CKL
- FO ran Engine Start, Pushback CKL from memory
- Most errors occur on descent/approach (7/13) and pre-departure (4/13) phases

Phase 4 – Design Solution

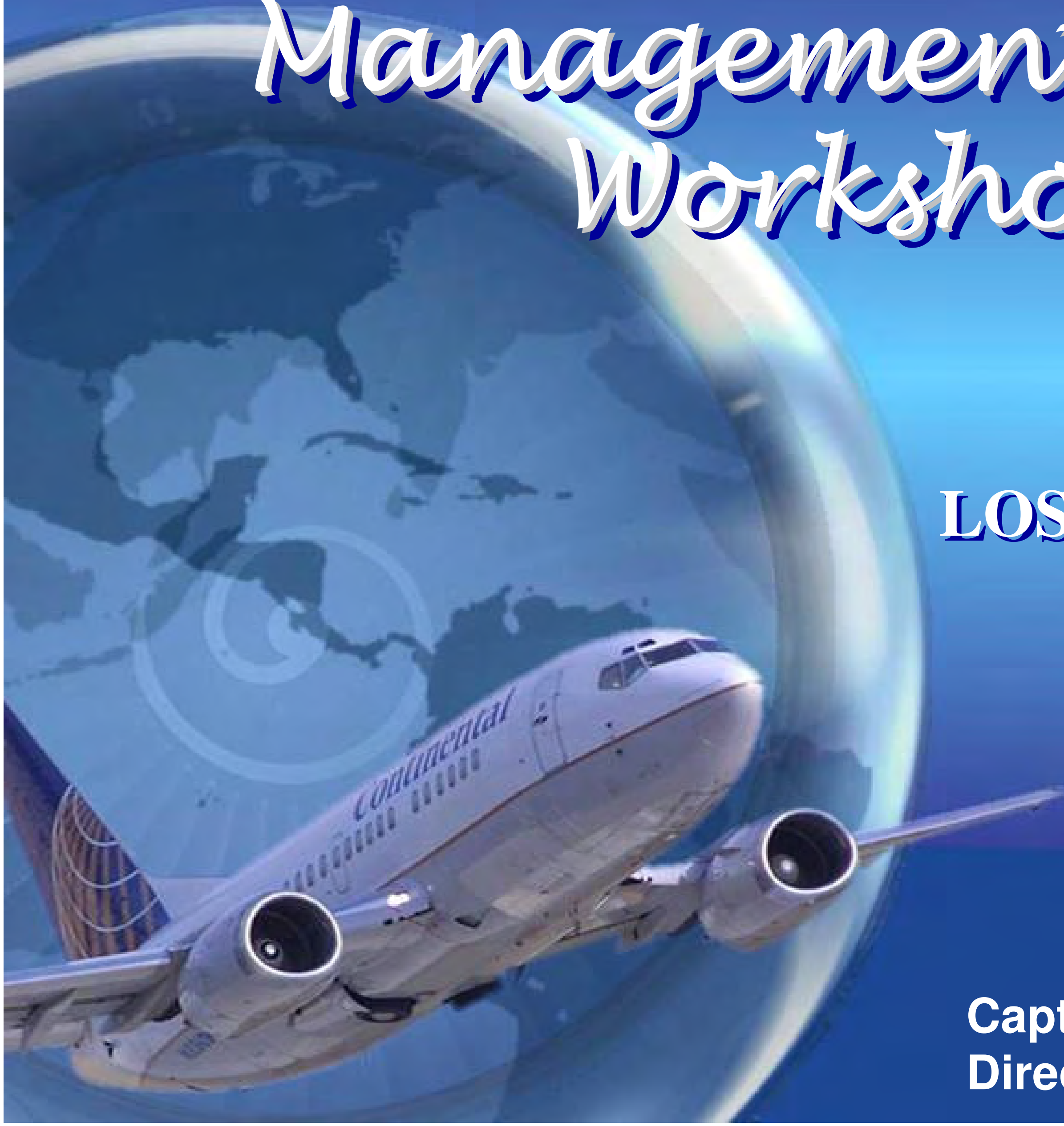
- New checklist alerting will be integrated into new airplane designs to prevent:
  - omission
  - forgetting, and
  - late execution of critical normal checklists
- Plus other data-driven enhancements to 777 baseline checklist design

Conclusions

- LOSA provides a unique opportunity to improve global aviation safety
- By cooperating, we can all greatly enhance LOSA's potential for improving safety
  - Consistent implementation is key
  - Will learn together what we don't know
  - Helps us to anticipate future system risks
- Safety tools must continue to seek common ground to better leverage their outputs
- Boeing believes in LOSA and will continue to strongly support it.


Thank You!

“Threat&Error Management(TEM) Workshop”



2nd IATA –ICAO
LOSA & TEM Conference
November 2nd-3rd, 2004
Seattle, WA

Captain Don Gunther
Director Human Factors & Safety

TEM Workshop

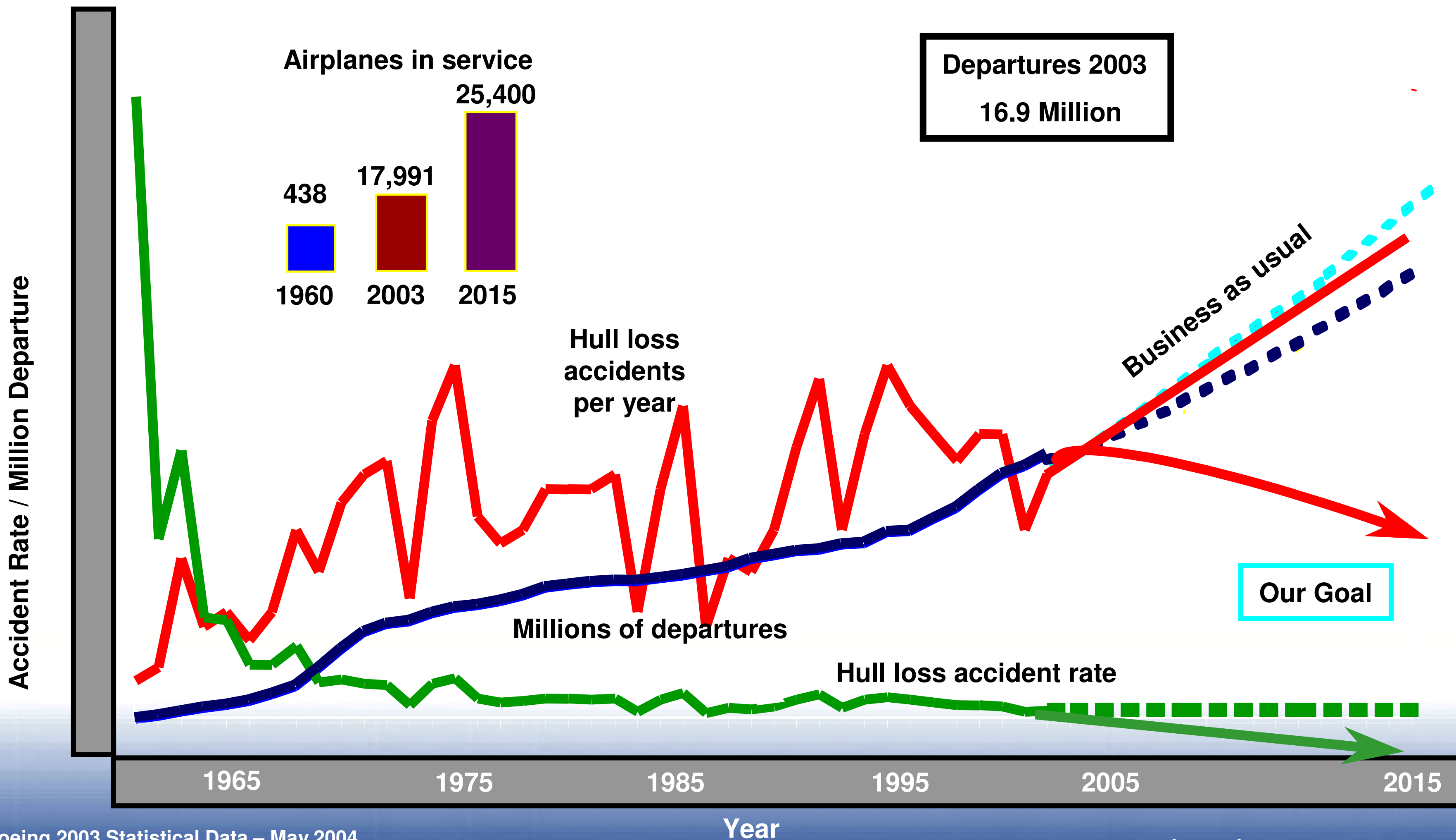
- Developing a TEM program
  - LOSA
- TEM and an Automation Policy
- TEM applied outside of Flight Operations
- TEM applied to incident and accident analysis
- TEM and Safety Change


Flight Operations
TEM Training

Why are we still doing CRM training?

We Need to Continuously Improve Aviation Safety

1965 - 2003



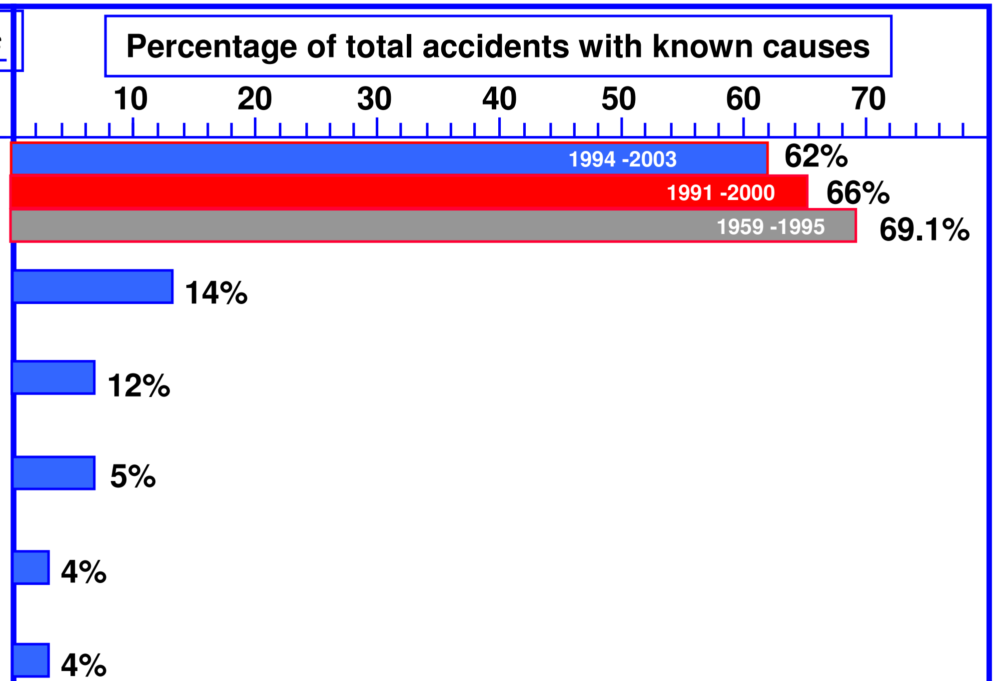
Boeing 2003 Statistical Data – May 2004

Continental Airlines, Nov. 2004

Accidents by Primary Cause

1994 - 2003

Primary Factor	*Number of accidents* Total
Flight crew	84
Airplane	19
Weather	16
Miscellaneous/other	7
Maintenance	5
Airport/ATC	5
Total with known causes	136
Unknown or awaiting reports	50
Total	186



Excludes:
- Sabotage
- Military action

Boeing 2003 Statistical Data – May 2004

Safety Culture

Aviation Week Article on Healthy Organizations

"Investing the time and money needed to get at the root cause of a problem takes total commitment at the most senior levels of a company or organization. In most organizational settings, communicators learn early in life how bad news can impact their leaders. If the news is valued and the communicator is protected, there is a real chance information can and will routinely flow upward in time for proper action to be taken."

The Safety Change Program
"Tailored to Continental"

- ♣ To properly target change we need current operational data, specifically for Continental, which is unique due to its…
  - History & Culture
  - Areas of operation (CMI, polar routes, etc.)
  - Philosophy


Line Observation Safety Audit
(LOSA)

“Normal” Performance

- **Distance between “Perfect” and “Normal performance varies as a function of culture, training, etc.**
- **LOSA enables us to get as closer to normal performance than was previously possible.**

The LOSA Process

- 1st year: LOSA and data analysis followed by course development
- 2nd & 3rd years: Training course for all crewmembers, Check Airmen training and imbedding of TEM (EM) into courseware, etc.
- 4th year: Preparation for next LOSA and targeting areas to be measured and new areas to be emphasized.

Line Observation Safety Audit
LOSA 1996

Error Management's early focus was:

Managing *crew error*

Line Observation Safety Audit
LOSA 2000

Line Observation Safety Audit
LOSA 2004

LOSA 1996 vs. 2000

- A 70% reduction in Checklist errors
- A 60% reduction in non-stabilized approaches (confirmed by FOQA data)
- Overall improvement in crew performance
- Still a need for improvement in Leadership skills

Threat and Error Management

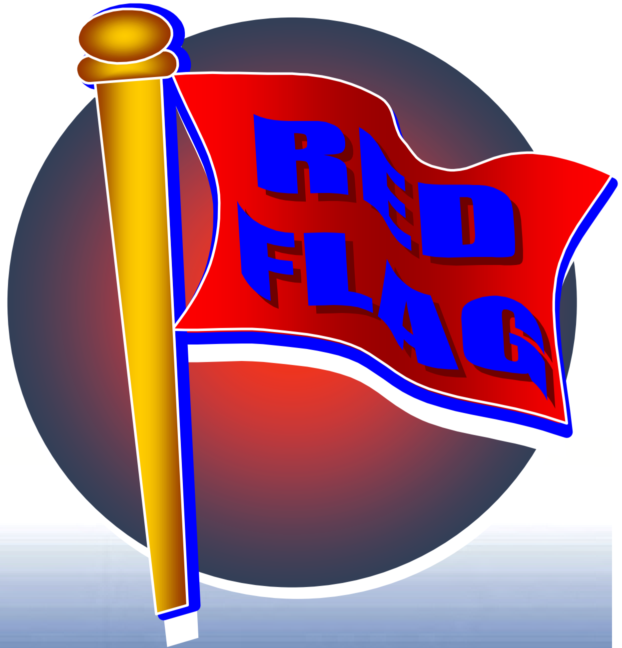
THREATS

Continental Airlines, Nov. 2004

Threats

"A threat is anything external to the crew that increases operation complexity and, if not managed properly, can decrease the safety margins."

- ♣ Threats
  - Do not equal errors
  - Increase error potential
- ♣ Threats = Red Flags



Threat and Error Management

Threat Management

Strategies/Countermeasures

(Industry, Corporate and/or Personal)

- To reduce the number of errors
- To improve the error management process by increasing the awareness of potential errors

Threat and Error Management

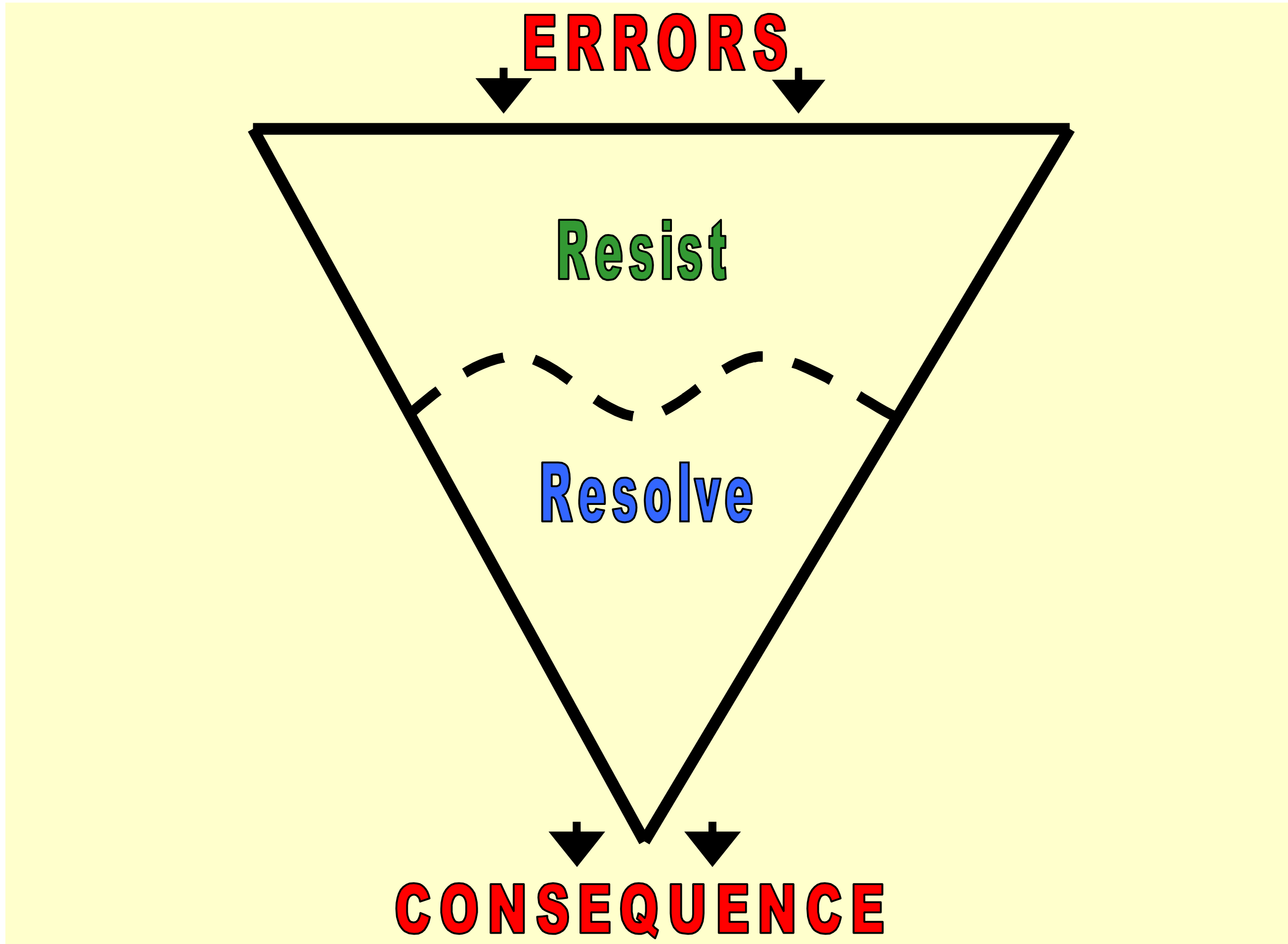
Error

Inadvertent action or inaction that leads to deviation from crew intentions or situational requirement

Error Management

Actions taken to deal with errors committed by either detecting and correcting them or by containing and reducing the severity

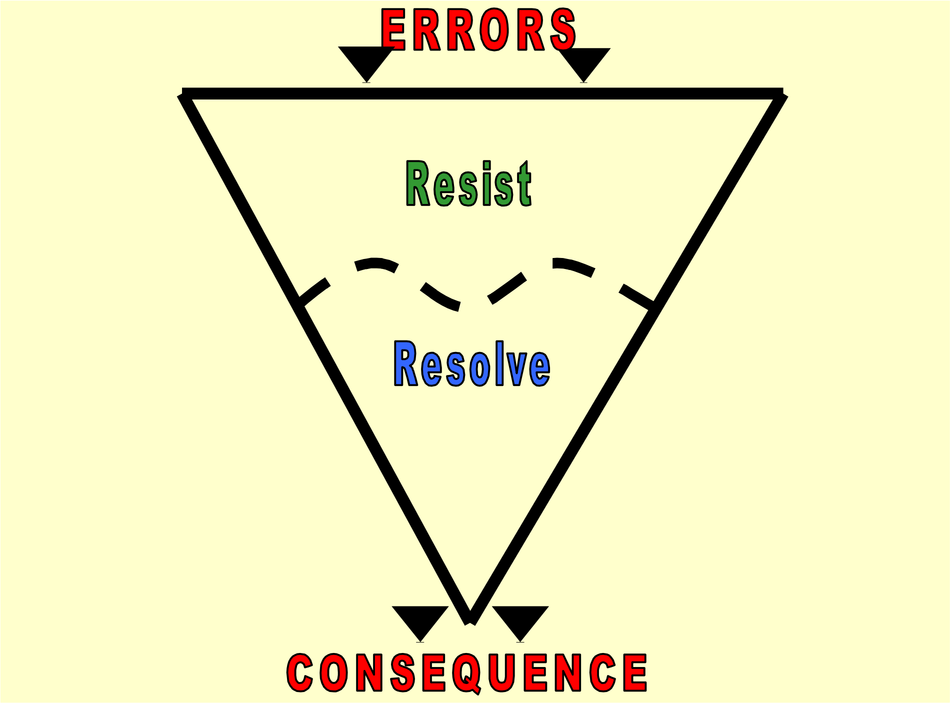
Error Management



Error Management

RESIST

HARDWARE & SOFTWARE THAT EXISTS BEFORE THE HUMAN ENTERS



RESISTANCE

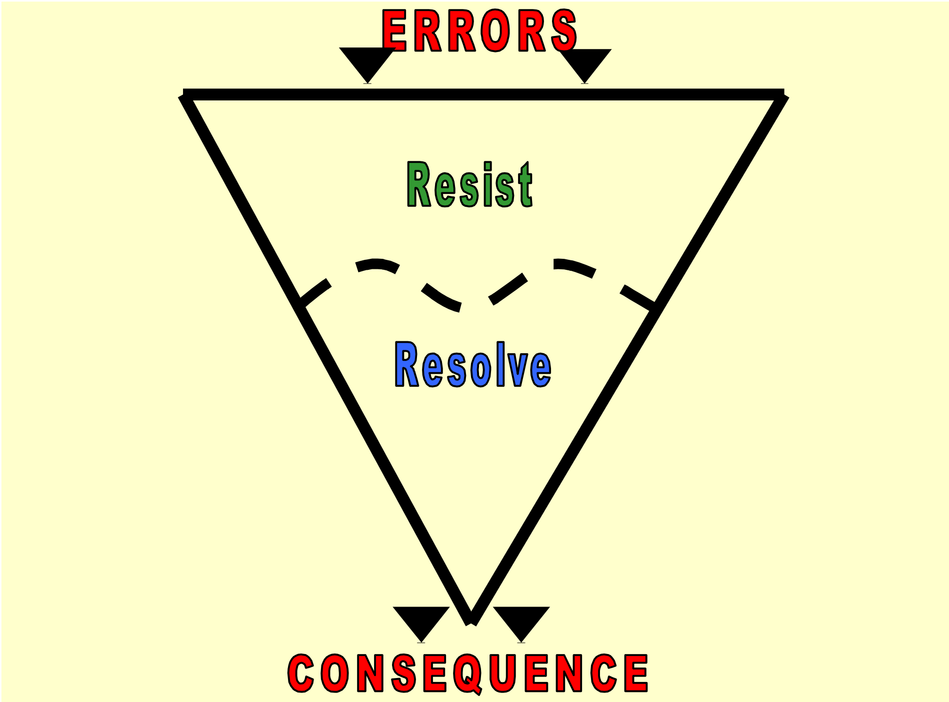
HARDWARE & SOFTWARE THAT EXISTS BEFORE THE HUMAN ENTERS

- GPWS
- TCAS
- TRAINING
- MANUALS
- SOP's
- CHECKLISTS
- AUTOMATION
- ATC

Error Management

RESIST

HARDWARE & SOFTWARE THAT EXISTS BEFORE THE HUMAN ENTERS



RESOLVE

WHAT THE HUMAN BRINGS TO THE SYSTEM

RESOLVE

WHAT THE HUMAN BRINGS TO THE SYSTEM

- PROFICIENCY
- VIGILANCE
- ASSERTIVENESS
- MONITORING &

  CROSSCHECKING

- DECISION MAKING
- EXPERIENCE
- LEADERSHIP
- SIT. ASSESSMENT
- CHECKLIST DISCIPLINE

Threat and Error Management

Consequences

Undesired Aircraft State (UAS)

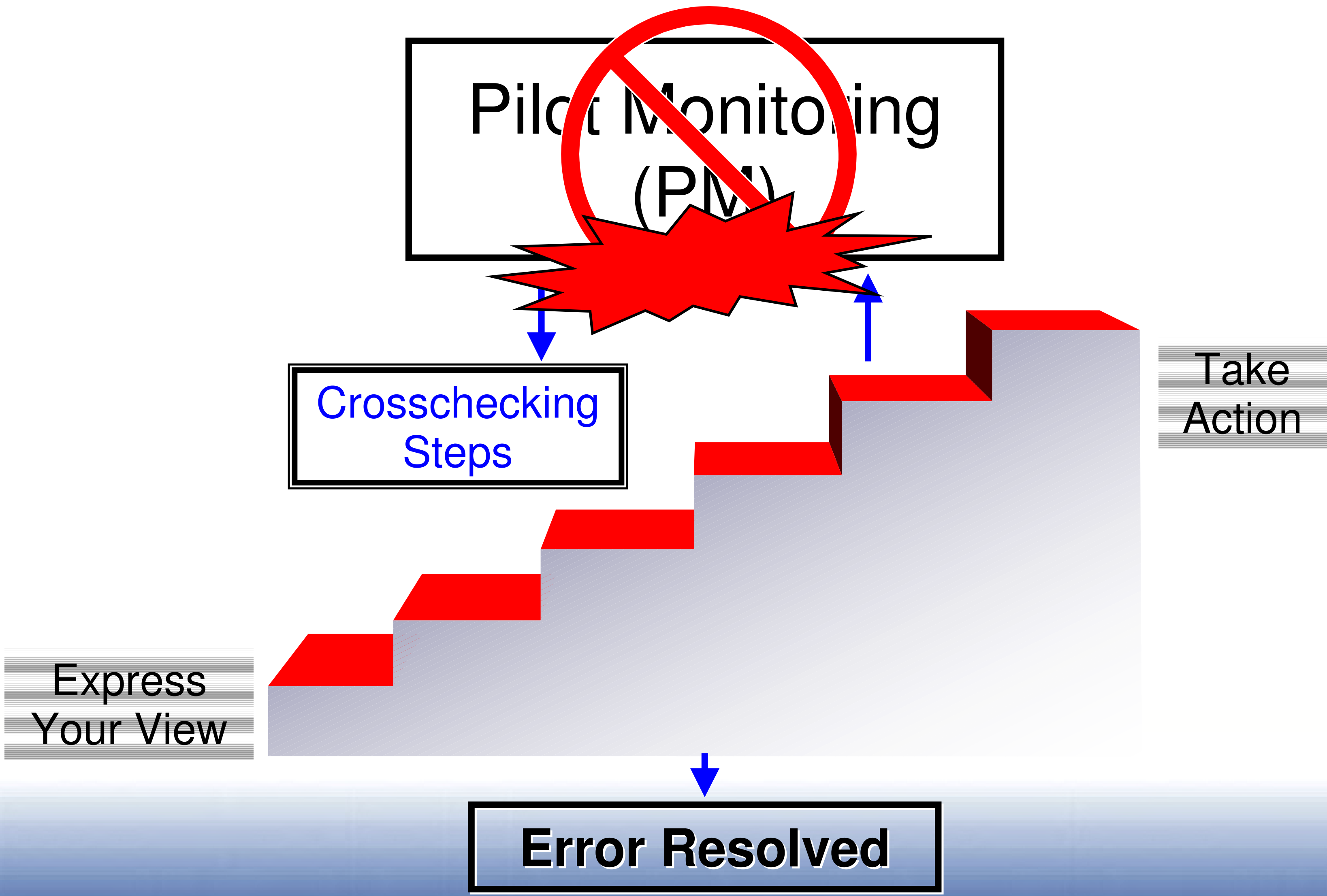
NASA Guidelines

- ♣ Positively delegate <u>flying</u> and <u>monitoring</u> duties
- ♣ Monitoring is as important as flying

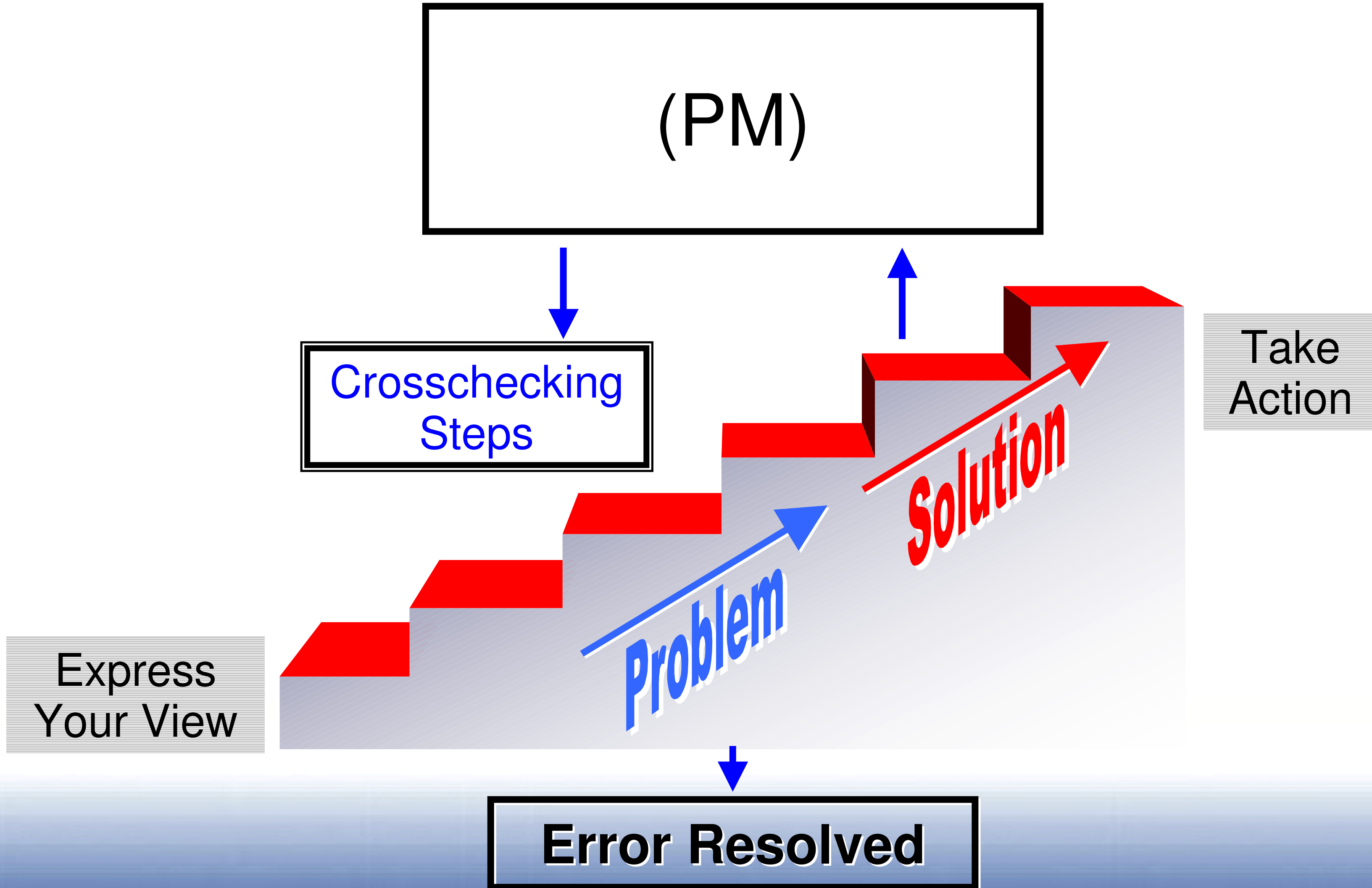
Monitoring & Crosschecking

- ♣ Flying pilot does not become involved with secondary tasks
- ♣ When conflict arises-resolve with outside source
- ♣ When in doubt-must express!

Monitoring and Crosschecking



Monitoring and Crosschecking



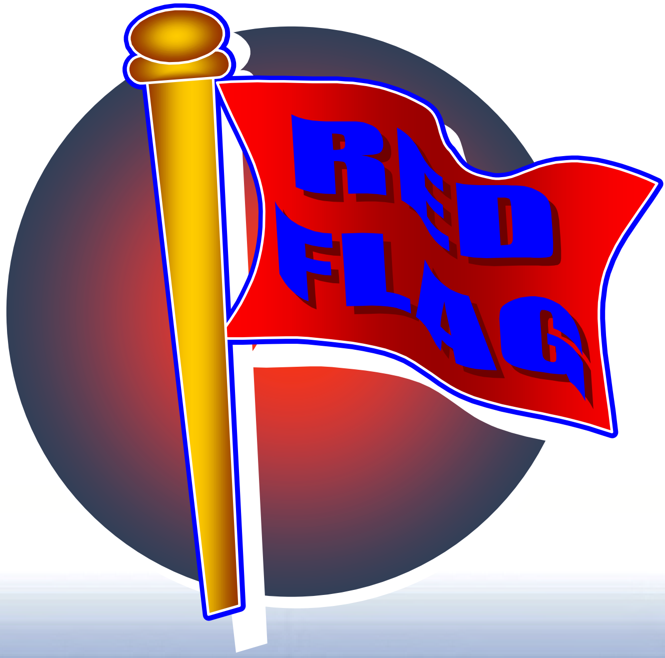
TEM
"the challenge"

How to improve

"Threat"

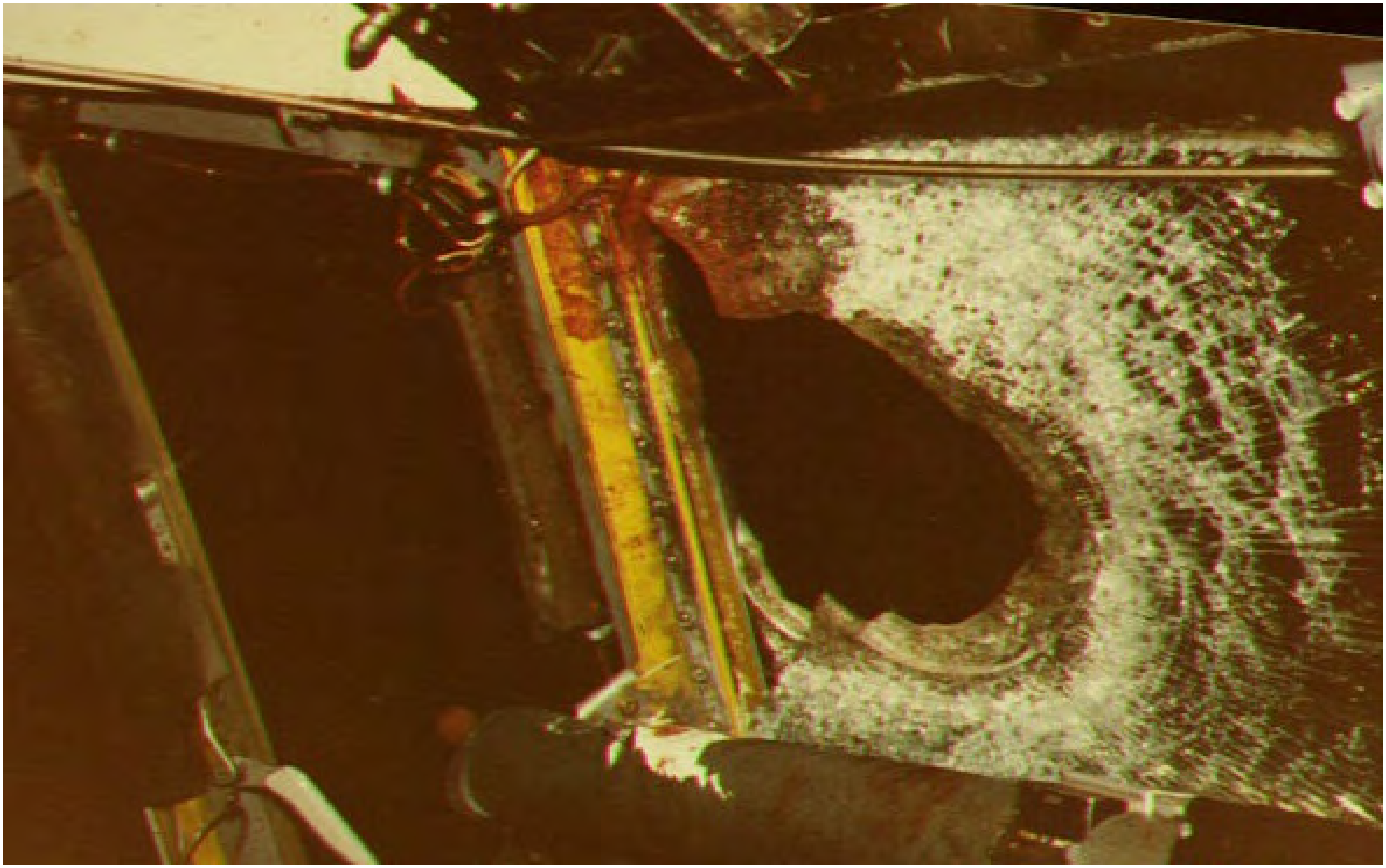
Identification?

"Get it on the Radar!"



Distraction

Distractions



Threat and Error Management

DECISION-MAKING

“Review & Management of Plans”

Decision making

Decision Making

Tactical

Perceive Situation

Situation Assessment

Select a Course of Action

Situation Assessment

The <u>Nature of the Threats</u>

“Situation Assessment”

Continental Airlines, Nov. 2004

Leadership

What have you seen?

Threat and Error Management
"Training"

TEM TRAINING CLASS

- ♣ Ideal class size 15-20
- ♣ The value of the introduction
  - Opening question
- ♣ Facilitation training
  - Line pilots
- ♣ Follow-on Check Airmen training

Sec. 2 Page 8
Rev. 08/01/04 #12 Continental Flight Operations Manual

- With any mode changes to the MCP, the PF should **verbalize** the change(s). Both pilots should **verify** the change(s) using the FMA and **monitor** for expected aircraft performance.
- When selecting the Autopilot and/or Auto throttle on or off, the PF should verbalize the change. Both pilots should verify the change and monitor for expected aircraft performance.

Threat And Error Management

General

Threat & Error Management (TEM) is an essential part of our improved level of performance that will enable them to deal with the increased challenges of maintaining a safe operation. A threat is anything that increases the complexity of the operation and, if not managed properly, can decrease safety margins. To effectively manage threats, they must be identified, then assessed, and countered. Identification of threats comes through many system alerting methods, i.e. aircraft system alerting lights, bells, horns, voice, and devices such as GPWS, TCAS, etc. Those devices may also show the best course of action to counter the threat. However, there are no systems and devices to detect, assess, and counter all threats. Threat

Flight Operations Manual Continental Sec. 2 Page 9
Rev. 08/01/04 #12

Crew Resource Management

Effective Crew Resource Management is the bedrock of Threat and Error Management. Technical proficiency, knowledge of aircraft systems and adherence to standard operation procedures continue as the foundation of aviation safety. Effective CRM within the TEM process should help a crew achieve a safe conclusion of a flight when faced with a non-normal, an

2

FLIGHT OPERATIONS

Crew Resource Management

Effective Crew Resource Management is the bedrock of Threat and Error Management.

We are committed to the TEM process. TEM coupled with effective CRM skills is expected behavior among all crewmembers. The following Crew Effectiveness Markers were developed to assist crewmembers in their understanding and practice of CRM.

Newsletter

Feedback to the pilots is essential for continued program success.

Human Factors & Safety

Issue # 4 November 2003

The ASAP Box Score

Here are a few statistics from the Aviation Safety Action Program (ASAP)

- The program has now been up for 27 months
- More than 2317 ASAP Reports have been submitted covering over 1470 events & safety issues.
- Only 2.7% of these events were known by the FAA and only 8.1% were known by the company through means

"We can't solve problems using the same thinking we used to create them." -Albert Einstein

Threat & Error Management (TEM)

The Flight Operation Manual now contains the Continental Airlines' "Automation Policy." This policy contains the strategies crews can use to manage many of the automation and other additional threats they encounter. In reading this policy, it should become apparent that proper use of the phrase "**Verbalize, Verify and Monitor**" is a very effective strategy to properly manage these threats and reduce and/or trap crew error.

Line Operations Safety Audits (LOSAs) have shown that crews who verbalize make fewer

didn't notice the airplane had come out of VNAV…crossed the VOR high…the easiest clearances maybe the most likely to mess up (complacency)."

ATC

We all agree that ATC, for the most part, does a great job in handling heavy traffic and in working with the flight crews to keep the operation running smoothly. Yet the "threat" of an ATC error, such as not using full call signs, a last minute clearance or even an "attitude" should raise a "Red Flag" that, if not properly managed, an error is just around the corner.

B-737 Standards Meeting

February 21st, 2001

The Role of the Check Airman in Threat & Error Management


TEM
&
Automation

To ERR is Human

To REALLY Screw up you need a Computer!

The Continental Airlines Automation Policy

TEM

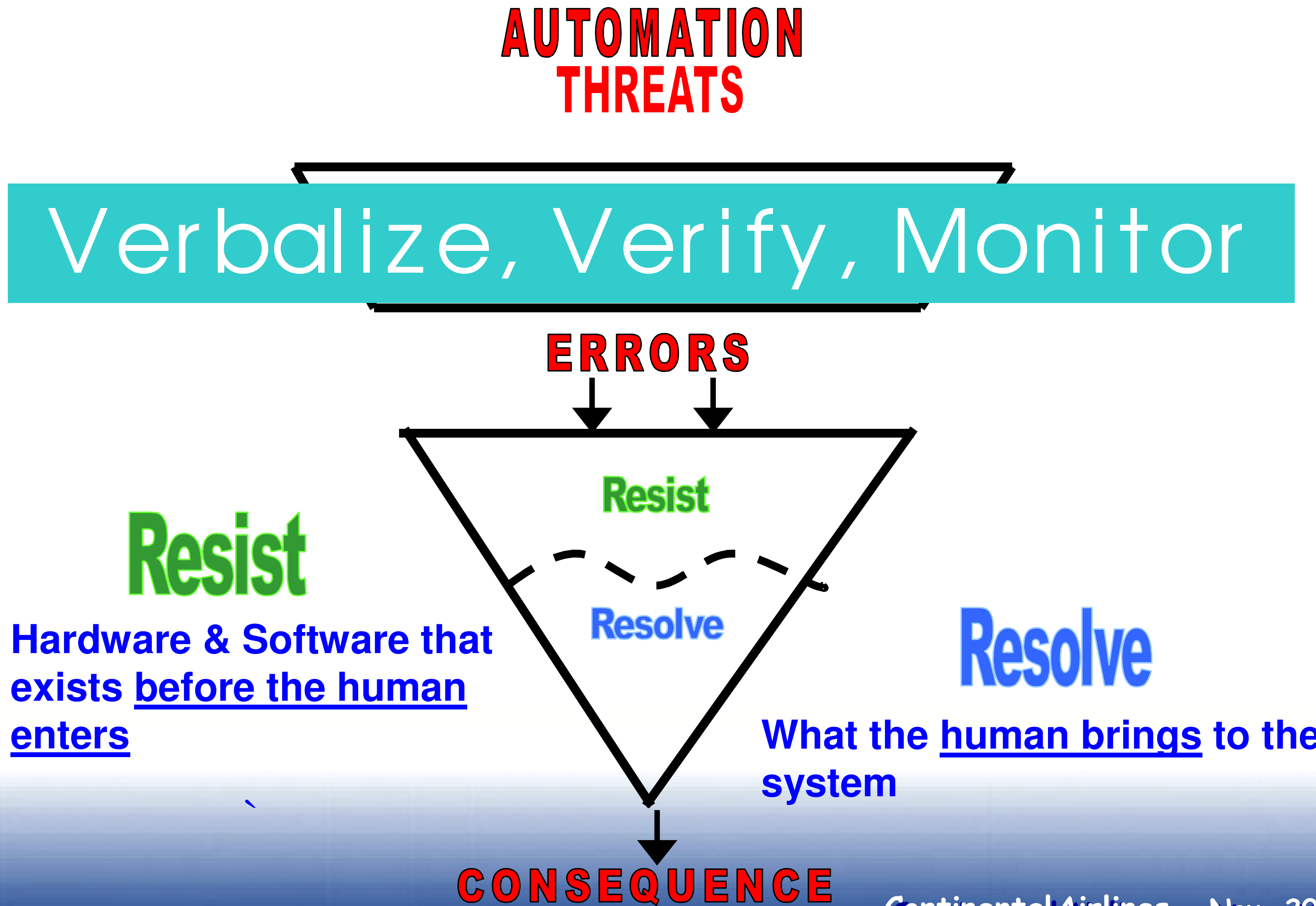
"the challenge"

Improve "Threat & Error" identification by using

Verbalize, Verify, Monitor

To help "Get it on the <u>RADAR</u>"

Threat and Error Management




TEM Training
outside of
Flight Operations

Maintenance Threat & Error Management (MTEM)

Tech Ops

Threat and Error Management (TEM)

Food Services


Threat and Error
Management (TEM)
Field Services

Threats

Influences that can lead to agent error

Distractions

Passenger events

Late Bags

Cabin Crew

Weather

Ramp slope

Maintenance

Late Gate Change

New Agent

Time pressures

Heavy traffic

Flight diversion

System malfunction

Unfamiliar gate

Flight Crew

Late Cargo

Decision-Making & Leadership

Important to understand factors that can degrade decision making:

Distractions

Work Overload

Supervisor Buy-in a Must!

Why Ramp LOSA?

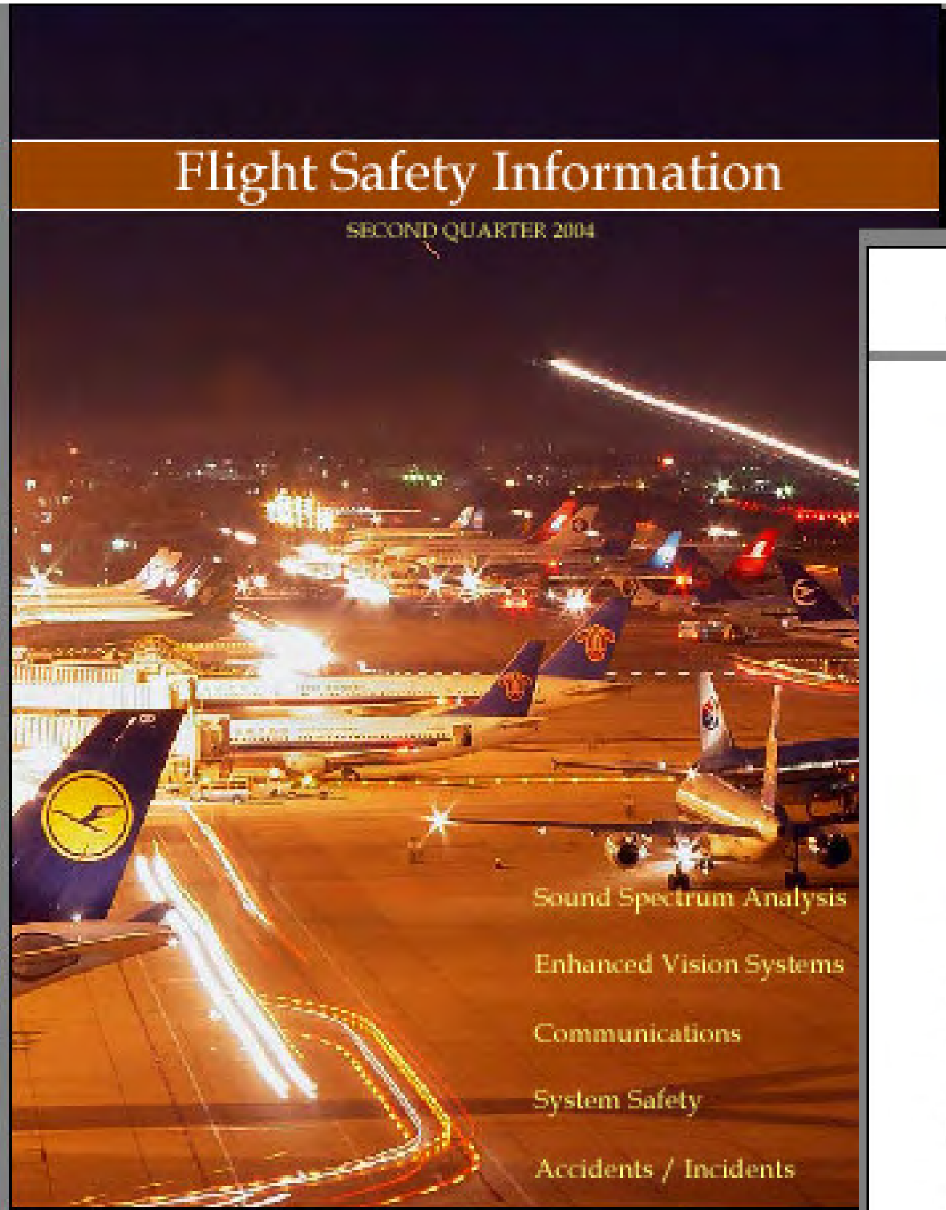
- The first step in managing threats is to collect data
  - Precursors (Threats) are identified and evaluated
  - Countermeasures (Strategies) are developed, communicated throughout the organization, and then implemented in the system

Identified Threats

Threats can be prioritized according to the probability of an incident or accident occurring and then by the severity of an incident or accident that may occur if the "threat" is mismanaged

Threat Management

The objective of “Threat Management” is to obtain an understanding of how to assess the various risk levels of the threats and to gain an insight on logical approaches (strategies) to deal them



System Safety and the Safety Order of Precedence

For every incident, there are many near accidents. H.W. Heinrich's Accident Safety Triangle projects that for every 300 hazards present, there are 29 incidents, and 1 accident. According to this, there are numerous hazards that could potentially develop into the cause of an incident or accident. The key is to identify these hazards in the system and assess them so that a solution may be determined.

System Safety is the application of special technical and managerial skills to the systematic, forward-looking identification and control of hazards throughout the life cycle of a project, program, or activity. Simply stated, system safety involves the identifying, evaluating, and addressing of hazards or risk. Its sole purpose is to prevent accidents.

The causes of an accident are factors, events, acts, or unsafe conditions which singly, or in combination with other causes, result in the damage or injury that occurred and, if corrected, would have likely prevented or reduced the damage or injury. A **hazard** is any condition, event, or circumstance, which could induce (cause) an accident. **Risk** is defined as the probability that an event will occur.

There are two major types of risks that are involved in system safety. An *informed risk* is a risk that has been corrected and assessed, whereas an *uninformed risk* is a risk that was not identified or was incorrectly measured. The objective of **risk management** is to obtain an understanding of how to access the various levels of hazards and to gain an insight on logical approaches to deal with those hazards. In order to control these risks, risk management techniques must be enforced. The first step of managing risks is to collect data. Once data is collected, accident precursors (hazards) are identified and evaluated. Finally, countermeasures (solutions) are developed, communicated throughout the organization, and are then implemented in the system.

"Safety System and the Safety Order of Precedence"
Flight Safety Information, Second Quarter 2004
by Curt Lewis.

The Safety Order of Precedence

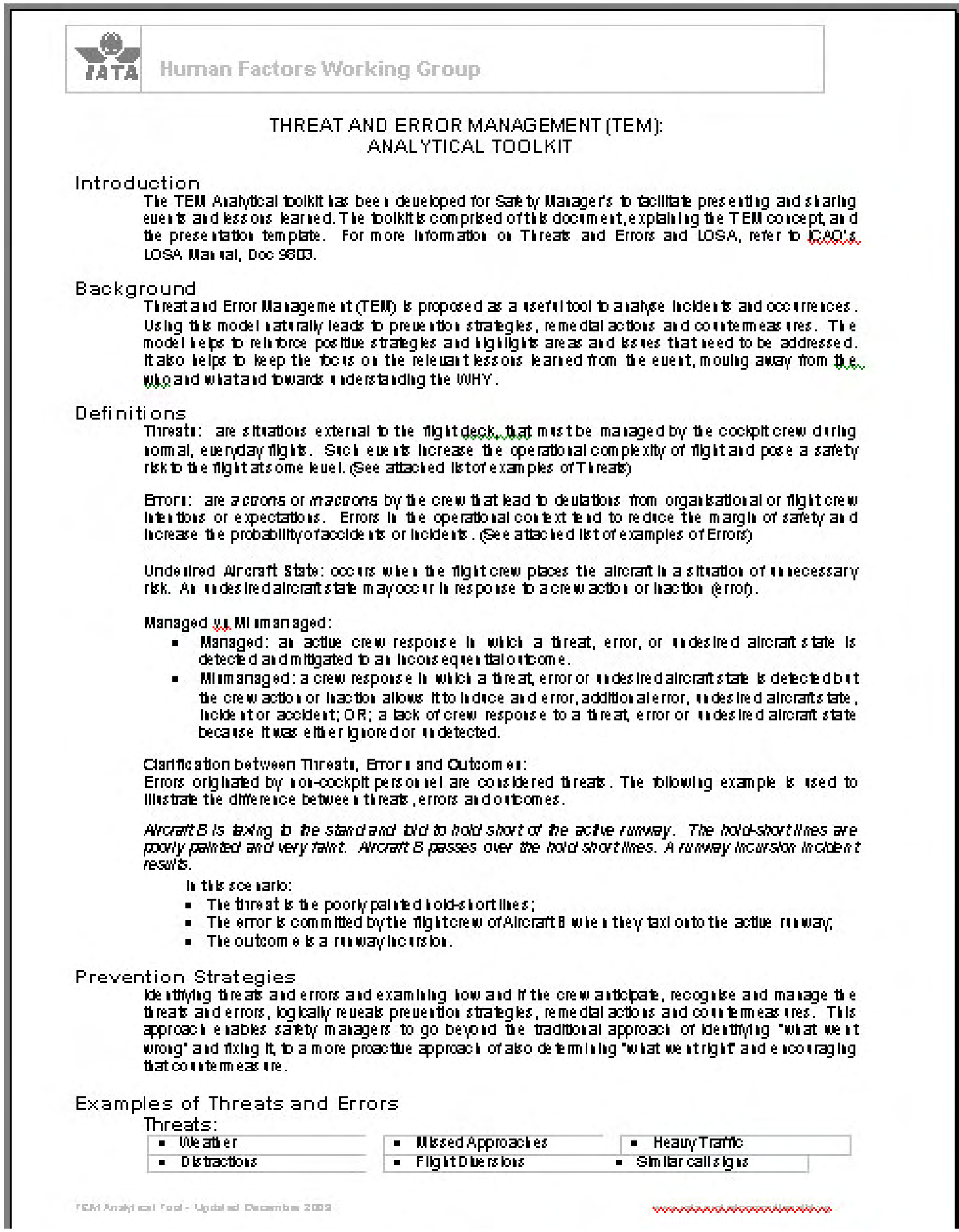
1. Design for minimum risk – Threat is corrected and eliminated
   - Fuel Truck eliminated from use on ramp
2. Control or Guard solution – Strategies put in place to decrease exposure
   - Hearing protectors
3. Personal warning solution – Warn personnel if you can't eliminate/control the hazard
   - Staying clear of engine intake until all clear
4. Develop procedures and training – Develop procedures and training to reduce risk
   - Pushback procedure card and guidelines

TEM applied to Incident & Accident Analysis

TEM Toolkit
for
Incident & Accident (IA)
Analysis

IATA Safety Advisory Committee

Incident & Accident analysis



Human Factors Working Group

THREAT AND ERROR MANAGEMENT (TEM):
ANALYTICAL TOOLKIT

Introduction

The TEM Analytical toolkit has been developed for Safety Manager's to facilitate presenting and sharing events and lessons learned. The toolkit is comprised of this document, explaining the TEM concept, and the presentation template. For more information on Threats and Errors and LOSA, refer to ICAO's LOSA Manual, Doc 9803.

Background

Threat and Error Management (TEM) is proposed as a useful tool to analyse incidents and occurrences. Using this model naturally leads to prevention strategies, remedial actions and countermeasures. The model helps to reinforce positive strategies and highlights areas and issues that need to be addressed. It also helps to keep the focus on the relevant lessons learned from the event, moving away from the who and what and towards understanding the WHY.

Definitions

Threats: are situations external to the flight deck, that must be managed by the cockpit crew during normal, everyday flights. Such events increase the operational complexity of flight and pose a safety risk to the flight at some level. (See attached list of examples of Threats)

Errors: are actions or inactions by the crew that lead to deviations from organisational or flight crew intentions or expectations. Errors in the operational context tend to reduce the margin of safety and increase the probability of accidents or incidents. (See attached list of examples of Errors)

Undesired Aircraft State: occurs when the flight crew places the aircraft in a situation of unnecessary risk. An undesired aircraft state may occur in response to a crew action or inaction (error).

Managed vs Mismanaged:

- Managed: an active crew response in which a threat, error, or undesired aircraft state is detected and mitigated to an inconsequential outcome.
- Mismanaged: a crew response in which a threat, error or undesired aircraft state is detected but the crew action or inaction allows it to induce and error, additional error, undesired aircraft state, incident or accident; OR; a lack of crew response to a threat, error or undesired aircraft state because it was either ignored or undetected.

Clarification between Threats, Errors and Outcomes:
Errors originated by non-cockpit personnel are considered threats. The following example is used to illustrate the difference between threats, errors and outcomes.

Aircraft B is taxing to the stand and told to hold short of the active runway. The hold-short lines are poorly painted and very faint. Aircraft B passes over the hold short lines. A runway incursion incident results.

In this scenario:

- The threat is the poorly painted hold-short lines;
- The error is committed by the flight crew of Aircraft B when they taxi onto the active runway;
- The outcome is a runway incursion.

Prevention Strategies

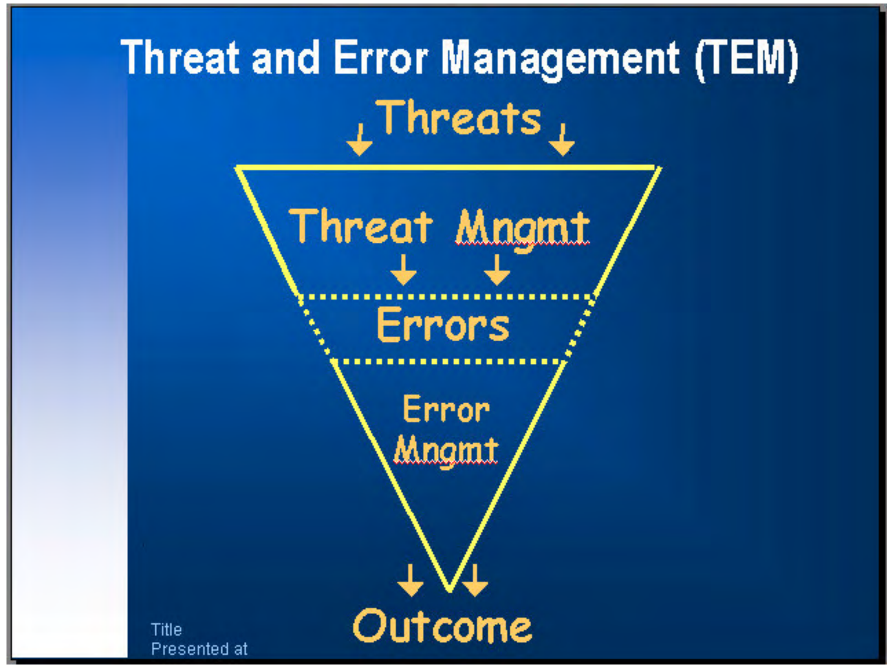
Identifying threats and errors and examining how and if the crew anticipate, recognise and manage the threats and errors, logically reveals prevention strategies, remedial actions and countermeasures. This approach enables safety managers to go beyond the traditional approach of identifying "what went wrong" and fixing it, to a more proactive approach of also determining "what went right" and encouraging that countermeasure.

Examples of Threats and Errors

Threats:

▪ Weather	▪ Missed Approaches	▪ Heavy Traffic
▪ Distractions	▪ Flight Diversions	▪ Similar callsigns

TEM Analytical Tool - Updated December 2003



Continental Airlines, Nov. 2004

THREAT AND ERROR MANAGEMENT (TEM): ANALYTICAL TOOLKIT

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Threat and Error Management (TEM)

Threats

1. List of the Threats
2.
3.
4.
5.
6.
7.
8.

Threat Management

1. Identify the Threat

2.

3.

4.

1. Was the threat managed or mismanaged? How?

2.

3.

4.

Errors

1. List of the Errors
2.
3.
4.
5.
6.
7.
8.

Error Management

1. Identify the Error

2.

3.

4.

1. Was the error managed or mismanaged? How?

2.

3.

4.

Undesired State Management

- List how the Undesired State was managed or mismanaged.

Undesired State Management

- Managed
  - Post mishap procedures followed
  - PAX, fuel spill, etc
  - Etc.
- Mismanaged…

Prevention Strategies

- List initial corrective actions at the present time and any proposed actions.
  - Crew Briefs
  - Training
  - Auditing procedures/policy

TEM and the Safety Change Process

Continental Airlines

Safety Change & Training Development Program

Program Objective

Develop the process by which safety data and crew performance and behavior data from FOQA, LOSA, ASAP, CASIS, Line Checks, Crew Contacts, IEP, VDRP and AQP are analyzed by Safety, Flight Operations, Inflight, Flight Standards & Training, FAA and ALPA Safety in order to facilitate change.

Data Driven - Safety Change & Training Development Program

Continental Airlines, Nov. 2004

Goal

- Become a better Threat Manager – actively identify threats in your operation
- “Threat Management is managing your future.”
- “Error Management is managing your past”
- Continue building a Safety Culture by encouraging open, honest communications


Thank You!
THREATS
Strategies
ERRORS
Resist
Resolve
CONSEQUENCE
Continental

Line Operations Safety Audit: LOSA Data from US Airlines

Robert Helmreich
James Klinect
Ashleigh Merritt
The University of Texas
Human Factors Research Project

Shared Vision of Aviation Safety
San Diego
October 13, 2004

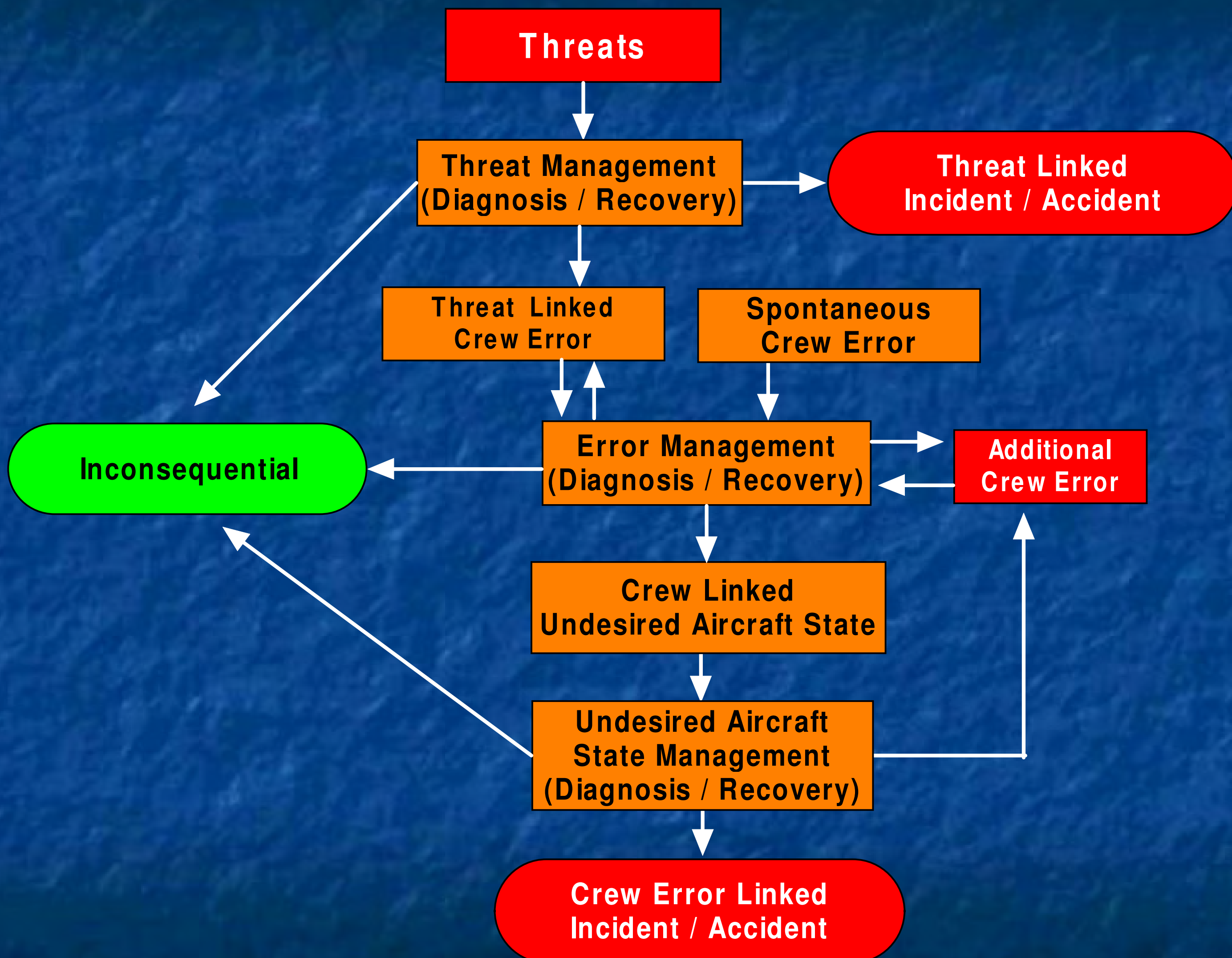
Things Happen

CFIT: Controlled Flight into Train

LOSA Goals

- The LOSA Collaborative collects proactive data on crew, organizational, and system performance without jeopardy to crews or organizations
  - Data provided to the University of Texas Human Factors Research Project
- LOSA framework is the University of Texas Threat and Error Management Model

Threat and Error Management Model



LOSA Operating Characteristics

1. Jumpseat observations during normal operations
2. Anonymous (crew) and confidential (organization) data collection
3. Voluntary crew participation
4. Joint management / union sponsorship
5. Trusted and trained observers

LOSA Operating Characteristics

6. Safety-targeted data collection form
7. Trusted data repository
8. Data verification roundtables
9. Data-derived targets for safety enhancement
10. Feedback of results to line pilots

The LOSA Database

- Since refining the TEM model and data collection methodology, data have been collected at 21 airlines in the US, the Asia Pacific region, and Europe
  - Non-US carriers codeshare with US airlines
- For this presentation data from 1310 flights by US airlines are summarized

Error

- Pilot induced deviation from crew or organizational intentions or expectations

Threat

An event or error that occurs outside the influence of the flight crew, but which requires crew attention and management if safety margins are to be maintained.

Mismanaged Threat: A threat that is linked to or induces flight crew error.

Threat prevalence

- 90% of flights faced one or more threats
  - 2/3 of threats are environmental (wx, airport conditions, ATC, terrain)
    - ½ of environmental threats occur during descent/approach/landing
  - 1/3 are airline (ground, ramp, dispatch, cabin, operational pressure, mx)
    - ¾ of airline threats occur during pre-departure

The top three threats

- 47% ATC threats
- 40% weather threats
- 23% aircraft malfunction/MEL threats with operational implications

Threat management

- 22% of flights had a threat that was mismanaged and led to some form of crew error

Top three mismanaged threats

- ATC threats
  - 12% of all ATC threats
  - 28% of all mismanaged threats
- Weather threats
  - 9% of all wx threats
  - 18% of all mismanaged threats
- Aircraft malfunction/MEL with ops implications
  - 15% of all malfunction threats
  - 14% of all mismanaged threats

A focus on ATC

- 50% of ATC threats involved a challenging clearance
- 20% involved runway change
  - 14% of both threats were mismanaged
- 50% of ATC threats during descent/approach/landing
  - 20% pre-departure
  - 15% during takeoff
- 2/3 of mismanaged ATC threats during descent/approach/landing

Error prevalence

64% of all flights had 1 or more errors

- 50% procedural (briefings, callouts, checklists, cross-verification)
- 33% handling errors (flight controls, ground navigation, automation, systems/instruments)
- 15% communications (intra-crew or crew-ATC)

When crews err

- Pre-departure/taxi 27%
- Take-off 22%
- Cruise 4%
- Descent/approach/landing 43%
- Taxi in 4%

The top three errors: Percent of all flights

- 21% manual handling/flight controls
- 20% checklists
- 17% crew-ATC

Cowboys among us: Flights with Unstable vs. Stable Approaches

	Approach	
	Unstable	Stable
	N=66	N=1244
Errors/segment	4.9	1.7
Errors mismanaged	3.0	0.4
Violations	2.4	0.5

The value of aggregate data

- Snapshot of system issues
- Benchmark for organizational comparisons
- Basis for system enhancement
  - ATC issues

The University of Texas

Human Factors Research Project

www.psy.utexas.edu/HumanFactors

The Losa Collaborative

www.LOSAcollaborative.org

Second ICAO-IATA LOSA & TEM Conference

Boeing Training Center - Seattle, Washington

November 3-4, 2004

A Practical Overview of the Line Operations Safety Audit (LOSA)

James Klinect

The University of Texas / The LOSA Collaborative

The University of Texas
Human Factors Research Project

LOSA
Collaborative

Introduction: James Klinect

- University of Texas (UT) – LOSA research for the industry
  - Project Developer / Coordinator – TEM & LOSA
- LOSA Collaborative – LOSA implementation for airlines
  - Founder / President
  - De-identified data donated to UT for research
- Disclaimer: Not an infomercial for the LOSA Collaborative
  - Sharing of mistakes made and lessons learned
  - Determine whether LOSA is for your airline
  - Provide enough information to do LOSA yourself

LOSA Airlines: 1996-2004

21 airlines / 26 LOSA projects / 3300+ observations

- AeroMexico
- Alaska Airlines
- Air New Zealand 98, 03
- Asiana Airlines
- Braathens ASA
- Cathay Pacific
- China Airlines
- Continental 96, 98, 00, 04
- Continental Express
- Continental Micronesia
- COPA Airlines
- Delta Airlines 00, 04
- EVA AIR
- Frontier Airlines
- Malaysia Airlines
- Mt. Cook Airways
- QANTAS
- Singapore Airlines
- Silk Air
- UNI AIR
- US Airways

Presentation Outline

- LOSA Rationale / Deliverables
  - *Why LOSA and what do you get?*
- LOSA Operating Characteristics
  - *What is the definition of LOSA and how does it work?*
- LOSA Mailbag
  - *What are the most frequently asked LOSA questions?*
- Q&A Session

LOSA Rationale / Deliverables

Commercial Aviation Today

- Over 1.6 billion people boarded an commercial aircraft last year (ICAO)

- In 2003, 20 million departures worldwide (ICAO)

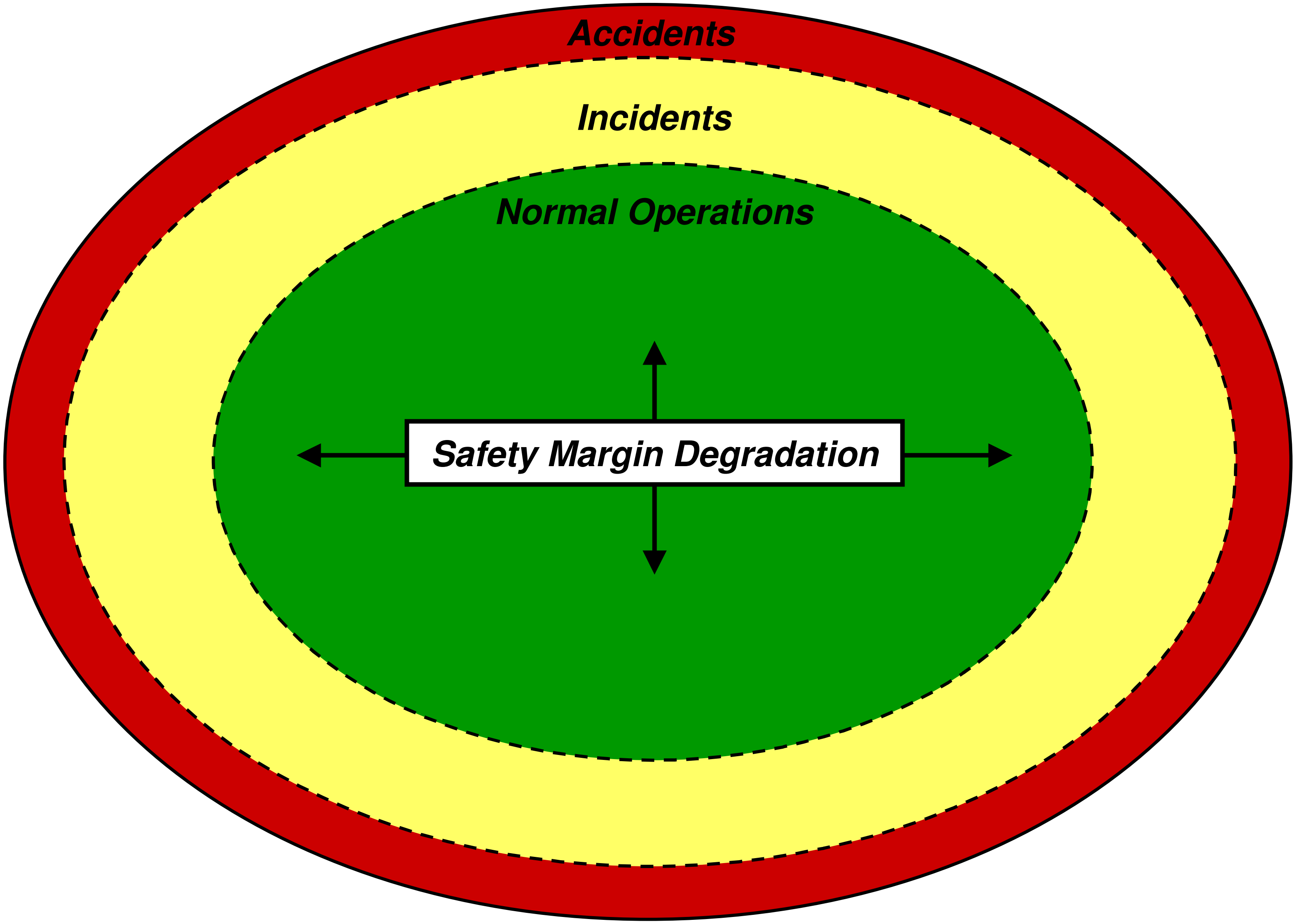
- 1994-2003 Fatal / hull loss accident rate = Approximately one in one million departures (Boeing)

- Two times more likely on a passenger train and thirty times more likely in an automobile to die than flying on a commercial airplane (National Safety Council)

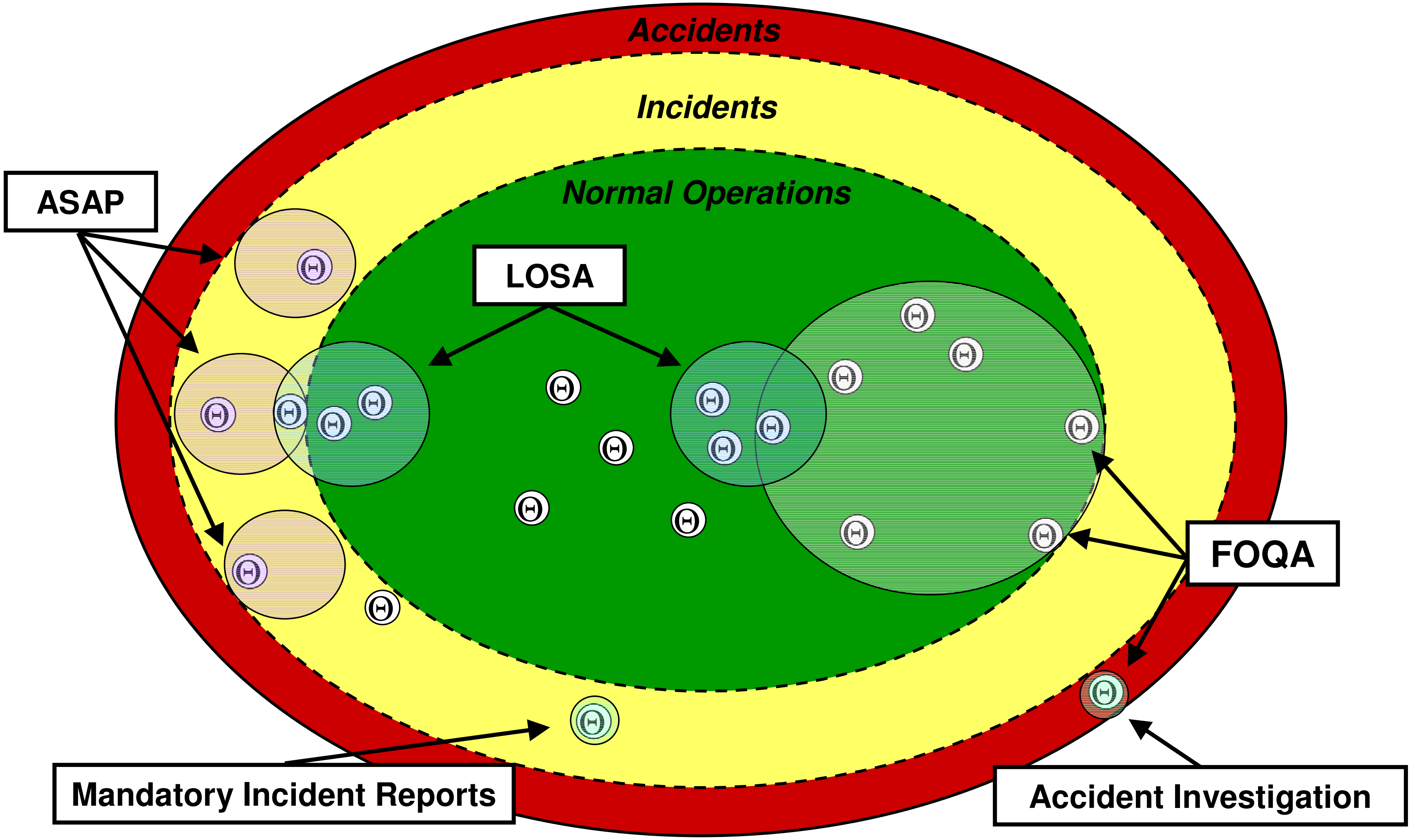
Commercial Aviation in 2014

- 5% more passengers every year from 2004 (ICAO)
- Global departures will increase by 30% - 26 million (ICAO)
- 43% of the US airports will be over congested. The nation's busiest airports are already over capacity (FAA)
- ATC - old tech / glut of retirees / funding shortages (FAA)
- How do we manage safety in a changing operating environment?
  - Collect proactive and reactive data and address active failures and latent conditions (In other words, plug the holes of Reason's Swiss cheese)

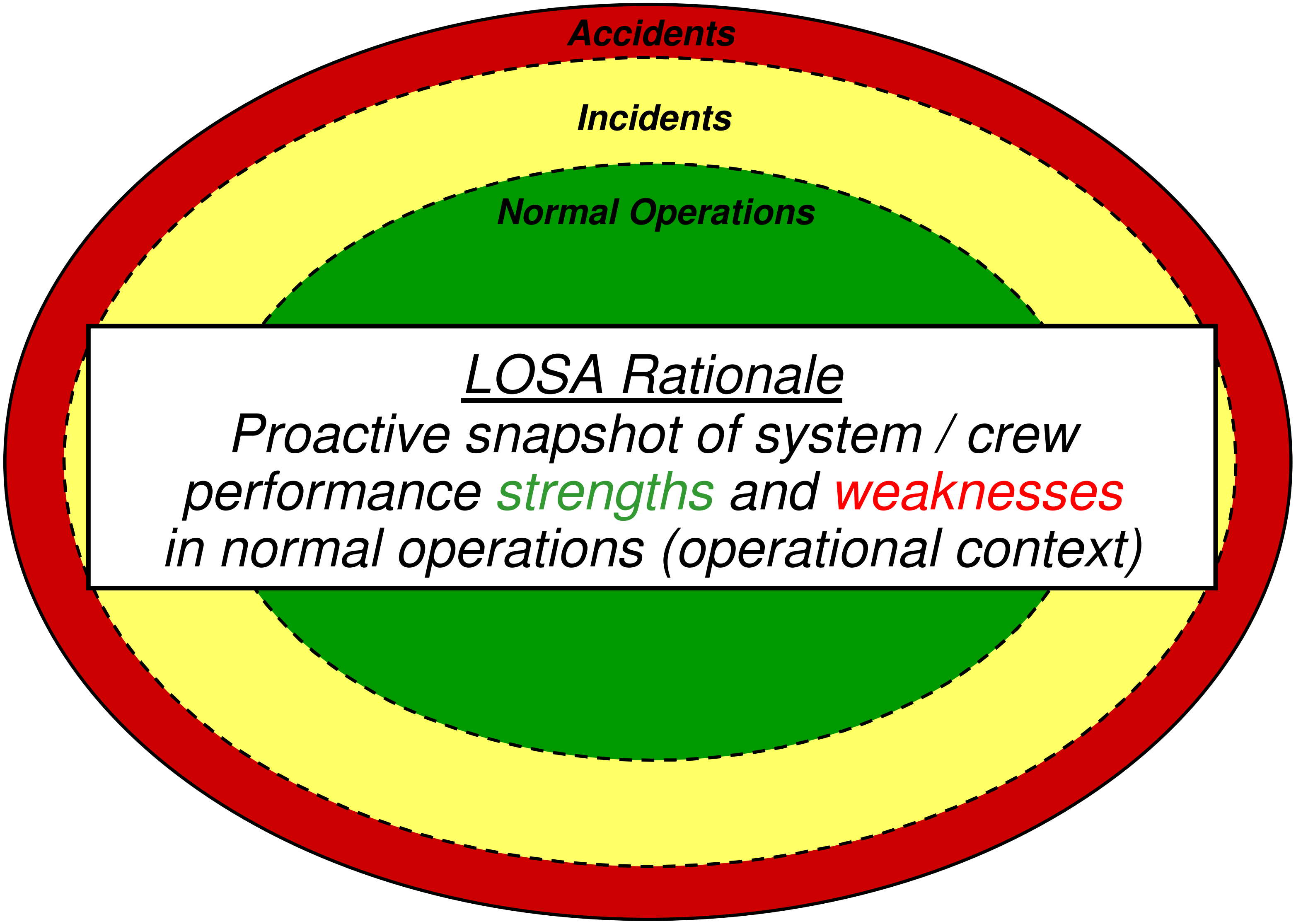
Aviation Safety Envelope



Aviation Safety Envelope



Aviation Safety Envelope



Reactive vs. Proactive Safety Data

- Reactive (Incidents / Accidents)
  - Event based – Data confirm a safety breakdown after an event
  - Concern – Breeds management complacency – “No events, no problem”
- Proactive (LOSA / FOQA / ASAP heads-up reports)
  - Principle based – Data shed light on possible precursors to events
  - Concern - Information overload / uncertainty whether fixes will work
- LOSA - flight operations health check –addressing safety issues before an operational heart attack
- Next step: What to measure during a LOSA?

LOSA Measurement Challenge

- Challenge - What type of observational data could provide measure of safety performance in normal operations?

- Concerns
  - Observer overload – Can't capture everything
  - Data analyst overload – Must have a roadmap for interpretation
  - Manager overload – Data need impact/face value to stimulate action

- Solution – Need a framework to collect, analyze data and derive data-driven safety priorities

LOSA / Threat and Error Management

What do flight crews do to safely fly from A to B?

1. Manage operational complexity → Threat Management
2. Manage their own errors → Error Management
3. Manage aircraft deviations → Undesired Aircraft State Management

LOSA Measures

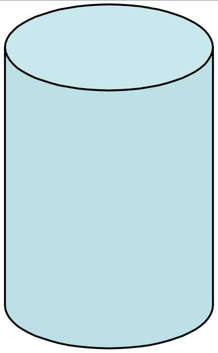
Why Threat and Error Management (TEM)?

- TEM safety assumption – Safety is improved if an airline can support flight crews to better manage threats, errors, and undesired aircraft states

- Caveat – Non-technical skills (e.g. CRM performance markers) are not a primary measure in LOSA
  - They are **one of many** mechanisms that contributes to effective threat and error management

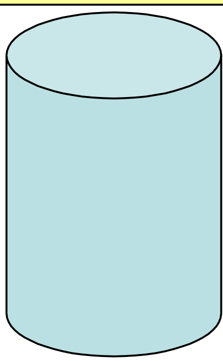
LOSA Final Report and Raw Data

LOSA Report



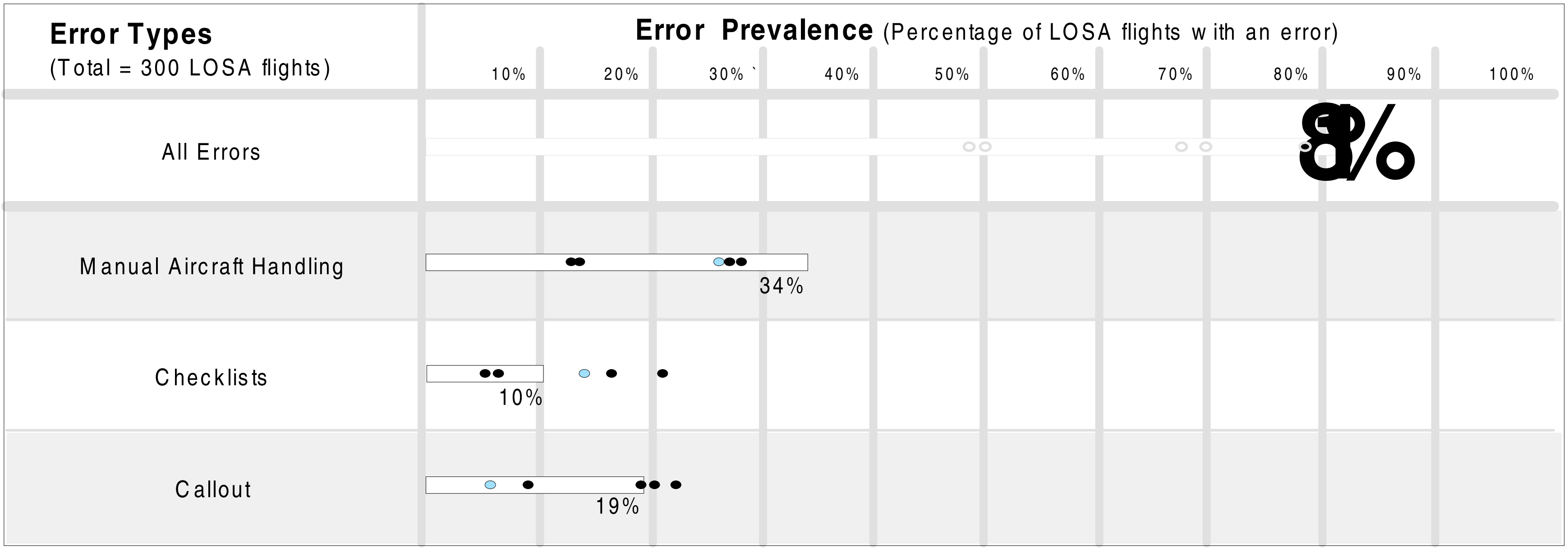
- Most frequent and mismanaged threats
- Most frequent and mismanaged errors
- Strengths and weaknesses of CRM performance
- Fleet and operational differences
- Comparison to other airlines on LOSA safety indices

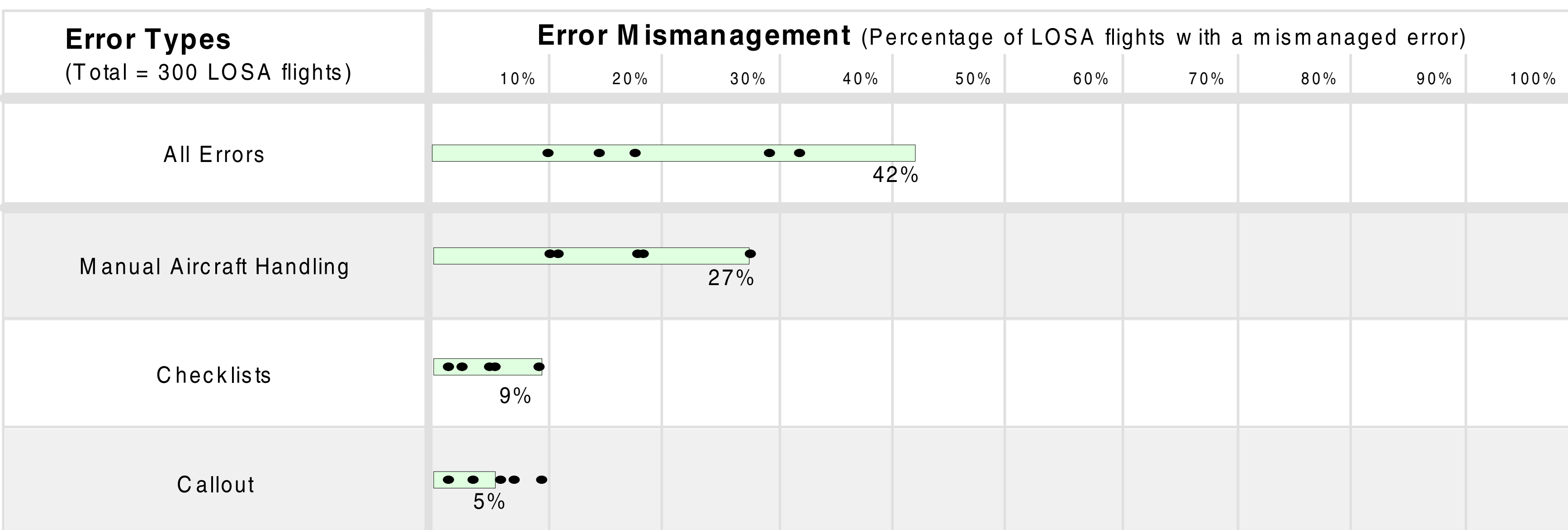
LOSA Raw Data



- Phase of flight and overall text narratives
- Listing and coding of every threat and error observed
- Responses from an in-flight pilot interview

Sample LOSA Analysis - Zed Airlines





LOSA Flight #23 Error #1 A340 ARPT 401 to ARPT 204 (Crew #8)

Phase of Flight: Takeoff/Climb Pilot Flying: CA

Takeoff / Climb Narrative – Almost immediately after takeoff, the Captain started a turn up the river, and did not wait until 400 feet, per SOP. About 300 feet, captain reached over to MCP (called FCU on Airbus) and selected Flight Path Angle. He did not tell FO of this selection, which is very unusual of a setting. In fact, the FO later asked me if I had ever seen anyone use this selection and stated that he has never seen it in his 2 years of being on the Airbus. Because the Captain did not tell the F/O what he was doing, when the FO noticed this setting, he reselected the more common mode (Heading). Captain then reached over and then reselected Flight Path Angle. This led to a brief discussion of whether of not the aircraft would capture NAV in this setting. As a result of all of this, the FO missed ATC handoff to departure control, a call that was not made until the aircraft leveled off at 5000 feet. Both Captain and FO were involved in heads-down stuff as the aircraft leveled off. If the autopilot would not have leveled off, then the crew would have not caught it, because they were doing extraneous things. (FO, programming MCDU; Captain, looking at weather).

LOSA Flight #289 Error #1 B737-700 ARPT 101 to ARPT 104 (Crew #6)

Phase of Flight: Des/App/Land Pilot Flying: CA

Error Description: ***Capt said during downwind (10000 ft). "They haven't given us a RWY yet" and F/O said "No they haven't, let me ask". F/O asked for 34R which approach said they could expect. Capt and F/O both said they had the field in sight at abeam point as Capt began slowing to 210 and configuring. Just at this time, approach said to slow to 210. They were handed to tower and told to expect base turn upon visual with 757, they were to follow. Both crew members called traffic and tower gave base turn and soon after cleared for visual. While on base turn Capt overshoot 34R and lined up with 35.***

Error Type: Manual Aircraft Handling

Error Code: Attempting or lining up for incorrect runway

Intentional?: No Threat Linkage?: Yes - ATC command threat #4

Committed by: Captain

Error Management Description: ***After being established on final for a few miles, Capt detected the undesired state and moved over to RWY 35. The FO was never detected the deviation. (Marginal Monitor / Cross-check).***

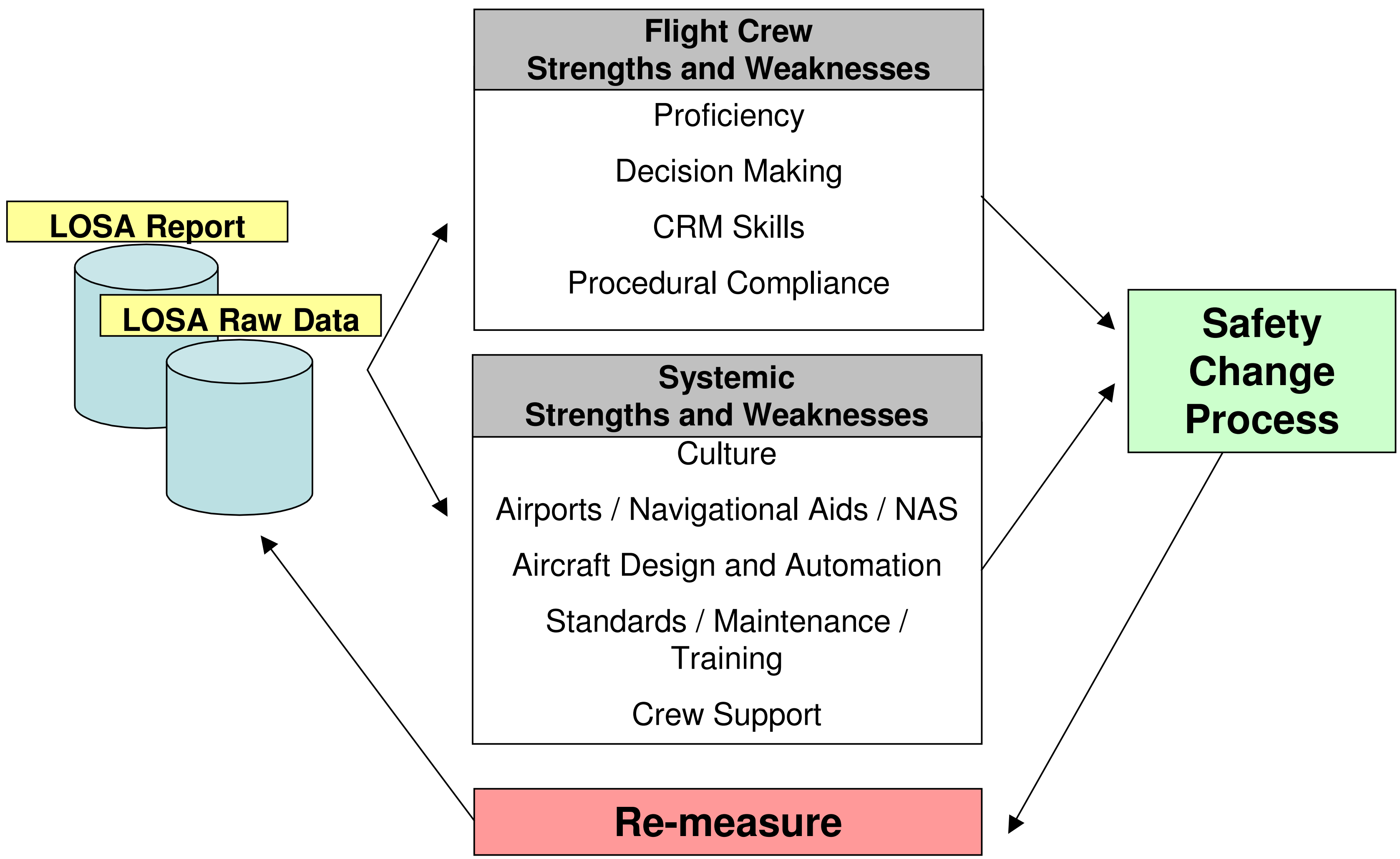
Crew Response: Detected and Action

Error Outcome: Undesired aircraft state - Lateral deviation

Detected by: All Crew Members

Undesired Aircraft State Outcome: Inconsequential

LOSA Cycle


LOSA Report
LOSA Raw Data
Flight Crew
Strengths and Weaknesses
Proficiency
Decision Making
CRM Skills
Procedural Compliance
Systemic
Strengths and Weaknesses
Culture
Airports / Navigational Aids / NAS
Aircraft Design and Automation
Standards / Maintenance / Training
Crew Support
Safety Change Process
Re-measure

LOSA Success Story Revisited

- Major airline (average 2600 departure a day)
- Two LOSA's (3 years apart)
- 1st LOSA – An example of targets identified:
  - Undesired number of "below standard" leadership ratings
  - Problems associated with checklist protocol / usage
  - High number of unstable approaches
  - Low rate of error trapping (errors detected and managed)

LOSA Success Story Revisited

- Airline response to data:
  - Formed committees to address targets for enhancement
  - Implemented a leadership training module in recurrent
  - Revised checklist philosophy
  - Established bottom lines for unstable approaches
  - Implemented error management training course for all pilots
  - Check airmen were trained in evaluating error management

LOSA Success Story Revisited

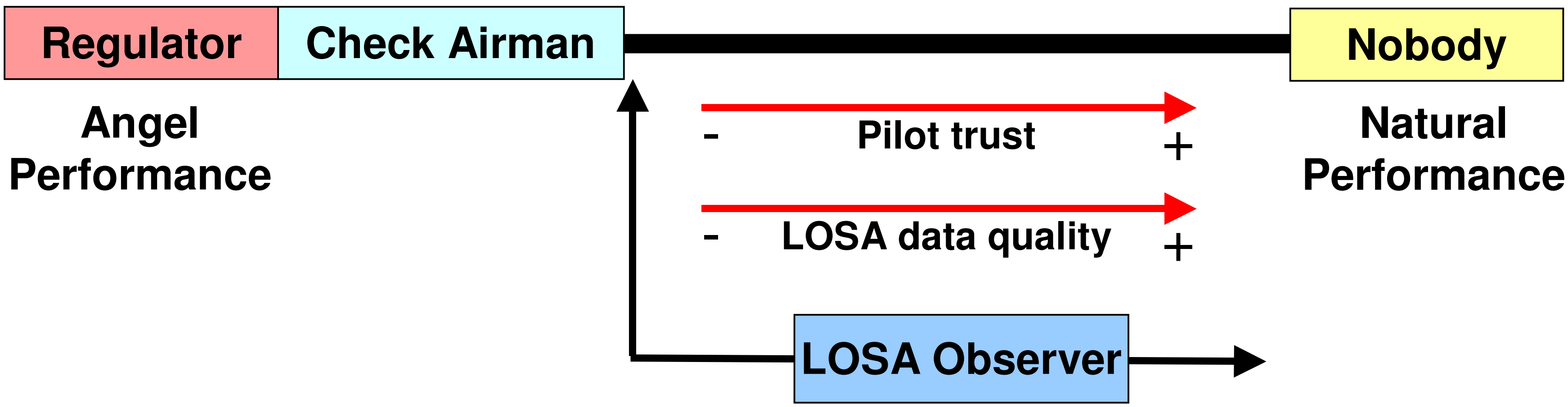
- 2nd LOSA results
  - Captain leadership scores significantly improved
  - 40% reduction in checklist errors
  - 77% reduction in unstable approaches below 1000 ft.
    - FOQA showed similar trends
  - Two fold increase in error trapping rates
  - Change in the check culture to evaluate error management
  - Increase management "buy-in" on the safety change process

- 3rd LOSA results – Are organizational changes made between the first two LOSA projects still effective?

LOSA Operating Characteristics

Secret of LOSA Success

LOSA success depends upon gaining pilot trust



Pilot trust in LOSA reduces observer reactivity, enhances the potential to capture natural performance, which is the primary objective of LOSA

Observer Reactivity

- Definition – Degree of influence that the presence of an observer has on observee performance (Rosenberg, 1963)

- Typical observers in the cockpit – line checkers
  - Jeopardy observations – discipline possible
  - Tendency to “fake good” for the checker

- Observer reactivity concerns and project execution issues stimulated the drafting of LOSA Operating Characteristics

LOSA Operating Characteristics

LOSA is defined by 10 operating characteristics

1. Jumpseat observations during normal operations
2. Anonymous, confidential, and non-punitive data collection
3. Voluntary crew participation
4. Trusted and trained observers
5. Joint management / union sponsorship
6. Systematic observation instrument
7. Secure data collection repository
8. Data verification roundtables
9. Data-derived targets for enhancement
10. Feedback of results to line pilots

LOSA Operating Characteristics

1. Jumpseat observations during normal operations
   - Regularly scheduled flights only
   - No line checks or training flights

2. Anonymous, confidential, and non-punitive data collection
   - No names, flight numbers, or other identifying information
   - Data only used for safety purposes – no disciplinary action
   - Observer identity kept anonymous

3. Voluntary crew participation
   - Flight crews have the right to decline a LOSA observation
   - Typical denial rate is very low – 1 per 100 flights

LOSA Operating Characteristics

4. Trusted and trained observers
   - <u>Trust</u>
     - Pilot observers - enhance adaptation and reduce observee reactivity
     - Selection process – management / union list of candidates
     - External observers offer a good quality control
     - Cap 15 observations per observer to reduce observer fatigue
   - <u>Training</u>
     - Five days – ground school (2), test observations (2) & recalibration (1)
     - Curriculum
       - LOSA protocol
       - Narrative training
       - TEM recognition, recording and coding
       - Performance markers

LOSA Operating Characteristics

5. Joint management / union sponsorship
   - Steering committee – Flight Ops, Training, Safety and Union
   - Symbolized with a signed agreement and sent to all pilots
   - Also responsible for LOSA publicity

6. Systematic observation instrument
   - TEM reduces observer bias - only record what is observed – no judgment of causes
   - Observers must be pilots or subject matter experts

7. Secure data collection repository
   - Third party or pilot association gate keeper
   - Pilots must believe that observations will not be “misplaced”

LOSA Operating Characteristics

8. Data verification roundtables
   - TEM data can be checked for coding accuracy and verified as consistent with SOP
   - Upon the completion of the roundtables, data analysis begins

9. Data-derived targets for enhancement
   - Serve as benchmarks and allows the measurement of organizational change – LOSA success story revisited

10. Feedback of results to line pilots
    - Results and information on how airline management intends to respond with organizational change

LOSA Defined

- To ensure standardization, LOSA must have all ten operating characteristics
- If less than ten, needs another acronym
- Endorsed by:
  - ICAO
  - FAA (pending advisory circular)
  - LOSA Advisory Board
  - UT / TLC
  - IFALPA
  - US ALPA

This document is an extract of ALPA Policy from the Administrative Manual, as found on the alpa.org web site on 3/2/2004.

ALPA ADMINISTRATIVE MANUAL

SECTION 80 – ENGINEERING & AIR SAFETY

PART 5 – HUMAN FACTORS AND TRAINING GROUP (HFT)

L. LINE OPERATIONS SAFETY AUDIT (LOSA)
SOURCE – Executive Board October 2003

Prior to any ALPA support for LOSA at an airline, that airline will, as a minimum, agree to:

1. Voluntary crew participation, wherein any Captain may refuse any observer access to the flight deck without cause.
2. Observations will only be conducted during normal revenue flight operations.
3. Joint management/pilot union sponsorship, committing both to active, willing participation for the benefit of a safer operation. This includes understanding and overcoming any cockpit rider security concerns in advance, educating the pilot group on the process and benefits of the LOSA program, and committing to make changes as may be indicated in the final report.
4. Non-identifiable, confidential and non-punitive data collection to facilitate the long-term gain without jeopardy.
5. Use of a targeted observation instrument.
6. Use of observers who are trained and calibrated to preclude false negative and incorrect judgment errors in the conduct of the observation.
7. Storage of the observations in a neutral, trusted data collection site.
8. Data-cleaning "roundtables" consisting of management and pilot union members to ensure the quality of the observations before they become data points.
9. Targets for flight operations enhancements shall be data-derived; the final product report shall be used to create an airline Action Plan to reach the target(s).
10. The end results are fed back to line pilots so that pilots will understand the findings and how the airline plans to improve the system.

LOSA Mailbag

Frequently Asked Questions

- What does LOSA cost?
  - Depends on a number of factors
    - Number of observations to be collected
    - Number of external observers
    - Depth of data analysis
    - Special requests – partner airlines / subsidiaries
  - Typical cost for an airline – LOSA Collaborative fee plus 2 to 3 times this fee for administration and in-house observers
  - Other efforts under way to lower costs
    - Observations only – no data analysis
    - Operating crew as observers / self report
    - Projects might have value but they are not a LOSA

Frequently Asked Questions

- Can LOSA be used for continuous monitoring instead of a sample snapshot?
  - Recommended as a sample-based, snapshot approach
  - Snapshot approach is more manageable
    - Start and end for data collection project marks a point in time to derive targets for enhancement and get to the real work of making changes
  - Complements other continuous programs such as FOQA and ASAP

Frequently Asked Questions

- How long does LOSA last and how many observations?
  - Project Length
    - Typically eight months from planning to a final report
    - Airline – 75% of time spent on planning
    - LOSA Collaborative - 30% of time spent on planning, observer training, data collection and 70% spent on data verification, analysis and final report
  - Project Size
    - Weighted sample to match daily departure rates per fleet
    - Minimum number of observations per fleet – 40 observations
    - Cap observers to no more than 15 observations to prevent observer fatigue

Frequently Asked Questions

- How realistic is LOSA data? Doesn’t the presence of an observer affect data quality?
  - Yes but with observer reactivity, LOSA results are “underestimates” of what actually occurs in normal operations
  - Consider the following…..
    - Intentional noncompliance – procedural deviations
    - Mismanaged threats, errors, and undesired aircraft states
    - Pilots talking on the cell phone during taxi-out
    - Pilots offering cigarettes to the LOSA observer in the cockpit

Frequently Asked Questions

- What is the difference between a threat, error, and undesired aircraft state in LOSA methodology?
  - Threats – External events or errors that flight crew have to manage to maintain adequate safety margins
  - Errors – Any pilot caused aircraft handling, procedural or communication deviation
  - Undesired aircraft states – Any mismanaged threat or pilot-error induced aircraft state that clearly compromises safety
  - Summary – Pilot cannot commit or become threats, they can only cause errors and undesired aircraft states

Frequently Asked Questions

- What are the biggest obstacles to long term LOSA success?
  - Senior management not briefed and/or prepared for the possibility of undesirable results
  - Line pilots not briefed well enough on the intent of LOSA
  - Results not fed back to pilots – affects second LOSA
  - Unmotivated observers
  - No defined safety change process upon receiving LOSA results

Frequently Asked Questions

- Where can I find more information about LOSA?
  - ICAO LOSA Handbook – Document 9803
  - ICAO Journal Special Edition LOSA – Vol. 57, #4, 2002
  - University of Texas Human Factors website
    - FAA LOSA Advisory Circular – Draft
    - www.psy.utexas.edu/HumanFactors and go to LOSA section

Q&A Session

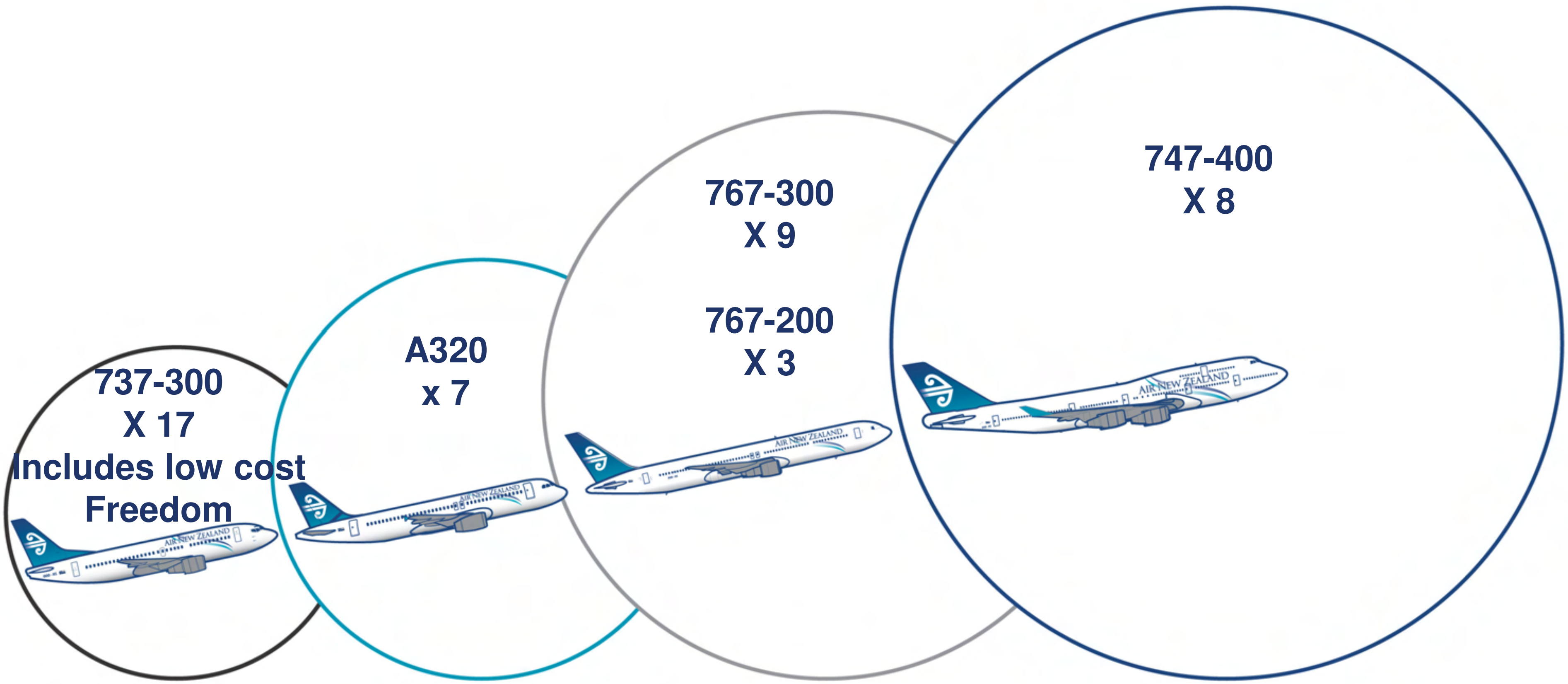
“Safety Change Process - Closing the Loop”

Captain Chris Kriechbaum
Manager Procedure & Capability Development
Air New Zealand

AIR NEW ZEALAND

BACKGROUND

AIR NEW ZEALAND



Regional Fleet 44

(11 ATR 72, 17 SAAB 340A, 16 Beech 1900D)

BACKGROUND

AIR NEW ZEALAND

- 25 domestic destinations
- 22 direct international destinations
- A small airline by world standards
- No FOQA programme
- Long involvement with UT

	PAX	ASKs	RPKs	Pax Rev
FY03	9.6m	30,514m	22,691m	2,791m

AirNZ's LOSA PROGRAMME

AIR NEW ZEALAND

> 1998 - 91 sectors

> 2001 – Joint audit with Ansett Australia, aborted

> 2003 – 200 sectors

  – All fleets, except A320

  – Steering Committee 65% through the data

> 2004 – First Regional LOSA @ Mt Cook – ATR 72 operator

BUSINESS RATIONALE FOR L.O.S.A.

AIR NEW ZEALAND

> Pro-active approach to safety.
> Attempt to measure the risk profile.
> Require facts not opinions - data driven approach.
> Verification of training.
> Ability to compare internationally.
> Ability to measure threats and errors.
> Provide further guidance on future improvements.

1998 LOSA DATA

AIR NEW ZEALAND

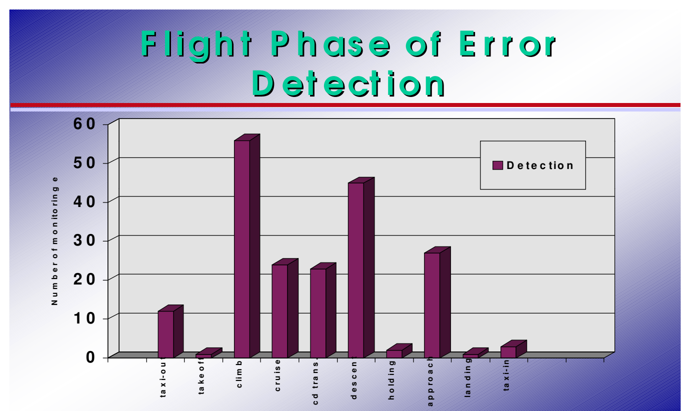
- 52% of flights had at least one error
- 78 separate errors recorded on a total of 91 flights
- Between Zero and 5 errors per flight
- Average of 0.86 errors on every flight
- **Consequential error rate high**

These errors included:

- Failure to cross-verify MCP/FMC/CDU settings
- Omitted or incomplete F/A briefings
- Incorrect settings / frequencies selected
- Incomplete cockpit briefings
- Checklist omitted, incomplete, or done from memory
- Failure to set altitude alerter
- Missed ATC calls or incorrect read back

1stLOSA RESULTS

- CRM behavioural markers generally positive
- Consequential error rate, the incentive for change
- Automation issues were a dominant theme
- Recommendations for procedure changes
- Culture/Trust issues



LOSA 1998 –CHANGES

AIR NEW ZEALAND

- Change in the Pilot/Management culture
  - "Just Culture" Introduction
- Skill improvement in error management
  - TEM Training
- Leadership training for Captains
  - Enhanced Command Course
- Improve F/A briefings
  - Combined EP training
- Terrain & Altitude awareness training
  - Improved Situational Awareness Modules
- Verification of FMC/MCP settings
  - SOP Changes.

AIR NEW ZEALAND

THE BUSINESS CASE

> Financial scrutiny was intense.
> Long term approach was adopted, especially in terms of potential financial benefits.
> Change in ANZ Operations management
>> Politics due to external pressures, was higher
>> Bigger promises made
>> Final sign-off was only 10 days before start
> A seperate LOSA Project Manager appointed.

THE 2003 EXPERIENCE –contd

AIR NEW ZEALAND

- Different observer mix
  - Mix of internal and external observers
  - External/Internal ratio smaller than previous audit
  - Pilot and non pilots
- Including NZCAA representative in process
- Methodology in 98 was significantly different than 03.
- Comparisons 98 to 03, were difficult to make.
- Significantly more information to work with.
- Higher costs

2nd LOSA RESULTS

AIR NEW ZEALAND

- Threat profile similar to comparison airlines
- Slightly higher in Airport Conditions – AKL ANZ's home base an issue.
- Cabin Threats relatively high.
- Overall good threat managers when compared with LOSA archive.
- Error rate very high, dominated by procedural error.
- The flip side was error mismanagement very low.
- Automation mismanagement still prevalent.
- Monitoring also a major feature.
- Command Leadership still featured.

LOSA 2003 – TARGETS FOR CHANGE

AIR NEW ZEALAND

- Enhance Command Leadership
- Adjust checklists & checklist usage
- Modify approach callouts & procedures
- Minimise distractions to crew
- Encourage airport companies to improve signs and ground markings
- Improve monitoring
- Work with ATC to minimise challenging clearances.

LOSA 2003 – CHANGES MADE TO DATE

AIR NEW ZEALAND

- Skill improvement in threat & error management techniques.

  - Route Guide changes – introduction of term “threats”

  - Standardising checklists over the fleets as much as possible

- Enhanced Leadership training for Captains

  - Structured and progressive leadership training starting earlier in career

  - Regular 360 degree feedback

  - Post flight debrief

- Procedure Changes

  - Stabilised approach criteria

  - Approach call-outs

- Developing a co-ordinated monitoring improvement programme.

- Improvements to ground markings and Jepp charts confirmed at AKL airport

LOSA BENEFITS

Air New Zealand

- Establishes a baseline for future comparisons.
- Data driven solutions - good decisions come from good information.
- Removes the scatter gun effect of training (Command Training, Combined CC/pilot, TEM etc)
- Elevates CRM and TEM profiles with-in Air NZ.
- Credibility in Aviation Community.
- Value for money.
- Justification of Capital and other Expenditure.

THE FUTURE

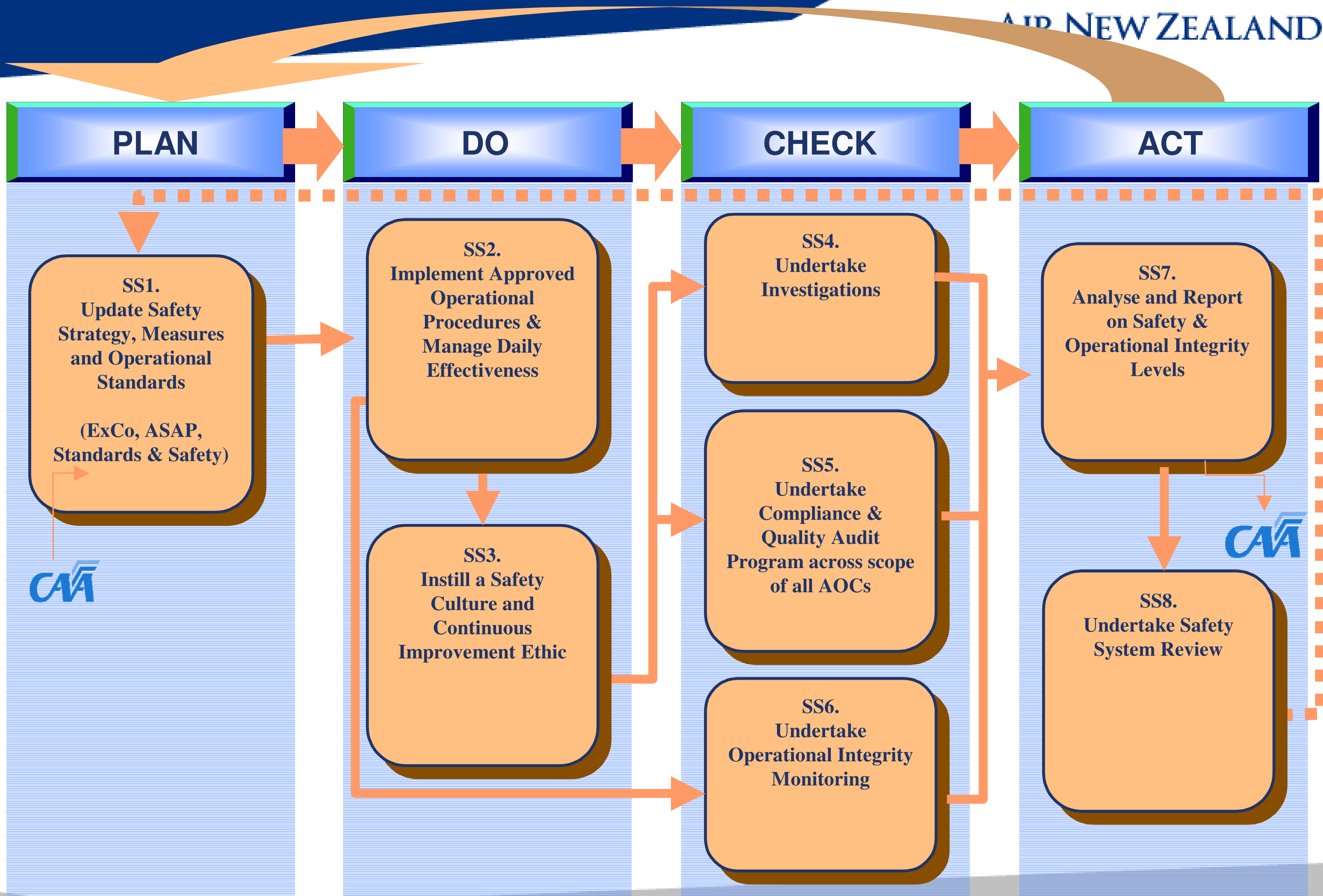
AIR NEW ZEALAND

THE FUTURE

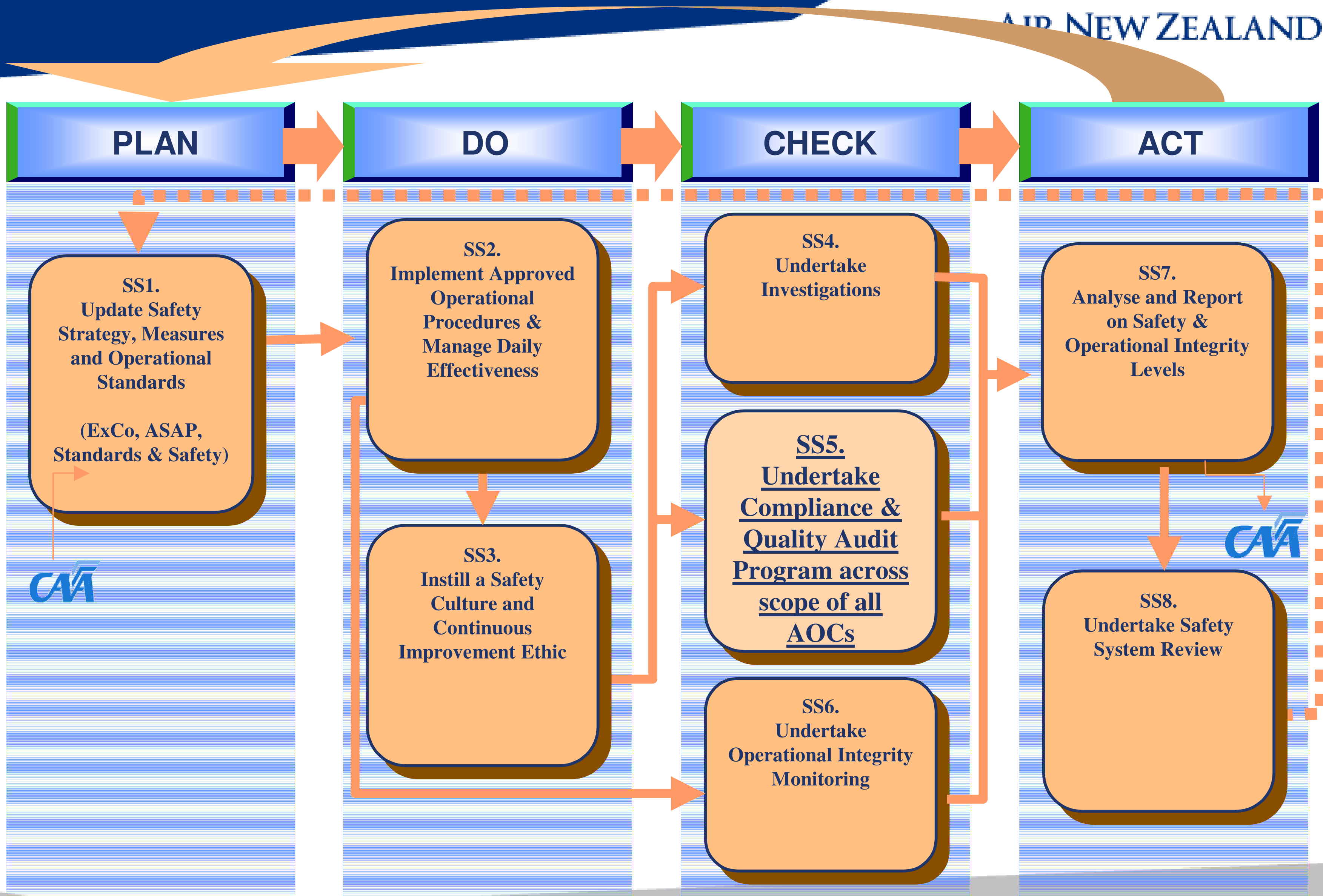
AIR NEW ZEALAND

- Full acceptance of the Threat and Error model
- Integration of LOSA process into Safety Management System
- Conduct mini LOSA's (specific fleets / routes)
- Alternate major LOSA's
- Full involvement of the National Regulator – NZCAA
- Reduction in Audit costs
- Reduction in Route Checks
- National LOSA Proposal by NZCAA

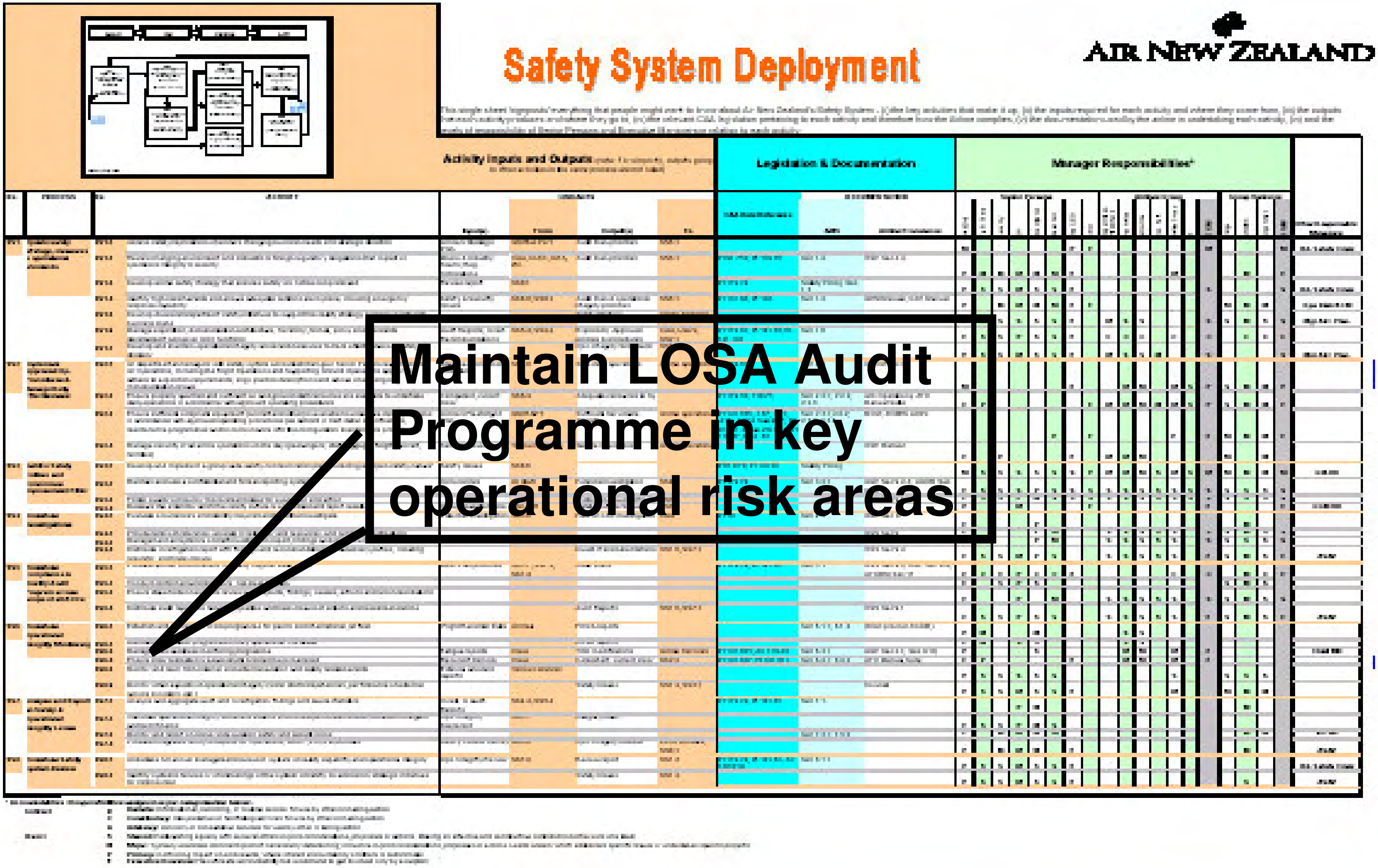
System of Safety & Operational Integrity



System of Safety & Operational Integrity

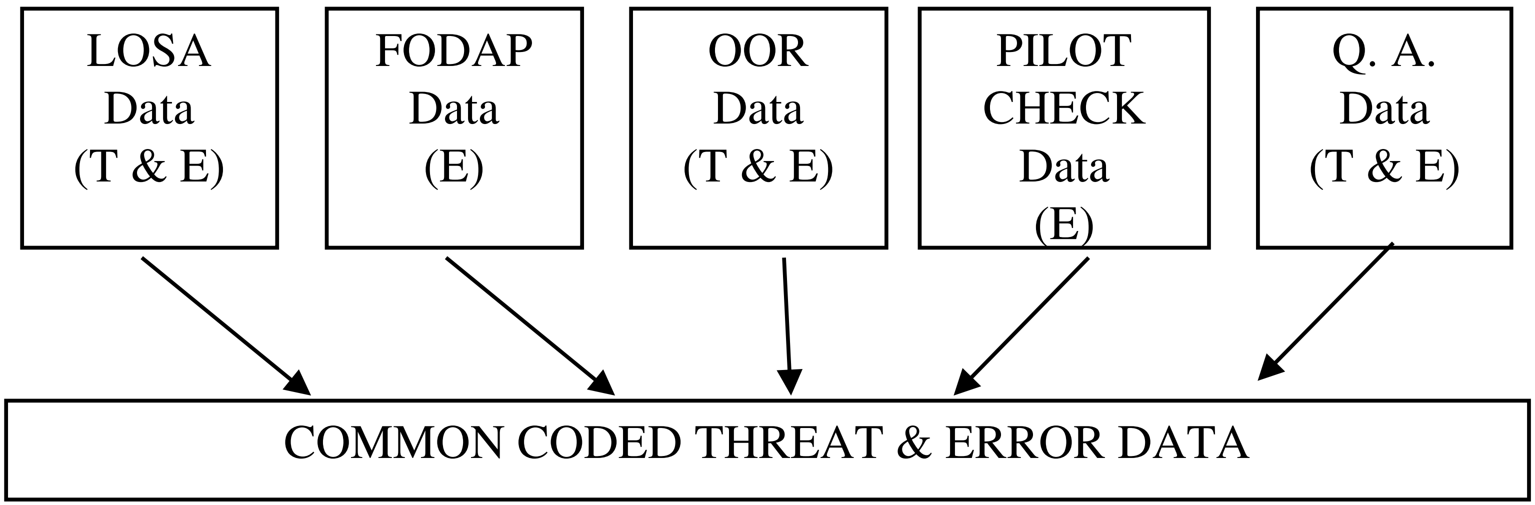


SAFETY SYSTEM DEPLOYMENT

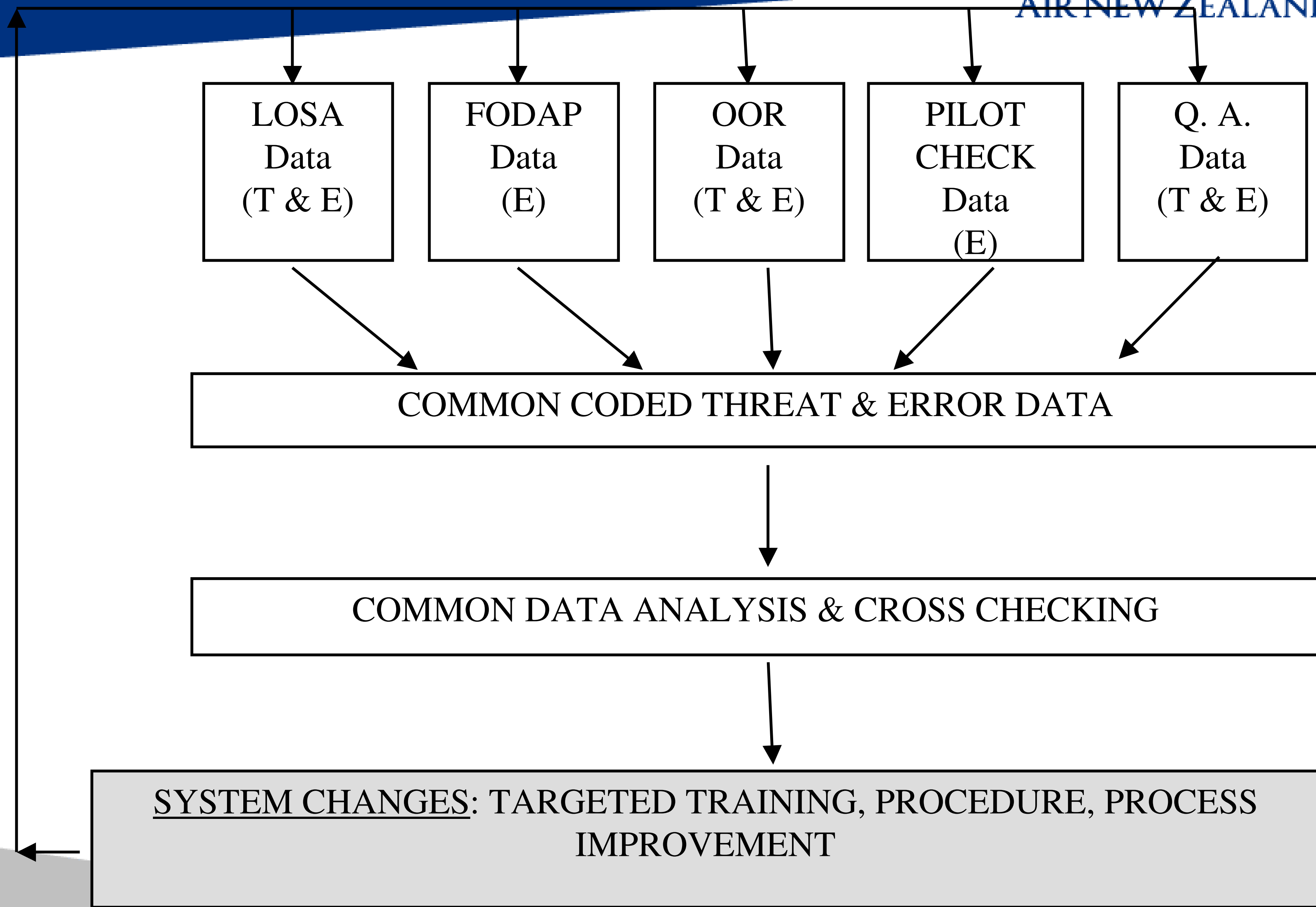


Maintain LOSA Audit Programme in key operational risk areas

THE INTEGRATION CHALLENGE:



THE INTEGRATION CHALLENGE:



INTEGRATED DATA BENEFITS

AIR NEW ZEALAND

- Loads of threat and error data - a benefit??
- Proactive rather than a reactive system
- Data driven solutions
- Targeted solutions
- Improved processes/procedures
- Reduction in:
  - Individual pilot checks
  - Quality audits
  - External audits
- Time and cost to integrate shouldn't be underestimated

NATIONAL LOSA PROPOSAL BY NZCAA

AIR NEW ZEALAND

- National LOSA – Seminar 29 July 2004 Wellington
- NZCAA initiated and run.
- All New Zealand Pt 121 airlines involved.
- Suggestions:
  - airlines pool resources to make it more affordable, in particular the back end analysis.
  - idea of joint funding a tertiary institution to do analysis, NZCAA had funding available for this
  - a satellite TLC run totally independently from any airline and under UT guidance

CONCLUSIONS

AIR NEW ZEALAND

- **LOSA process here to stay in Air N.Z.**
- **Integrated into our SMS**
- **Still work to be done to achieve all the benefits**

- **Questions?**

Contact Details:

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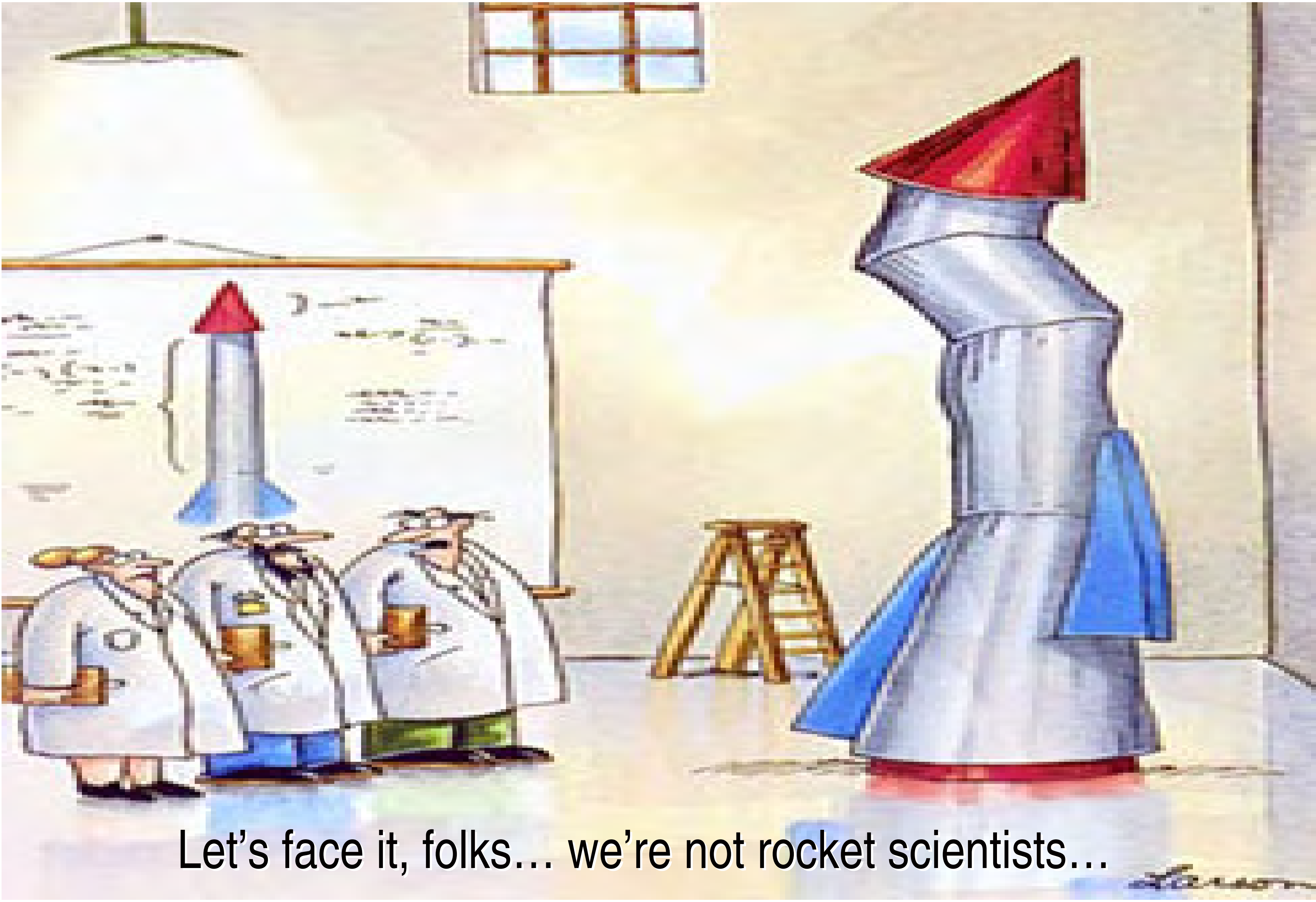
Monitoring Normal Line Operations: The Big Picture

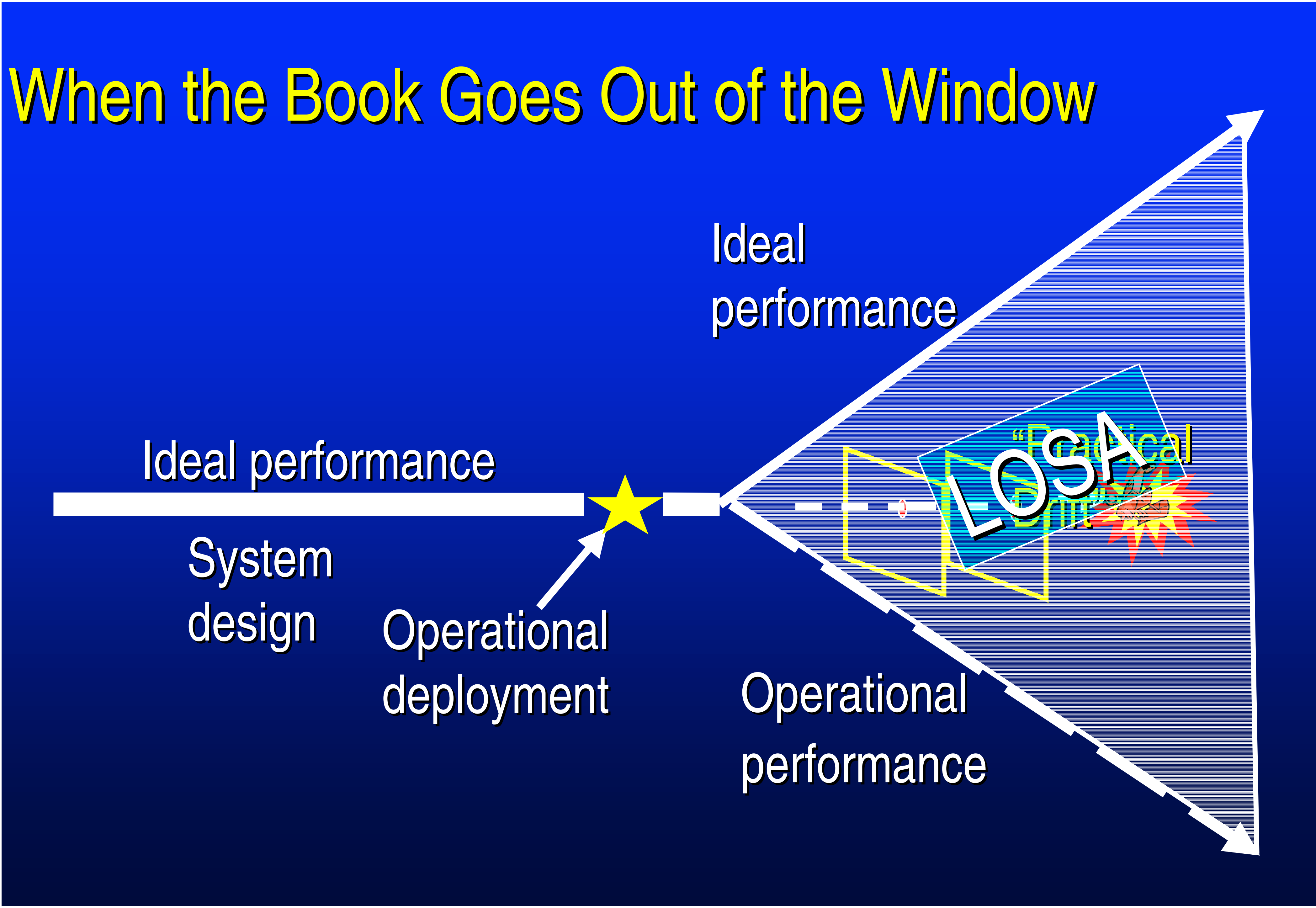
Captain Dan Maurino
Flight Safety and Human Factors – ICAO

Second IATA/ICAO LOSA/TEM Conference
Seattle, Wa.
3 – 4 November 2004



Let’s face it, folks… we’re not rocket scientists…

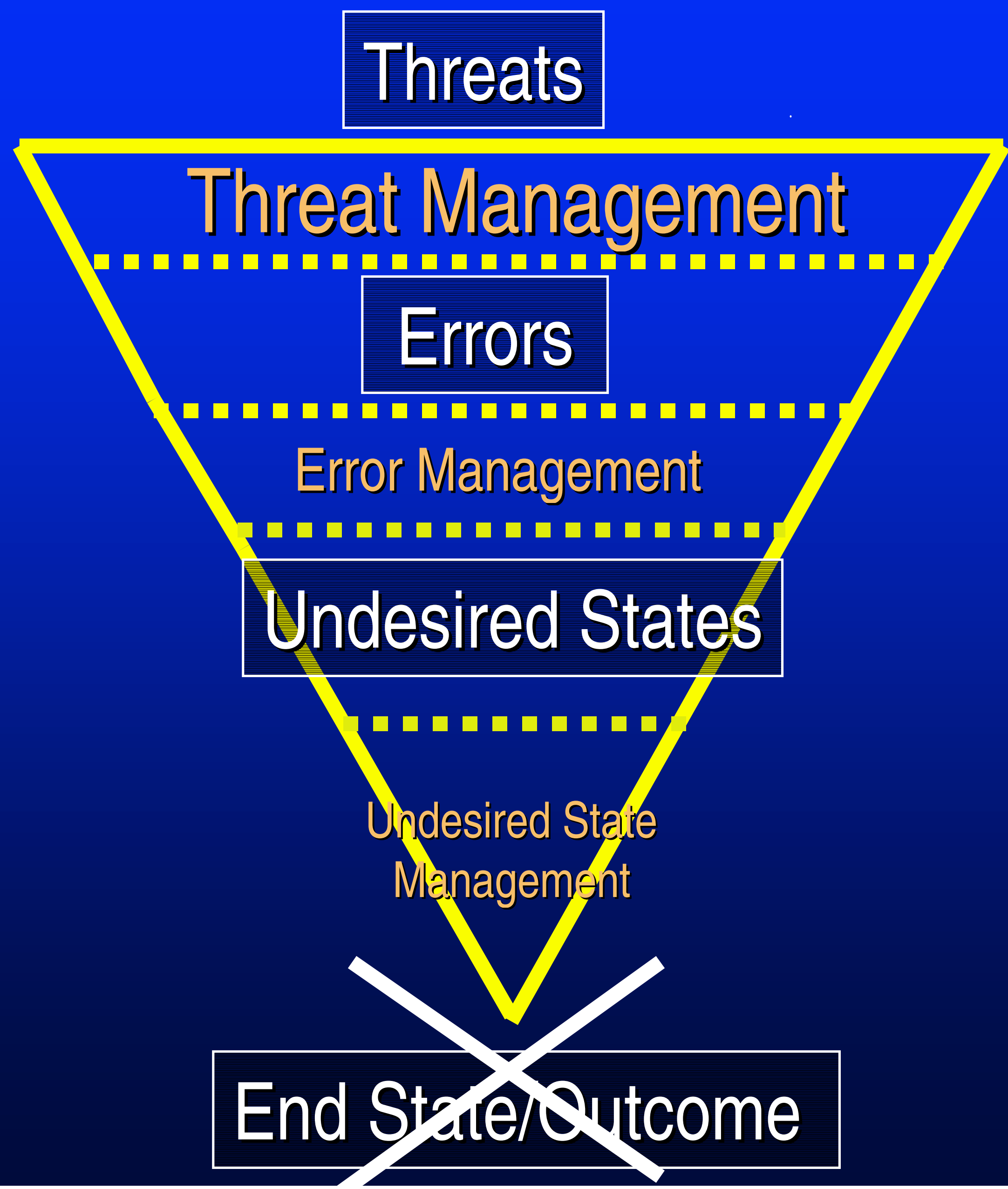
Threat & Error Management (TEM) Model


When the Book Goes Out of the Window
Ideal performance
Ideal performance
System design
Operational deployment
LOSA
“Practical Drift”
Operational performance

Critical Differences

- [Safety] Concept: safety data capture during normal operations, through direct observations, on a regular and systematic basis
  - Normal Operations Monitoring
- Framework: Threats, Errors and Undesired Aircraft States
  - TEM Model
- Tool: A metric to capture non-outcome driven safety data
  - LOSA

TEM Model


Threats
Threat Management
Errors
Error Management
Undesired States
Undesired State
Management
End State/Outcome

Key Safety Management Points & Features

TEM & LOSA

- Threats belong in the present and the future; errors belong in the past
- Undesired states are recoverable; end states are a *fait accompli*
  - TEM provides a framework to capture process data rather than outcome data
  - LOSA is a tool to capture both performance and context

An Expanding Role

- TEM as framework
  - Flight/Cabin Crew Training (Numerous airlines & IATA)
  - Safety management (IATA)
    - Safety Advisory Committee (SAC)
    - Human Factors Working Group (HFWG)
    - Cabin Safety Working Group (CSWG)
  - Research (UT)
  - Auditing normal operations (Numerous airlines & ICAO)
  - Pilot licensing (ICAO)

ICAO – Extending Audits to ATC

Normal Operations Safety Survey (NOSS)

- Guidelines document to monitor normal ATS ops (based on TEM & LOSA)
- Project Team – ICAO Study Group
  - ASA, Airways NZ, DLR, EUROCONTROL, FAA, IFATCA, LVNL, NavCanada, UK CAA
- FAA/UT to develop observation forms and observer training
- Three project NOSS planned during 2005
- ICAO NOSS world-wide conference – November 2005
- Project completed – Q4/2006

ICAO – Flight Crew Training and Licensing Panel

Nine competency units

1. Apply TEM principles throughout
2. Perform aeroplane ground operations
3. Perform take-off
4. Perform climb
5. Perform cruise
6. Perform descent
7. Perform approach
8. Perform landing; and
9. Perform after landing and post-flight

Note.- The application of TEM principles is a specific competency unit but which is to be integrated with each other competency unit for training and testing purposes.

2004 – Industry Milestones

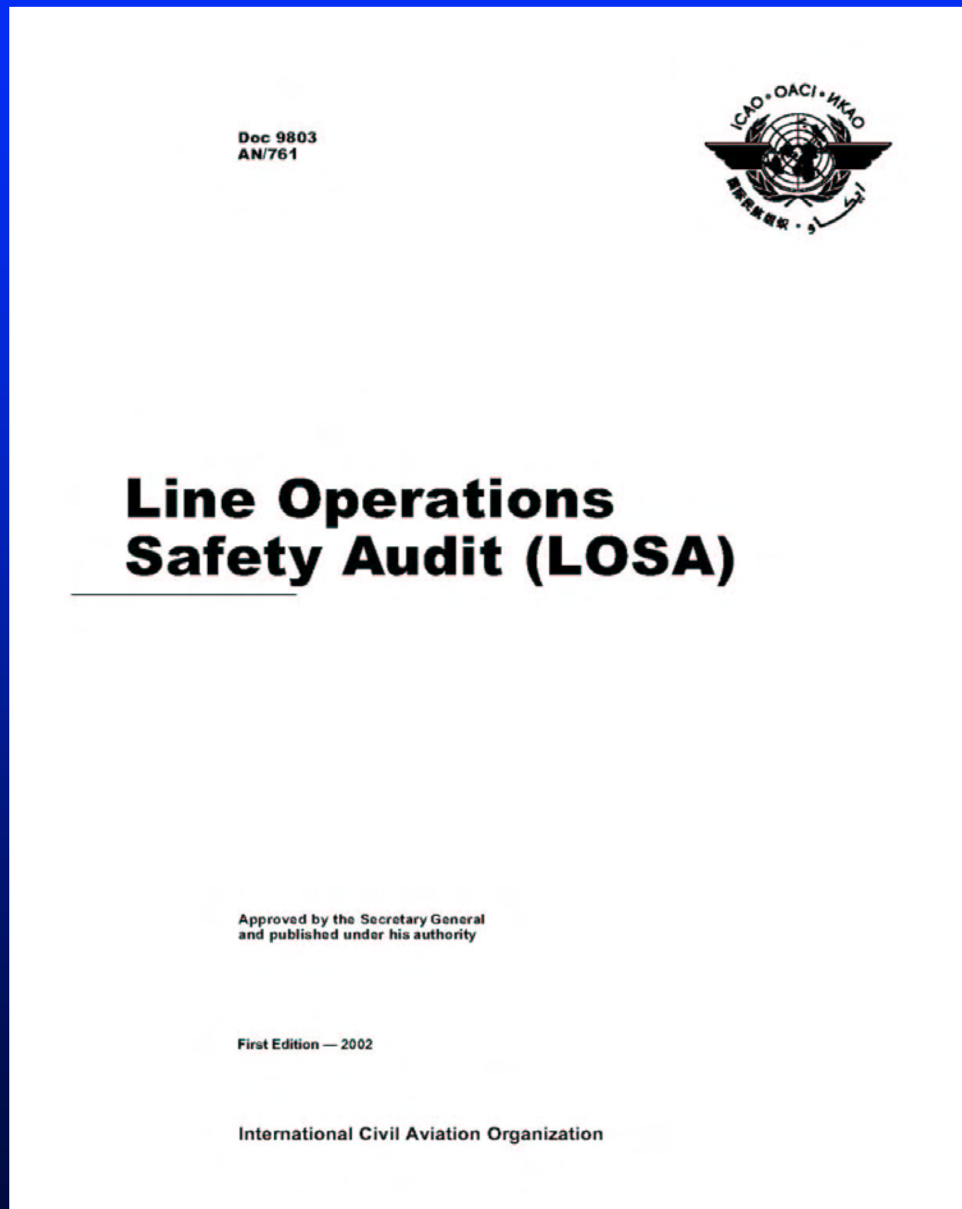
- The LOSA experience in Latin America & Spain
  - Aeromexico, Avianca, COPA, LanChile, TACA, Varig, Air Europa
- The Canadian "awakening"
  - Air Transat, Jazz, WestJet, Transport Canada
- More repeat LOSAs
  - Delta, US Airways
- The first LOSA in a regional airline
  - Mount Cook, New Zealand
- The FAA draft Advisory Circular (AC) on LOSA

The Interfaces within the LOSA Project

Industry stakeholders as of November 2004

- University of Texas at Austin (UT)
- The LOSA Collaborative (TLC)
- ICAO
- IATA
- IFALPA
- User Airlines
- Boeing

ICAO LOSA Manual (Doc 9803)



Doc 9803
AN/761

Line Operations Safety Audit (LOSA)

Approved by the Secretary General
and published under his authority

First Edition — 2002

International Civil Aviation Organization

June 2003 – The LOSA Advisory Board (LAB)

ICAO, IATA & IFALPA
LOSA Education / Watchdog

Boeing
Internal design research and product development

The University of Texas
FAA-funded LOSA research to the industry

LOSA Airlines
LOSA User Group

The LOSA Collaborative
LOSA Implementation

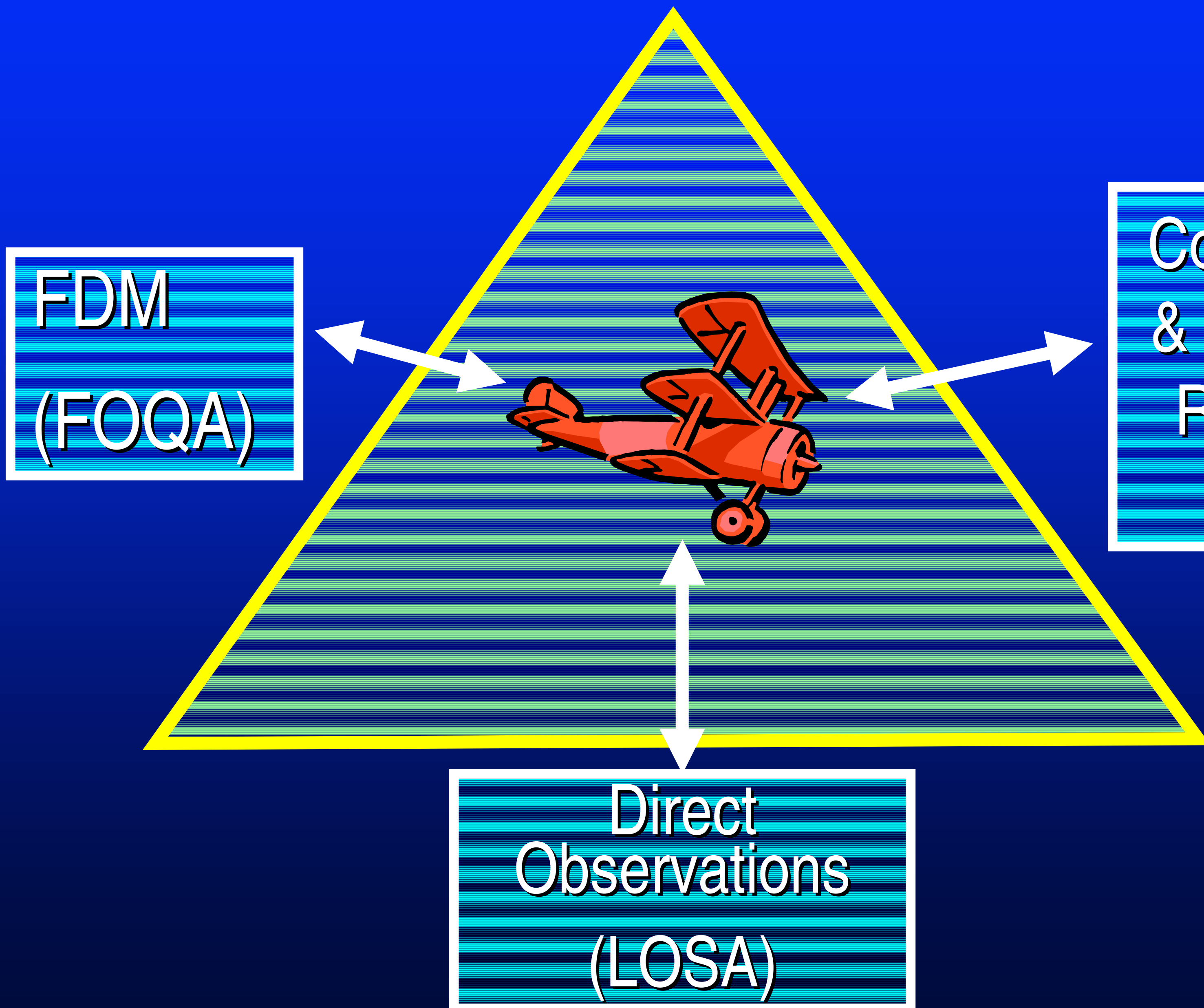
Clearing the Air

LOSA

- Is not the sixth generation CRM
- Is not an evaluation of CRM
- Is not new form of line checks
- Is not regulatory compliance audit
- Is not another opportunity for research
- Is not culturally incompatible
- Is not connected to NOTECHS
- Is not connected to LOAS

- LOSA is a safety manager’s data collection tool that generates SMS data not available through other tools
- Ten Operating Characteristics (Doc 9803)

The Way Ahead – SMS



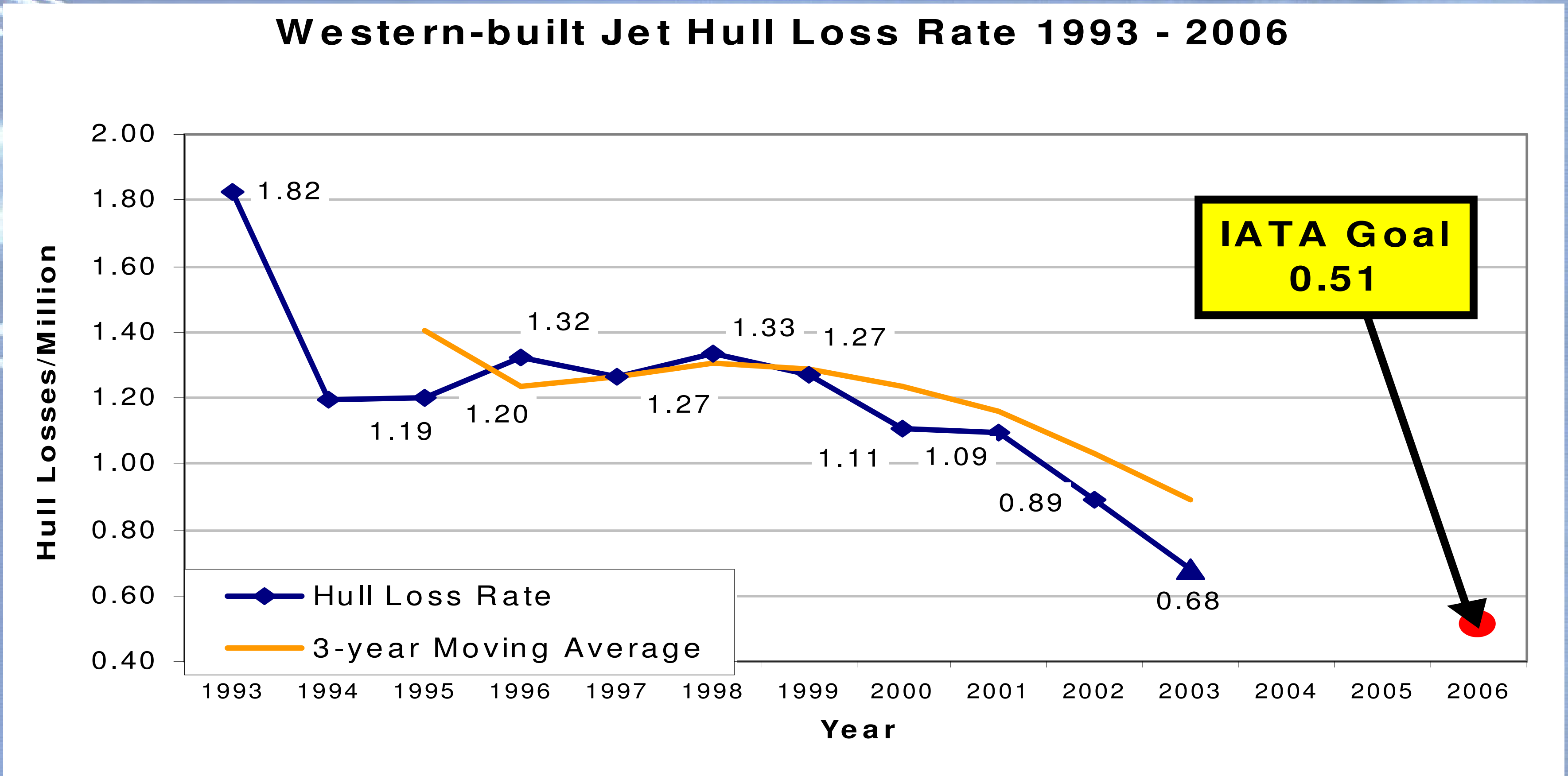
The Application of Threat and Error Management (TEM) Across Aviation Fields

Martin Maurino
Safety Analyst
Safety Department
IATA

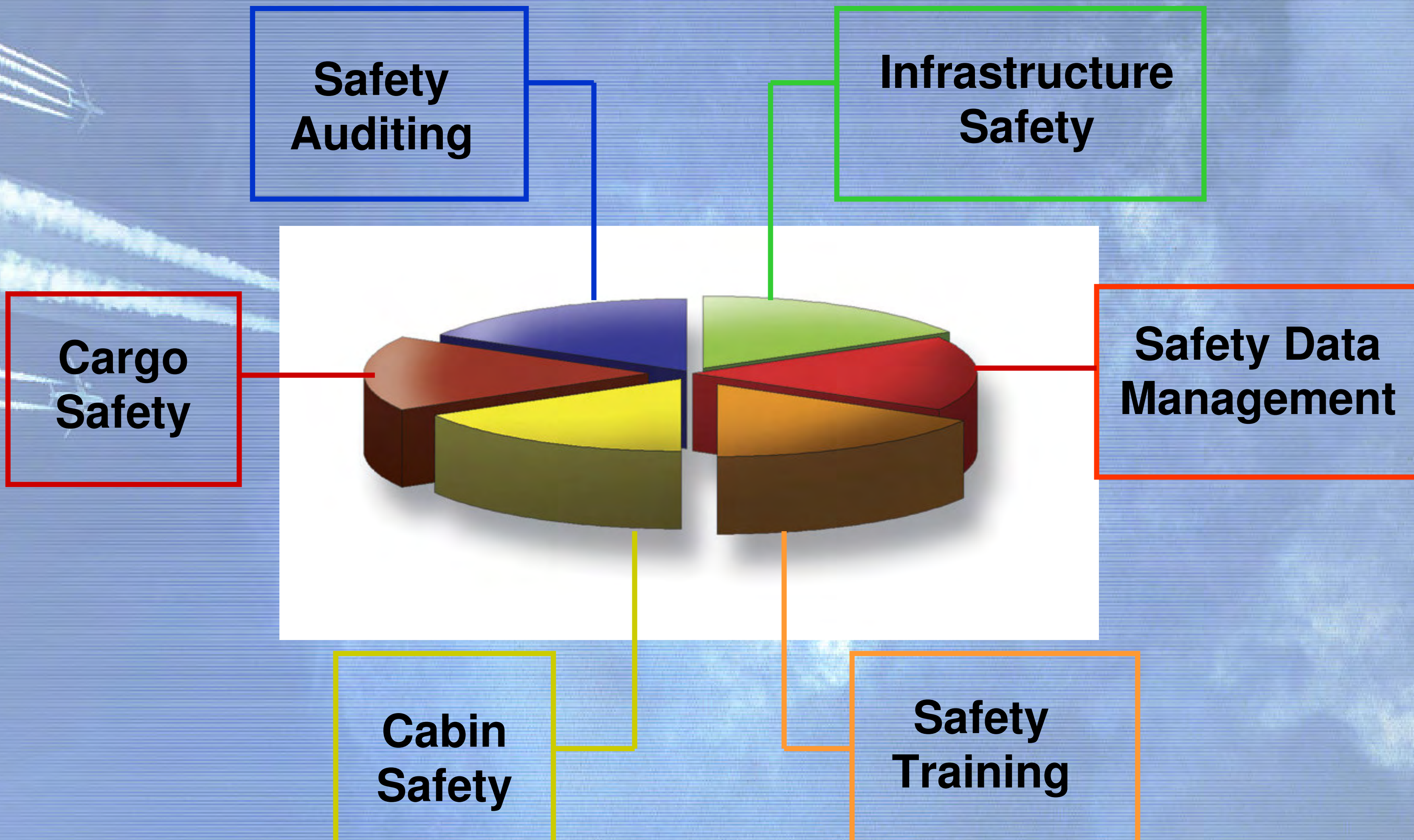
Presentation Outline

- IATA's Safety goal
- TEM in the 6-point Safety Program
- TEM in incident/accident analysis
- TEM in cabin operations
- TEM in data management
- Integrated Threat Analysis (ITA)

IATA's Safety Goal



TEM in IATA's Programme



Incident/Accident Analysis

Threat and Error Management

- Tool for incident/accident analysis.
- Framework to identify operational strengths/weaknesses and provide prevention strategies.

Incident/Accident Analysis

Incident Review Meeting (IRM)

- Confidential forum to share safety-critical information and determine possible prevention strategies.
- TEM used as analytical tool for presenters.

IATA

Narrative

XYZ Airways Flight 123 (ABC to DEF) took off from ABC at 19:00 in fair weather. Approximately 10 minutes after takeoff, the No.2 engine failed, and the crew decided to return to ABC. The aircraft also experienced minor problems with the compass and pressurization. The crew were distracted by these problems, which resulted in the aircraft being low on the instrument approach and off-course on the ILS. The crew decided to perform a go-around. The aircraft was below V_{ref} and at a low altitude. One minute later, the aircraft crashed killing all but one of the 36 passengers and crew onboard. The accident happened in darkness.

Threat Management

1. Engine failure during climb
2. Problems with compass/ pressurization
3. Night engine out approach
4. Engine out go-around

1. Engine shutdown according to SOP
2. Working pressurization problem during engine out approach
3. Low altitude outbound on procedure/Off course at minimums
4. Pitched up to stick-shaker/ Speed well below Vref

Crew Action Management

1. Control of pressurization
2. Low on instrument approach
3. Off course ILS
4. Pitch control of engine out go-around

1. Let distraction carry over to instrument approach
2. FO questioned application of SOP's/ FO callouts
3. At minimums ½ mile off course
4. Initial pull-up put airplane in slow speed/low altitude/ engine out position

Undesired State Management

- Low altitude
- Excessive Pitch
- Slow Speed

Prevention Strategies

1. Training should include the management of distractions during engine failure situations
2. Engine out training at night during low visibility

Incident/Accident Analysis

Benefits of TEM in IRM

- Data standardization tool to develop prevention strategies based on analytical findings.

TEM in Cabin Operations

Cabin threats: external to cabin crew

Operational
- Time pressures
- Flight Diversion

Flight deck events
- Flight crew errors
- Pilot incapacitation

Crew support events
- Errors by MX, GS, etc.
- Faulty equip. boarded

Aircraft
- Design issues
- Equipment malfunction

Passenger
- Intoxicated passengers
- Smoking in the lavatory

TEM in Cabin Operations

Cabin crew errors: cabin crew-centred

- Procedural: Forgetting to check one piece of equipment on checklist.
- Communication: Informing the Capt of a lavatory fire when it's smoke
- Proficiency: Not knowing how to shut off galley power
- Operational decision: Continuing service during turbulence
- Intentional non-compliance: Disregarding sterile cockpit rule

TEM in Cabin Operations

Undesired states: cabin crew places A/C in unnecessary risk.

Configuration:
- Slides in wrong mode
- Safety equipment missing

Critical phases/turbulence
- PEDs in use
- Items not secured

Ground States:
- Doors/isles obstructed
- Exits unmanned during refuelling

Cabin/Passenger management
- Passengers not seated
- Passengers not briefed

Others

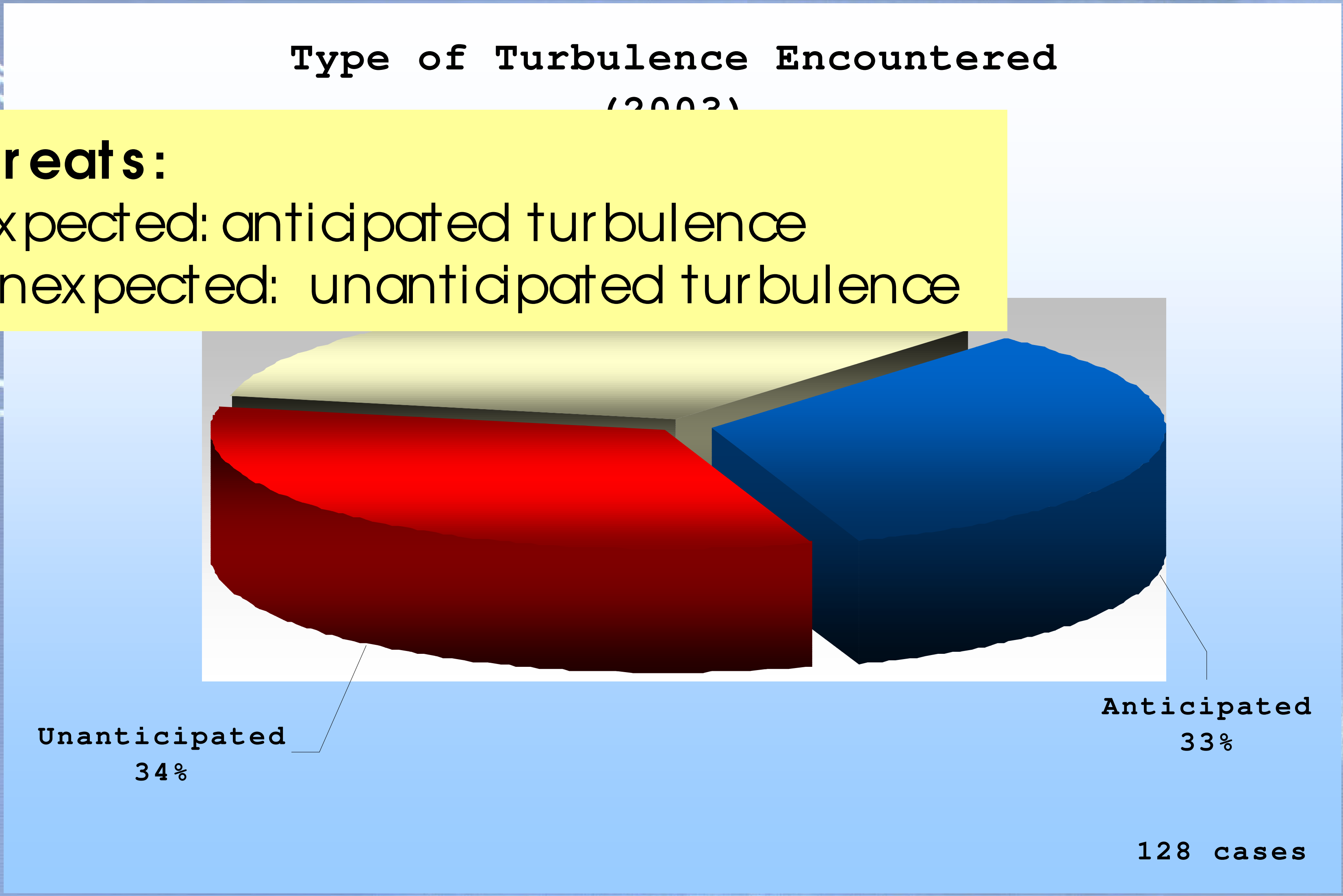
TEM in Data Management

STEADES

- Global database containing ASRs and CSRs.
- Over 300,000 de-identified records.
- Data analysed using TEM model.
- Case studies: turbulence-related cabin crew injuries and ground damage.

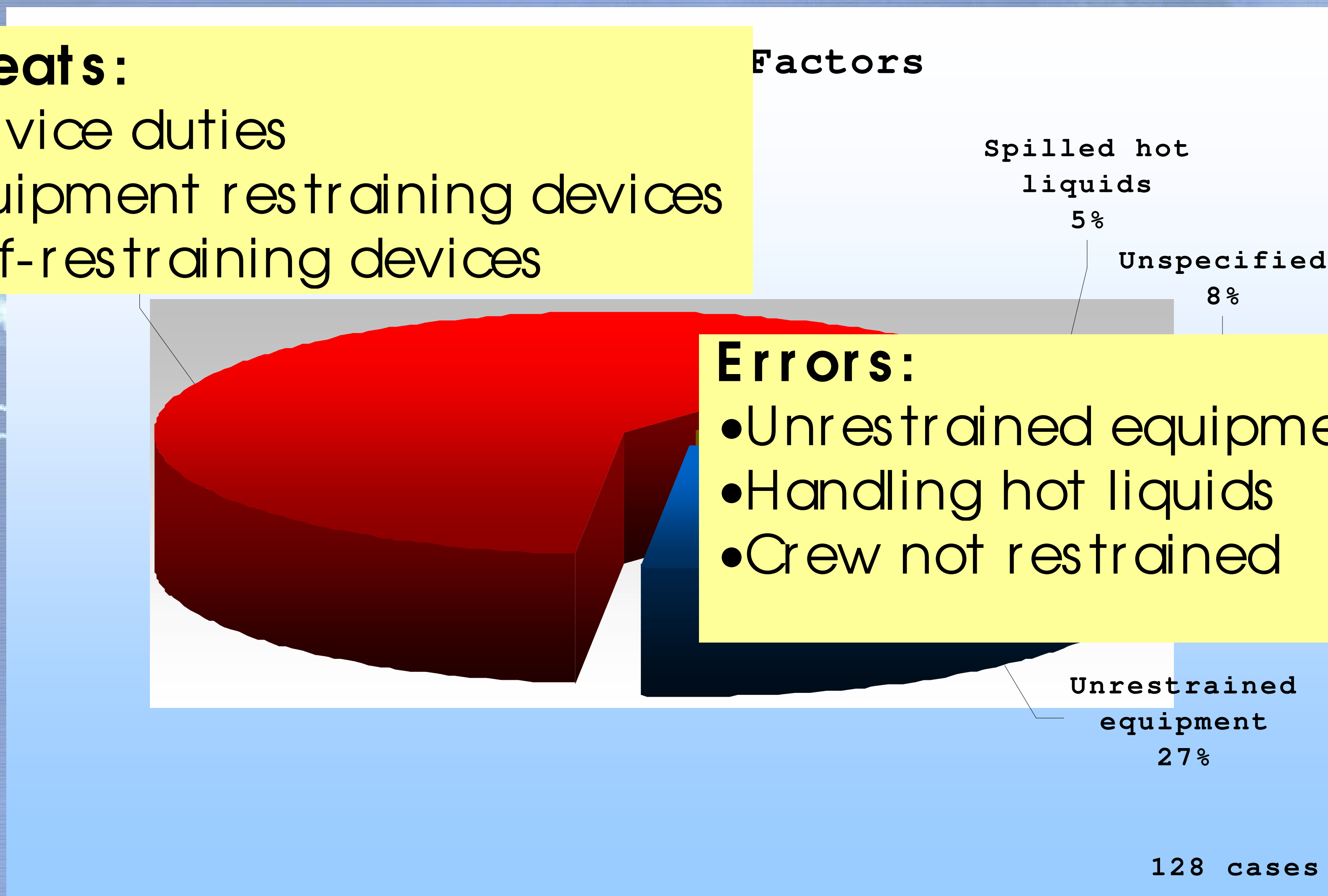
TEM in Data Management

Threats:
- Expected: anticipated turbulence
- Unexpected: unanticipated turbulence



TEM in Data Management

Threats:
- Service duties
- Equipment restraining devices
- Self-restraining devices



Errors:
- Unrestrained equipment
- Handling hot liquids
- Crew not restrained

TEM in Data Management

Threats (service duties):
- FC/CC Communication
- Organisational pressure
- Location on A/C
- Lack of time

Errors (service duties):
- CC/CC Communication
- Decision to continue service
- Leaving unrestrained objects

Threats (safety duties):
- Galley/cabin design
- Location on A/C
- Minimum crew
- Passenger behaviour

Errors (safety duties):
- Equipment handling
- Galley management
- Going back to cabin

the Time of Injury
3)

related
22%

TEM in Data Management

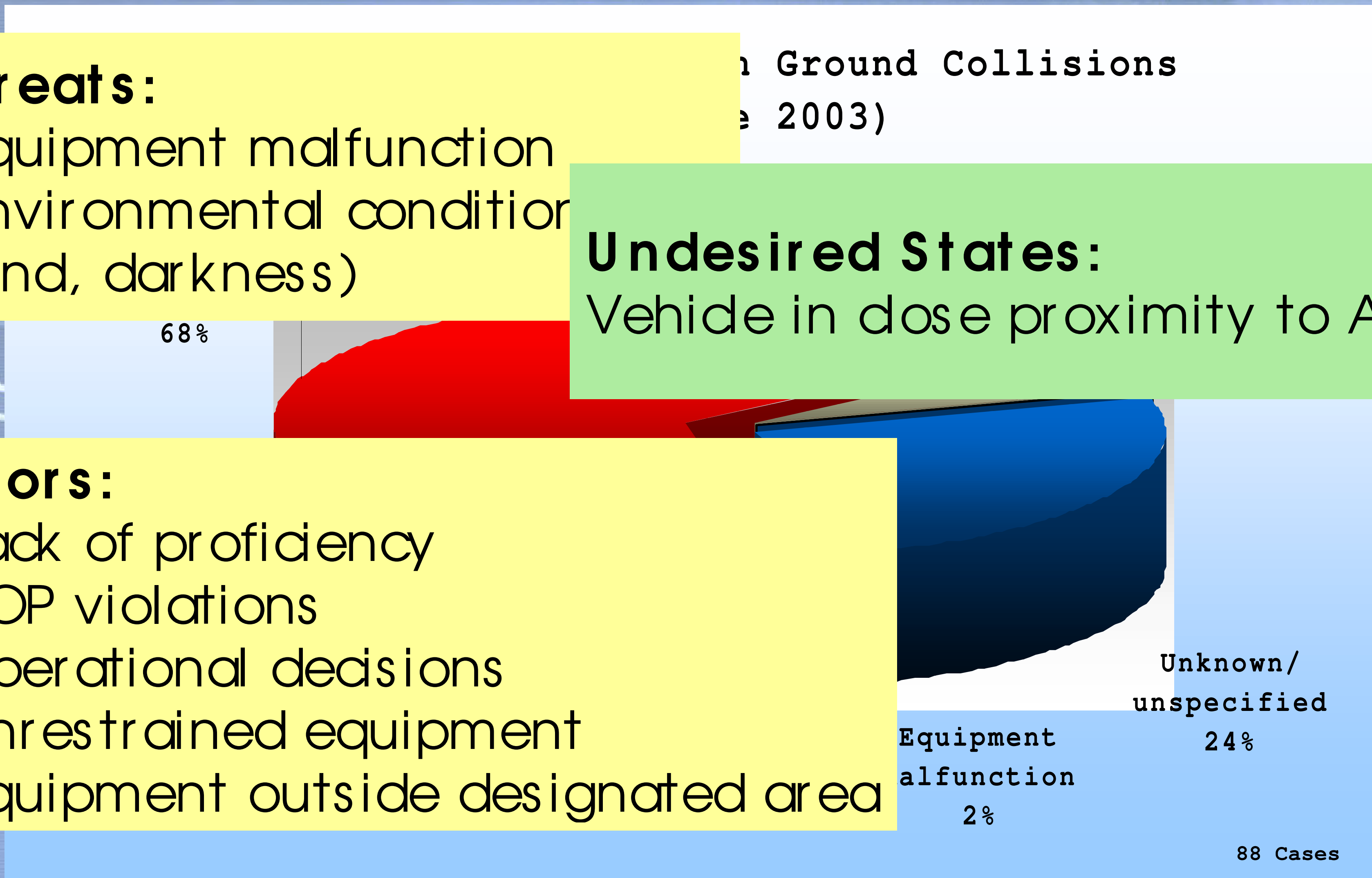
Cabin Threats:
- Armrests
- Partitions
- Overhead bins
- Equip/baggage

Galley Threats:
- Counter tops
- Bins/Carts
- Protruding latches
- Hot liquids

Undesired States:
Unrestrained people/objects

Outcome:
- Injury
- A/C damage

TEM in Data Management

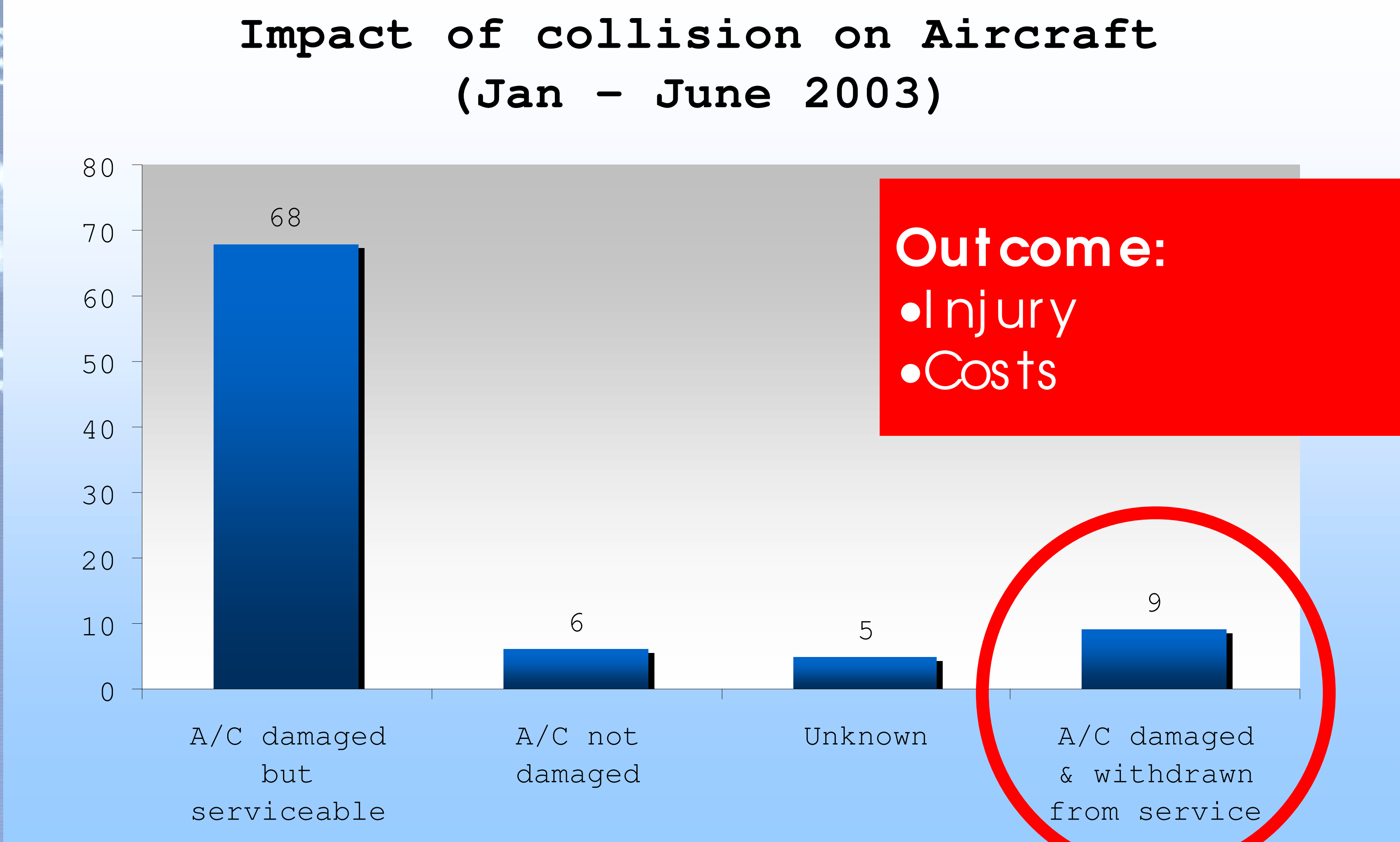


Threats:
- Equipment malfunction
- Environmental condition (wind, darkness)

Undesired States:
Vehicle in close proximity to A/C

Errors:
- Lack of proficiency
- SOP violations
- Operational decisions
- Unrestrained equipment
- Equipment outside designated area

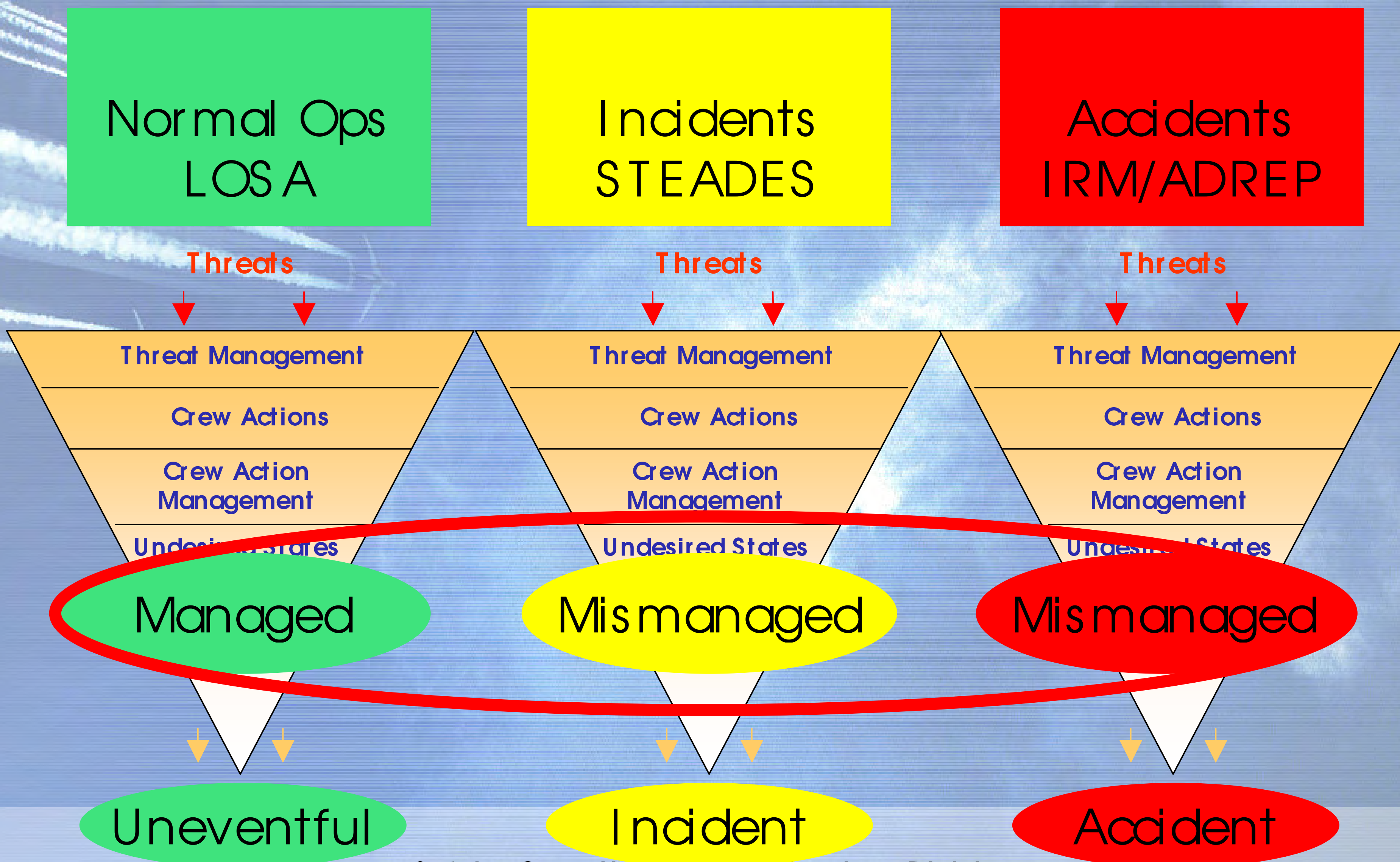
TEM in Data Management



Outcome:
- Injury
- Costs

88 Cases

Integrated Threat Analysis



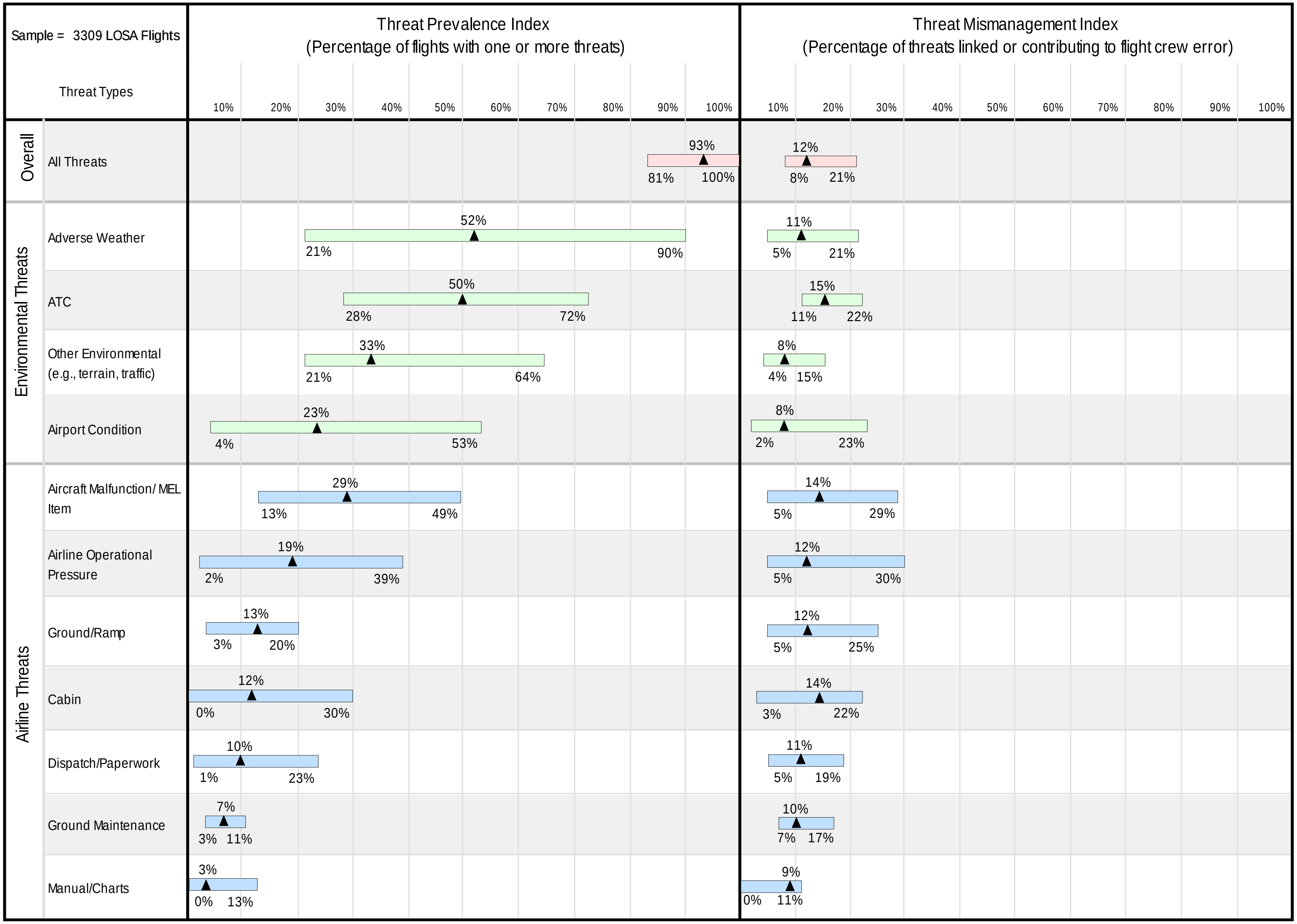
TEM in IATA's Programme

- Safety Managers tool:
  - Identification of precursors to accidents
  - Redefinition of SOPs
  - Development of prevention strategies
  - TEM toolkit
  - STEADES TEM alignment
  - HFWG ITA project
- Training tools:
  - Case studies/Workshops
  - Focus on airline-specific concerns
  - IATA turbulence injury reduction CD-ROM
  - ATDI TEM trainer course

Conclusion

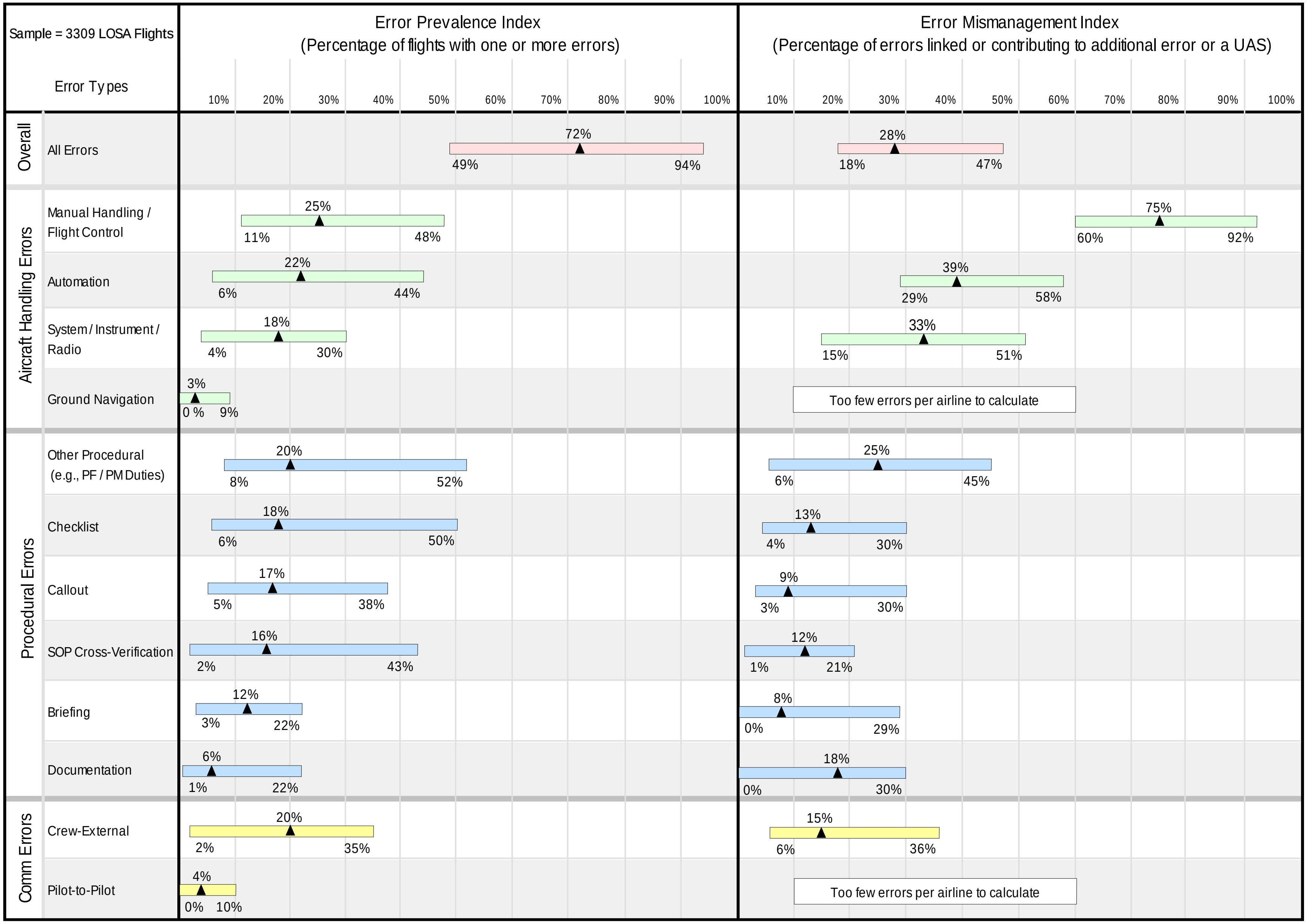
- IATA SAC is using TEM.
- Framework used across different fields.
- Airline benchmarking.
- Interventions based on analytical findings.

The LOSA Collaborative / University of Texas at Austin Human Factors Research Project
LOSA Archive Threat Profile -- November 2004



Note: The black triangle is the global percentage, based on 3309 flights in the LOSA Archive. The bars represent the range across airlines in the LOSA Archive.
Example – ATC threats: 50% of the 3309 flights in the Archive had one or more ATC threats – consider this an industry average. The ATC threat prevalence rate varied from a low of 28% at one airline to a high of 72% at another. On average, 15% of all ATC threats were mismanaged; the ATC threat mismanagement rate varied from a low of 11% at one airline to a high of 22% at another.

The LOSA Collaborative / University of Texas at Austin Human Factors Research Project
LOSA Archive Error Profile -- November 2004



Note: The black triangle is the global percentage, based on 3309 flights in the LOSA Archive. The bars represent the range across airlines in the LOSA Archive.
Example – Checklist errors: 18% of the 3309 flights in the Archive had one or more checklist errors – consider this an industry average. The checklist error prevalence rate varied from a low of 6% at one airline to a high of 50% at another. On average, 13% of all checklist errors were mismanaged; the mismanagement rate for checklist errors varied from a low of 4% at one airline to a high of 30% at another.

A Glimpse at Archie: The LOSA Archive

Ashleigh Merritt, Ph.D.
The University of Texas
Human Factors Research Project (UTHF)

Second ICAO/IATA
LOSA/TEM Conference
November 3-4, 2004

What is Archie?

- A repository of de-identified airline data retained by UTHF
- Archie currently has 3309 'stories'
  - Each story describes a commercial airline flight somewhere in the world
  - Each story is told by a LOSA observer
  - Each story describes a crew doing their job – the challenges, successes, and the **@#!!.

How big is Archie?

- As of October 2004
  - 15 airlines
  - 3,309 flights
  - 11,000+ threats
  - 7,000+ errors
  - 1,500+ undesired aircraft states

All data provided by The LOSA Collaborative and participating airlines

How old is Archie?

- Five LOSAs in five years to develop the methodology
- Data in the Archive starts in 2000
- Had to wait for Archie to grow before doing any industry-wide analyses.
  - If Archie was a dog, it would be a bloodhound
  - but still a puppy!

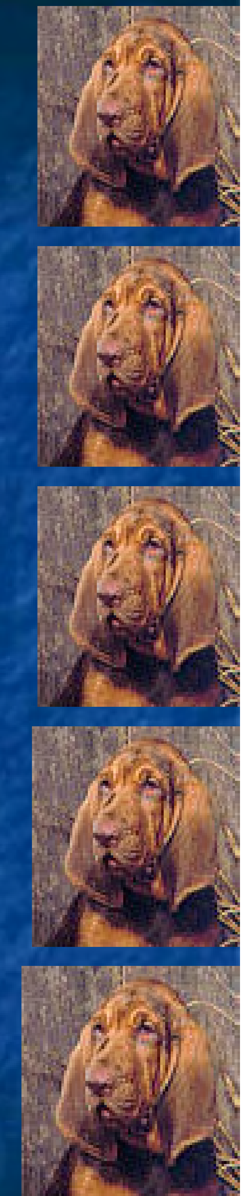
Archie's Attributes

1. Archie is byal and faithful
2. Archie alerts of danger
3. Archie is a tracker
4. Archie plays well with others

1. Archie is loyal and faithful

- The LOSA Archive has been created to serve the aviation industry
- All data in the Archive are de-identified
  - No airline will ever be identified
  - No pilot or crew can ever be identified
- The data never leave UTHF; that is the promise to industry

2. Archie warns of Danger



- Refer Handouts
  - Threat Prevalence and Management
  - Error Prevalence and Management
- How safe are we as an industry?
  - Higher prevalence and mismanagement rates warn of potential problems
  - Global patterns help prioritize safety interventions
  - And the good news is it's all proactive…

3. Archie is a good tracker

- The richness and complexity of the data allow literally thousands of paths to be pursued
  - When did it happen, who was flying, how experienced were they, how was it managed, what else was going on, what happened next, has it happened before, does it happen often, does it happen more on certain aircraft, does it happen at particular airports, etc. etc. etc.
- Archie can dig and dig…

Tracking Unstable Approaches

- Example: Unstable Approaches
  - 152 in 3309 flights
  - More threats in the flight overall?
  - More ATC threats (challenging clearance, late runway change) in descent/approach/land?
  - Any airport noticeably worse?
  - Crews less experienced?
  - Captain as Pilot Flying more often?
  - The crew took action, yes?
  - The crew landed safely, yes?

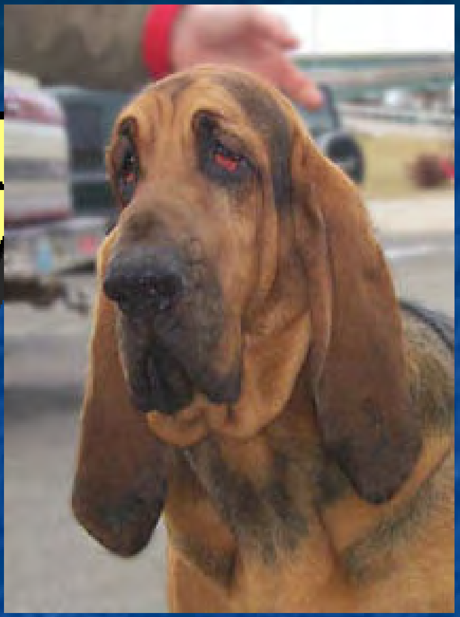
Tracking Unstable Approaches

- Unstable approaches do not have more threats overall, nor do they have more ATC threats in D/A/L.
- Captains and First Officers are Pilot Flying equally, and the crews are not less experienced.
- Not enough flights to answer the airport question, yet.
- The crew detected the problem and took action one-quarter of the time.
- Unstable approach flights had more errors and more mismanaged threats and errors overall. In fact, they had more errors in predeparture/takeoff than other flights, suggesting a "loose" crew from the start.
- All 152 unstable approach flights landed "safely"…
    - 24 landed long outside the touchdown zone, 10 landed short, 5 had firm landings, 4 had floated landings, and 3 landed off the center-line.
- Archie will continue to dig…

4. Archie plays well with others

Summary

- Archie is loyal, faithful and true
  - LOSA is based on trust between pilots and management; The Archive is based on trust between industry and UTHF
- Archie warns of danger
  - The aggregate database provides a snapshot of system performance and a global benchmark
- Archie is a real bloodhound
  - The Archive coding system and narratives allow extensive tracking and drill-down analyses
- Archie plays well with others
  - Data from the Archive will be used in upcoming ASAP and FOQA research projects



The University of Texas

Human Factors Research Project

www.psy.utexas.edu/HumanFactors

Integrating Threat & Error Management into the Airline Process

Dan Saegaert

Program Manager

Threat & Error Management

Overview

- Commitment
  - Policy (FOM)
  - TEM Model
- Internal Media and Publications
  - Flight Operations
  - Flight Safety
- Training Department
  - Common Syllabus (AQP modules designed with TEM in mind)
  - I/E calibration
  - Observer program
- Continuous Improvement Process

Have you ever experienced this?

Commitment

- Leadership endorses and supports safety programs
  - Advanced Qualification Program (AQP)
  - Flight Operations Quality Assurance (FOQA)
  - Aviation Safety Action Program (ASAP)
  - Line Operational Safety Audit (LOSA)
- Management establishes policy

Briefings

All pilots will be included in the Departure, Takeoff and Approach briefings. Pilots should develop a brief that incorporates the highest threats to that flight segment (i.e., weather, security, terrain, etc.).

The Captain will ensure that all briefings are conducted in accordance with the following guidelines:

Flight Attendant Briefing

Prior to pushback, the Captain will brief the OBL. If possible, the entire crew should be present for the Flight Attendant briefing. Topics **should** include:

- **All flights**.

Threat management -

Allows you to manage your future

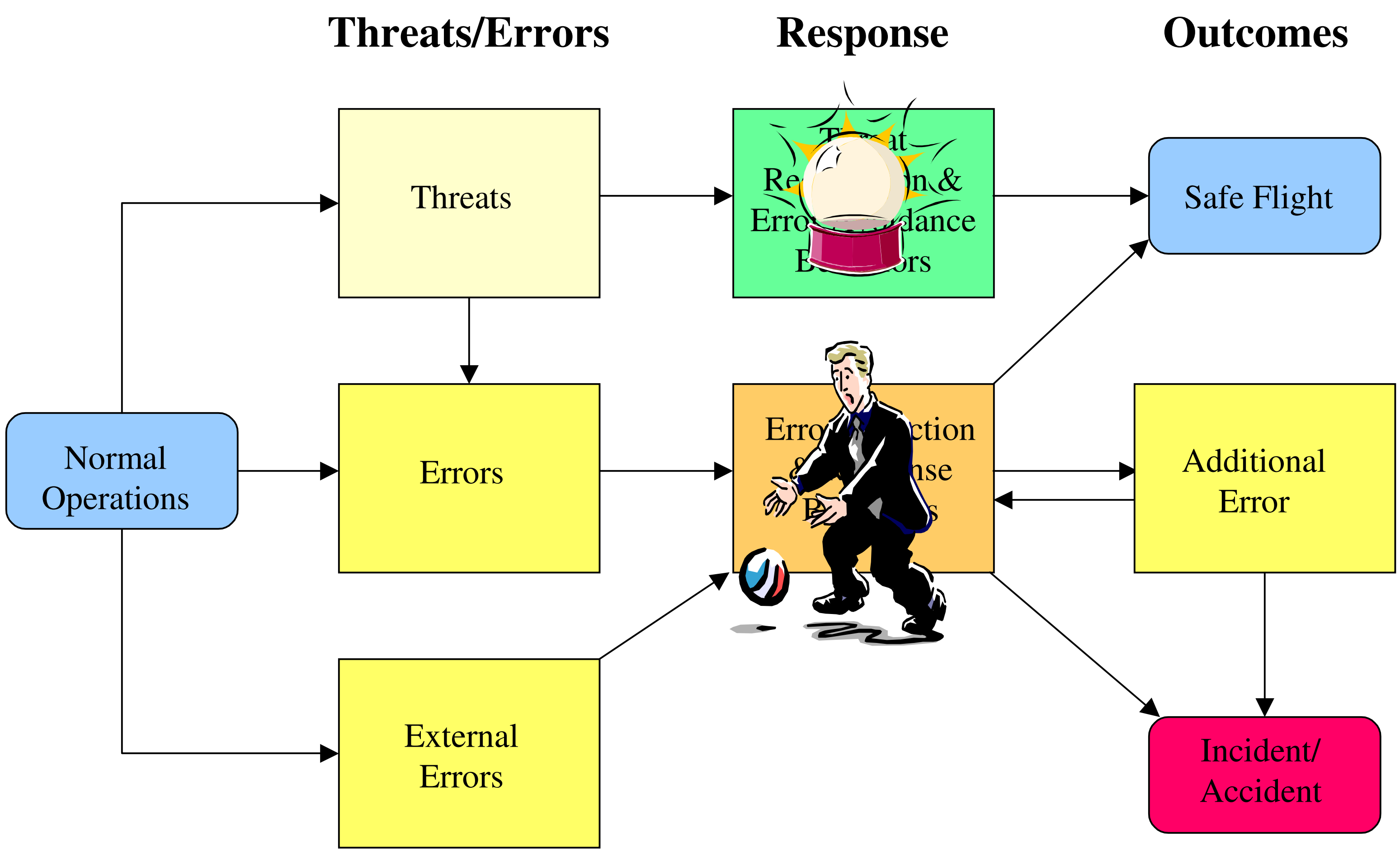
Threat management – the crew manages their crystal ball

Error management -

Requires you to manage your past

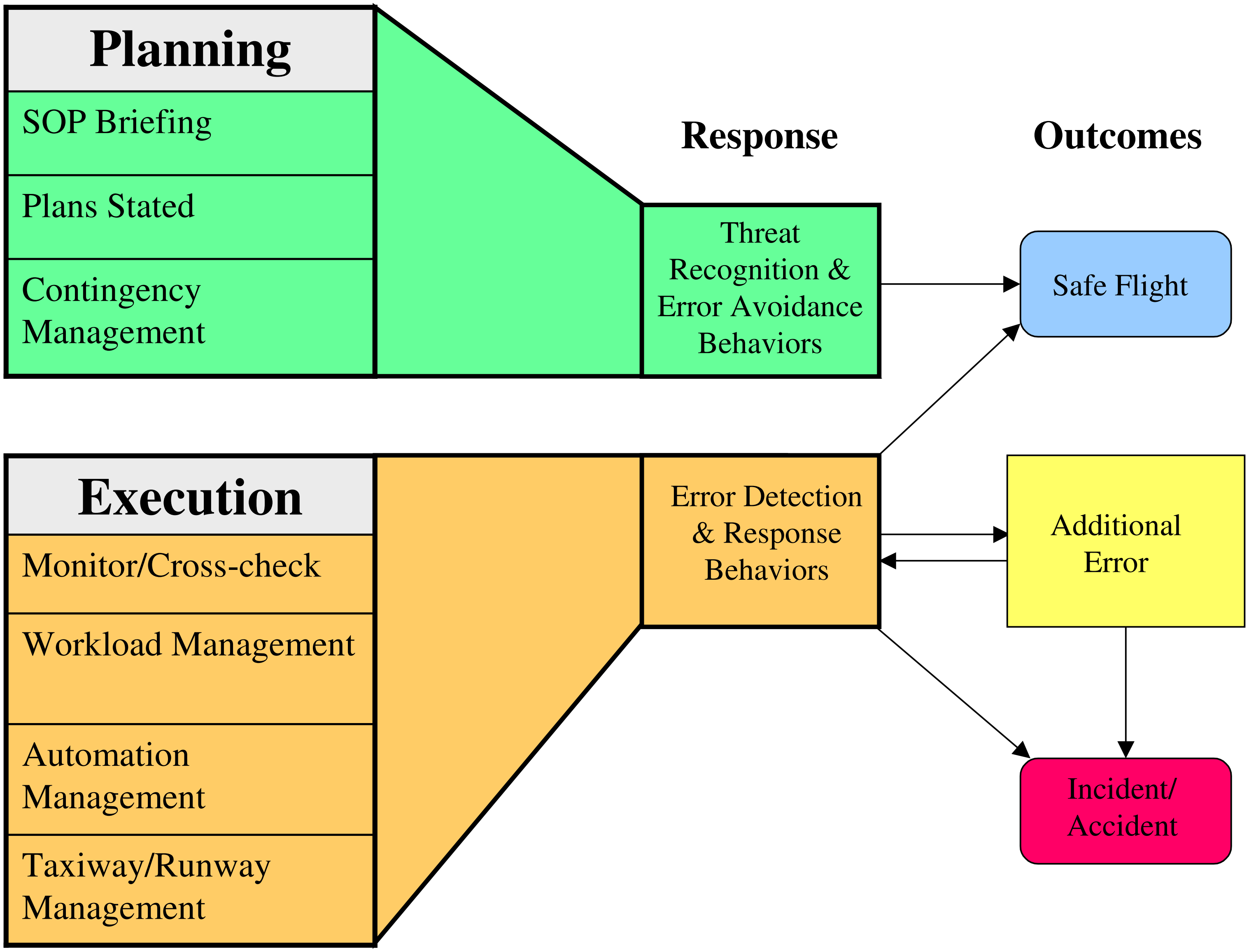
Error management – the crew manages the ball that dropped

Delta’s TEM Model

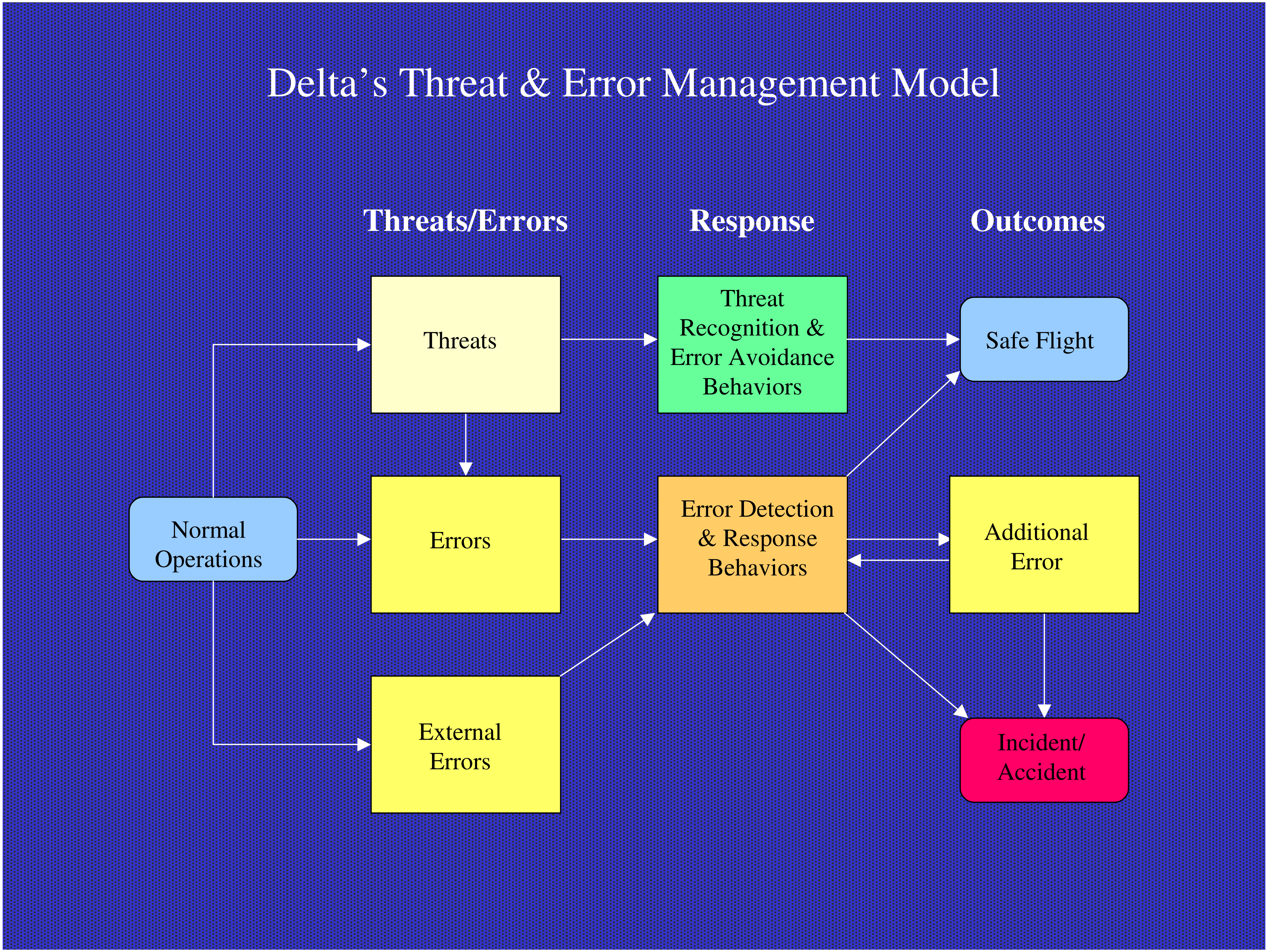


Based on Helmreich's TEM Model

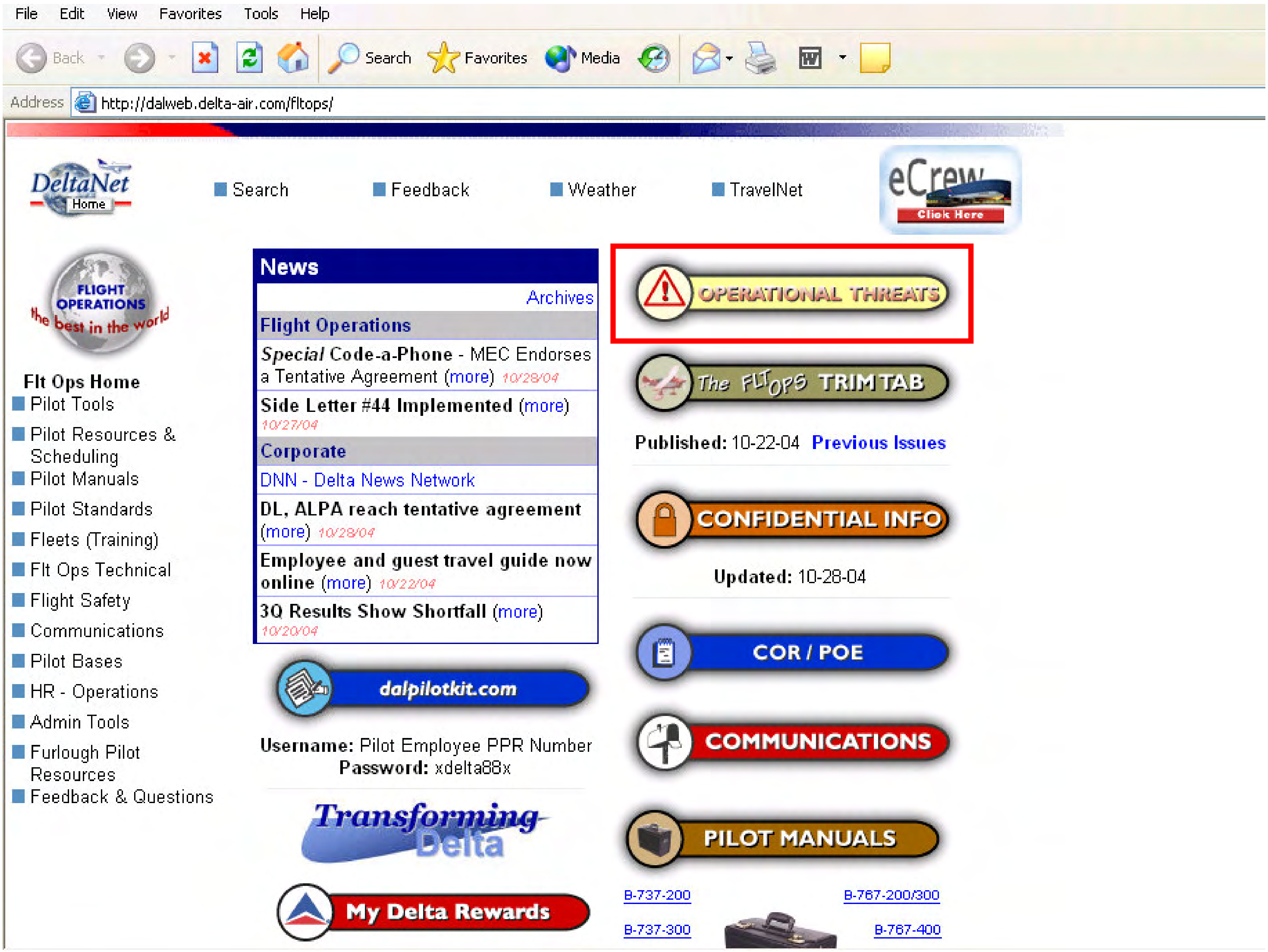
Delta's TEM Model



LOSA Collaborative Checklist (2004)


Delta's Threat & Error Management Model
Threats/Errors
Response
Outcomes
Threats
Threat Recognition & Error Avoidance Behaviors
Safe Flight
Normal Operations
Errors
Error Detection & Response Behaviors
Additional Error
External Errors
Incident/ Accident

Internal Media and Publications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DeltaNet Home
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FLIGHT OPERATIONS the best in the world
Flt Ops Home
Pilot Tools
Pilot Resources & Scheduling
Pilot Manuals
Pilot Standards
Fleets (Training)
Flt Ops Technical
Flight Safety
Communications
Pilot Bases
HR - Operations
Admin Tools
Furlough Pilot Resources
Feedback & Questions
News
Archives
Flight Operations
Special Code-a-Phone - MEC Endorses a Tentative Agreement (more) 10/28/04
Side Letter #44 Implemented (more) 10/27/04
Corporate
DNN - Delta News Network
DL, ALPA reach tentative agreement (more) 10/28/04
Employee and guest travel guide now online (more) 10/22/04
3Q Results Show Shortfall (more) 10/20/04
dalpilotkit.com
Username: Pilot Employee PPR Number
Password: xdelta88x
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My Delta Rewards
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The FLT OPS TRIM TAB
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PILOT MANUALS
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B-737-300
B-767-200/300
B-767-400

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Address http://dalweb.delta-air.com/flight_safety/index_threats.htm

Flight Safety

Threats to Our Operation

- ACAS Bulletin: TCAS II and VFR Traffic
- Altitude Deviation Prevention Toolbox
- Delta Flight Incidents
- Delta In-Flight Shutdown Statistics for 2003
- Fleet Irregularities for September 2004
- Runway Incursion Toolbox
- TCAS RAs - End of Year 2003 & TCAS RA G/A Events
- NASA/ASAP Reports
- Tech Ops Safety Related Maintenance Events

[Back to Flight Safety Home]

Delta Flight Safety

Flight Safety Home

- Threats
- Flight Safety Publications
- Significant Event Photographs
- Fleet Irregularities
- F.O.Q.A.
- GO Team
- NTSB Investigations
- YTD Performance

F l i g h t   S a f e t y

Runway Incursion Toolbox

- Did you know...?
- Airport Surface Detection Equipment
- High Speed RTO for Ground Alert
- Runway Incursions: Where are we?
- Airport Movement Area Safety System (AMASS)
- Runway Incursion Prevention Plan - Milan Airport
- FAA Runway Safety Publications
- Runway Incursion Events
- Runway Incursion at LAS
- Airport Signs and Markings
- Delta Runway Incursion Event, JFK
- LAX Runway Incursions
- MSP Intersection Markings

Volume VIII,

APB
All Points Bulletin

SUMMER 20

Safety

Lawrence A. "Bud"

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Leadership rema
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Captain "Bud" Sittig,

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Flight Ope

Today, Delta has
the Flight Opera

Flight Safety

A Flight Operations Publication • Oct. / Nov. 2004

PLANE TALK

Inside This Issue

APPROACHES NOT AUTHORIZED — page 2

2004/2005 DE-ICING NOTES — page 3

LOSA-THE NEXT STEPS — page 3

A/C COMMAND (NOTAC) CHANGE & FLEET STATUS — page 4

DELTA FUEL GAUGE — page 5

SECURITY QUESTION OF THE MONTH — page 5

AUG/SEP/OCT RETIREMENTS

CLOSING THE DEAL

By Timothy Hagfors, chief pilot-Cincinnati

"You are a salesman."

That's what my ex-boss, a former NFL tailback, said to me shortly after I began my first career as an engineer. The look I gave him telegraphed a need for clarification. He continued, "Whether you empty the trash or do research in the laboratory, you're a salesman and each and every time you come in contact with somebody, you're representing our company and our product."

That was 1979.

Twenty five years later, his wisdom has meaning to us in the airline industry as well. We are selling our product by our daily contact with our passengers. While we have little control over issues such as contract negotiations and industry trends, we have more control over keeping passengers away from our competitors than many of us believe.

Over the years, we've learned better ways to serve the customers such as podium IROP P/A's, greeting passengers during a cabin walk-through and a personal "thank you" when you notice a Medallion bag tag. Yet, simply modifying what we do every day can have a great impact on how we "sell our product."

MANAGING OUR PASSENGERS' EXPECTATIONS

Southwest Airlines and AirTran are particularly good at this. Passengers don't expect much when they fly a discount airline but end up pleasantly surprised with their experience. Their expectations were exceeded. Legacy carriers, however, have "raised the bar" for so long, exceeding expectations or simply meeting them can be difficult to do.

Most passengers know (to the minute), for example, their scheduled departure time. In fact, you'll notice at push back, many of them glance at their watches. However, very few of them know our exact scheduled arrival time. They know approximately when we are due to arrive but they assume if we've departed on time, we'll arrive on time and they won't have to worry about connections or calling to update someone with an estimated arrival time.

The following are a few scenarios commonly experienced and some techniques offered by line pilots particularly adept at serving our customers as ways to address the scenarios:

Departing On-Time

A P/A five or ten minutes before departure anticipating an on-schedule departure and predicting an on-time arrival is helpful in meeting (or, in some cases, exceeding) their expectations.

Anticipating an On-Time Arrival

Keep in mind that the DOT classifies a flight as "on time" for their purposes if it will arrive within 15 minutes of scheduled arrival time. Often, when we anticipate arriving 5-10 minutes late, we may classify the flight as "late" when it will remain within DOT on time limits (That dreaded "L" word). In those cases, it may be more appropriate when making a PA to inform the passengers of the arrival time without saying that the flight will be "late." In other words, don't convince a passenger we're late when DOT says we're on time.

Arrival at the Gate On-Time

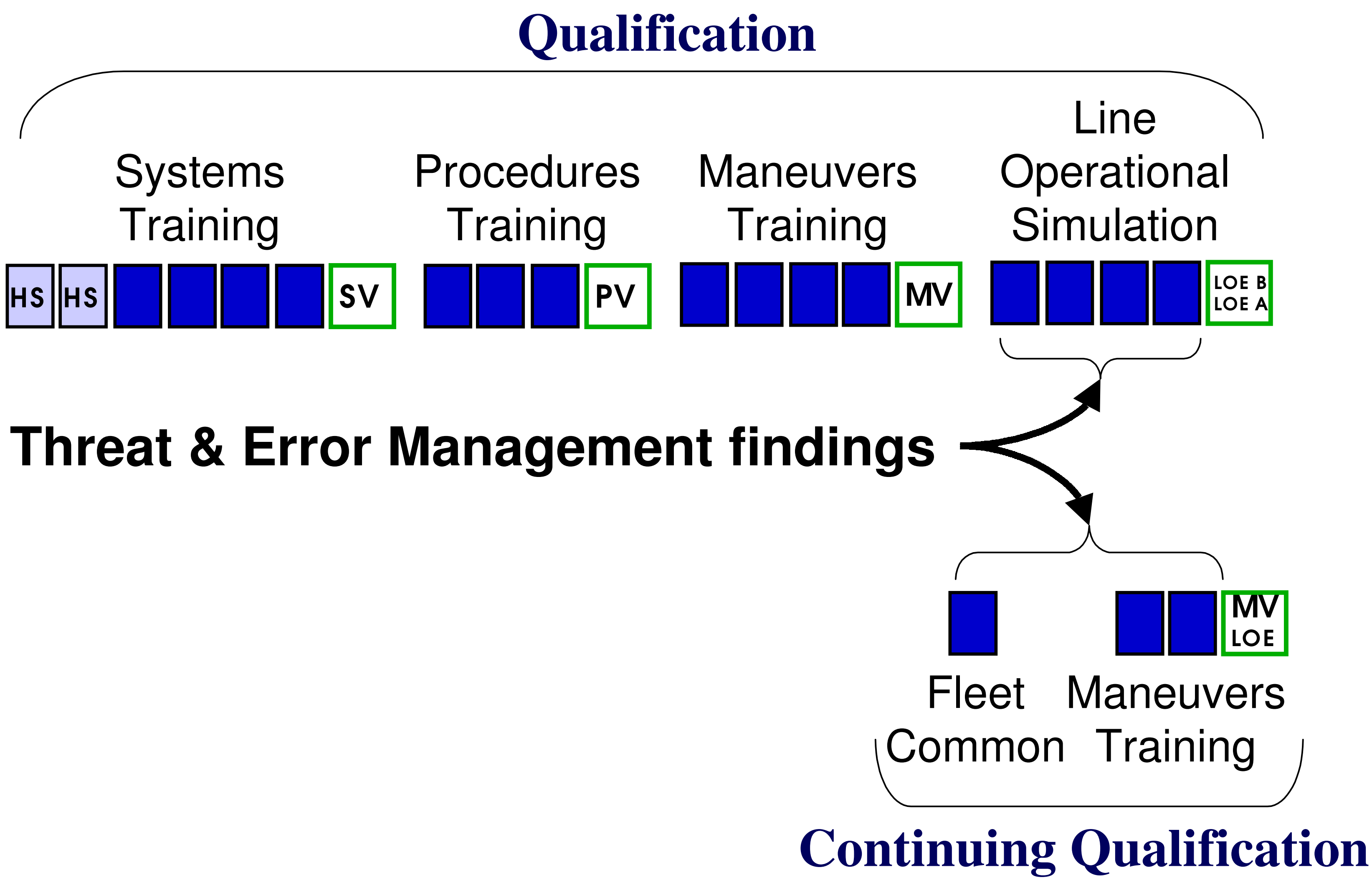
When we expect to arrive early, discreetly informing them (after completion of the shutdown checklist) we've succeeded by announcing, "Due to our earlier-than-scheduled arrival, your friends, family or business associates meeting you should be along shortly," enables us to advertise our success. Similarly, an announcement welcoming them to their destination on schedule and thanking them for

(continued on page 5)

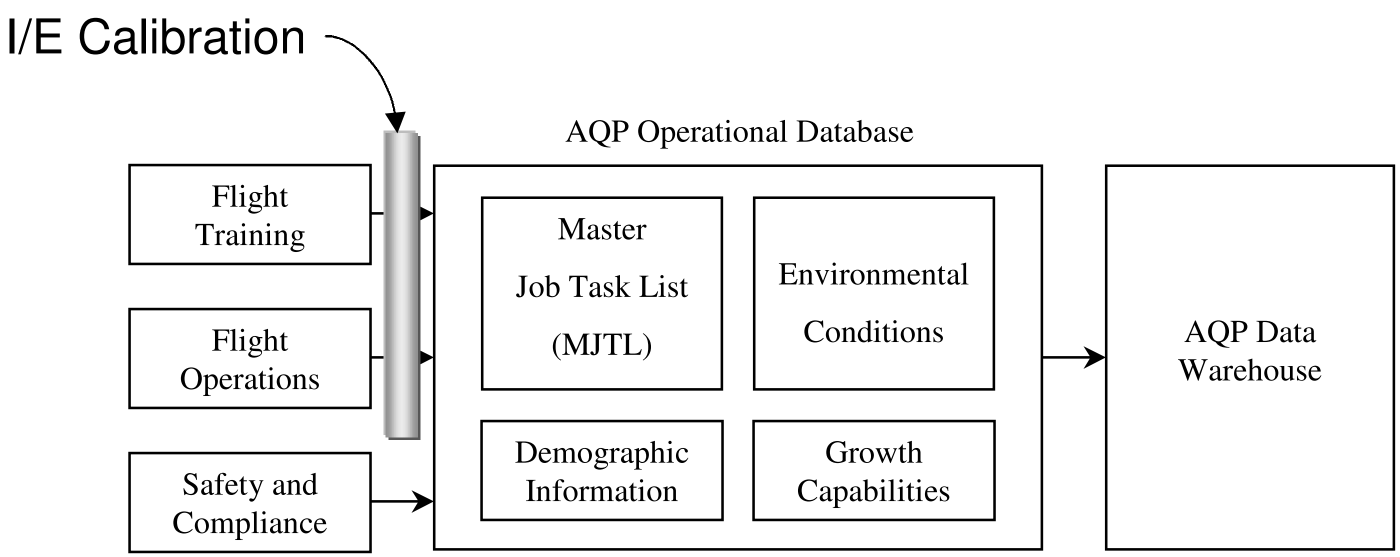
Training

Quality, Integrity, and Productivity

Common Syllabi

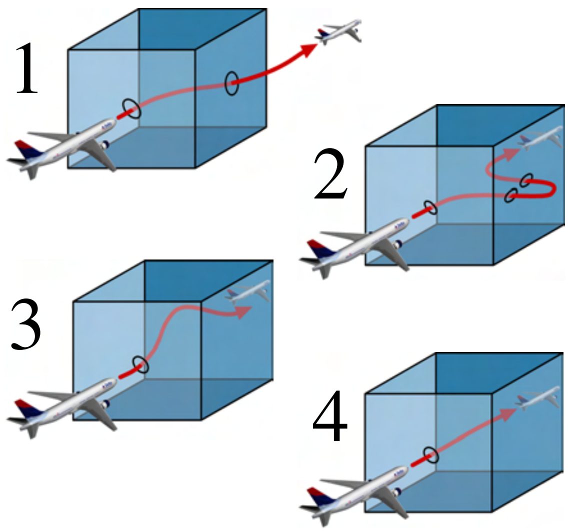


AQP Database



I/E Calibration

Grading Criteria Review



Error Type	Detected By
PD	AA
PY	PD
NC	PF
CM	PM
DM	ND
SA	OP
WL	AT

Qualification Standards Review

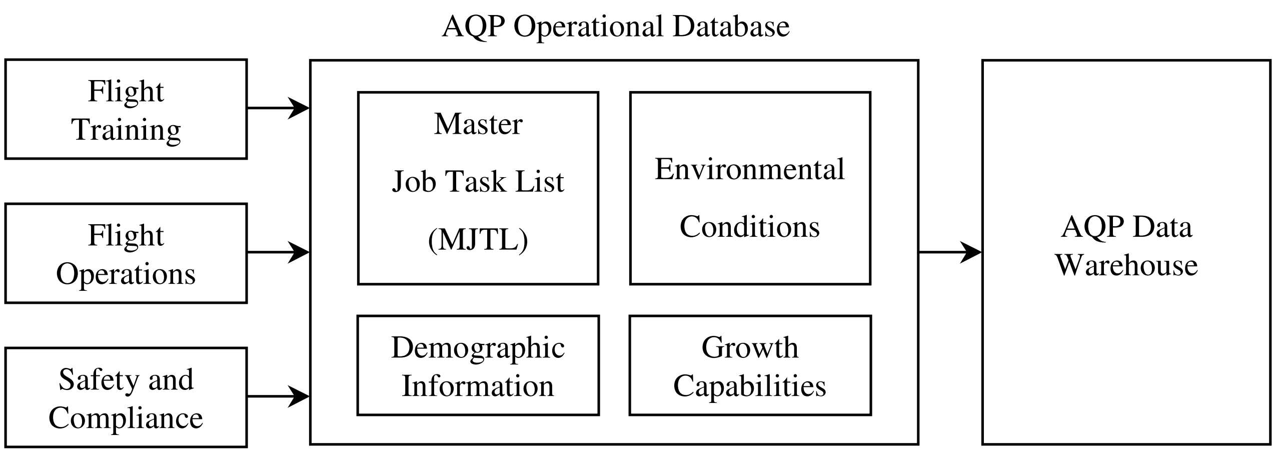
Calibration Exercise

Referent Rater Reliability (RRR)

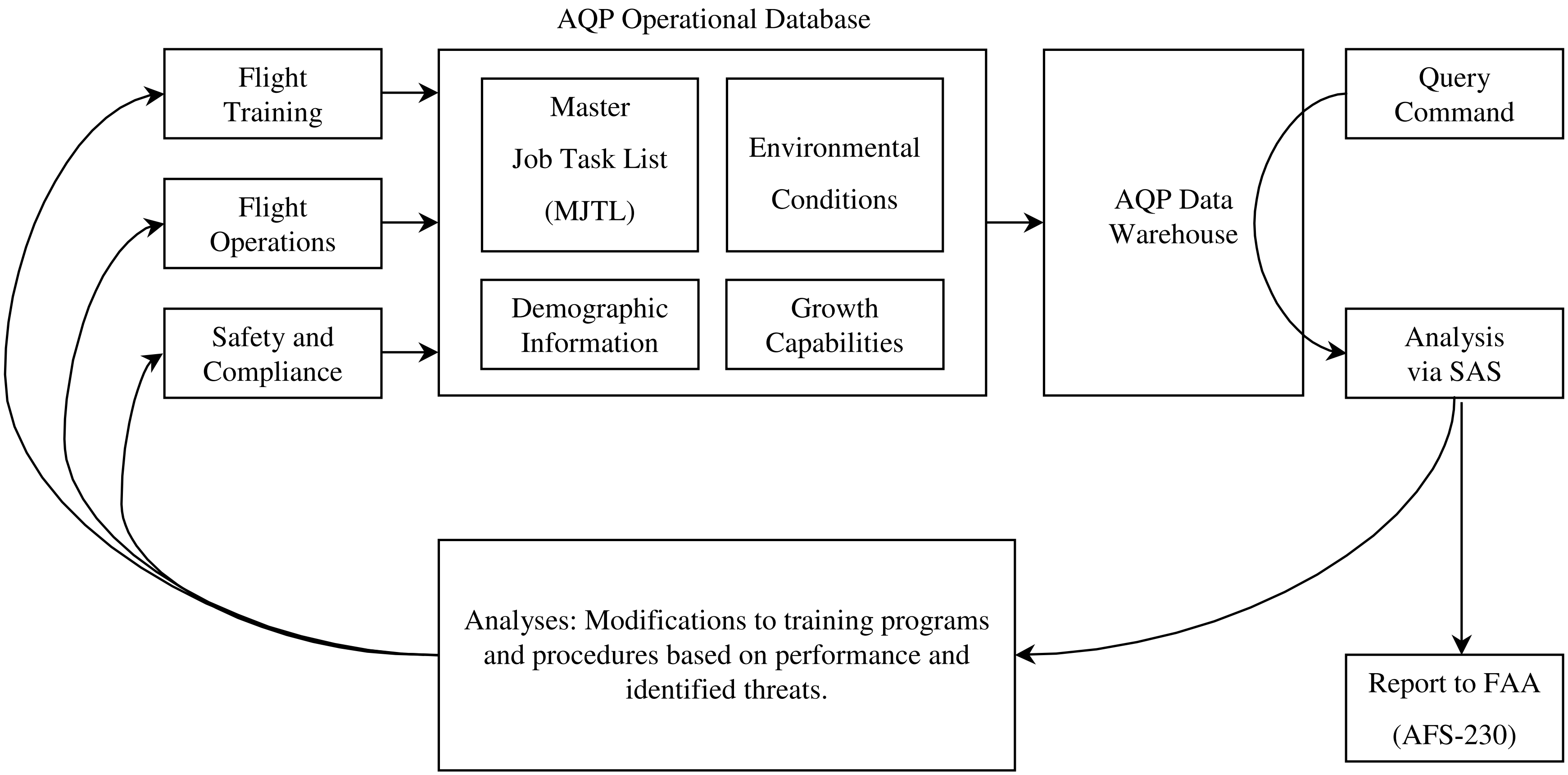
&

Inter Rater Reliability (IRR)

AQP Database

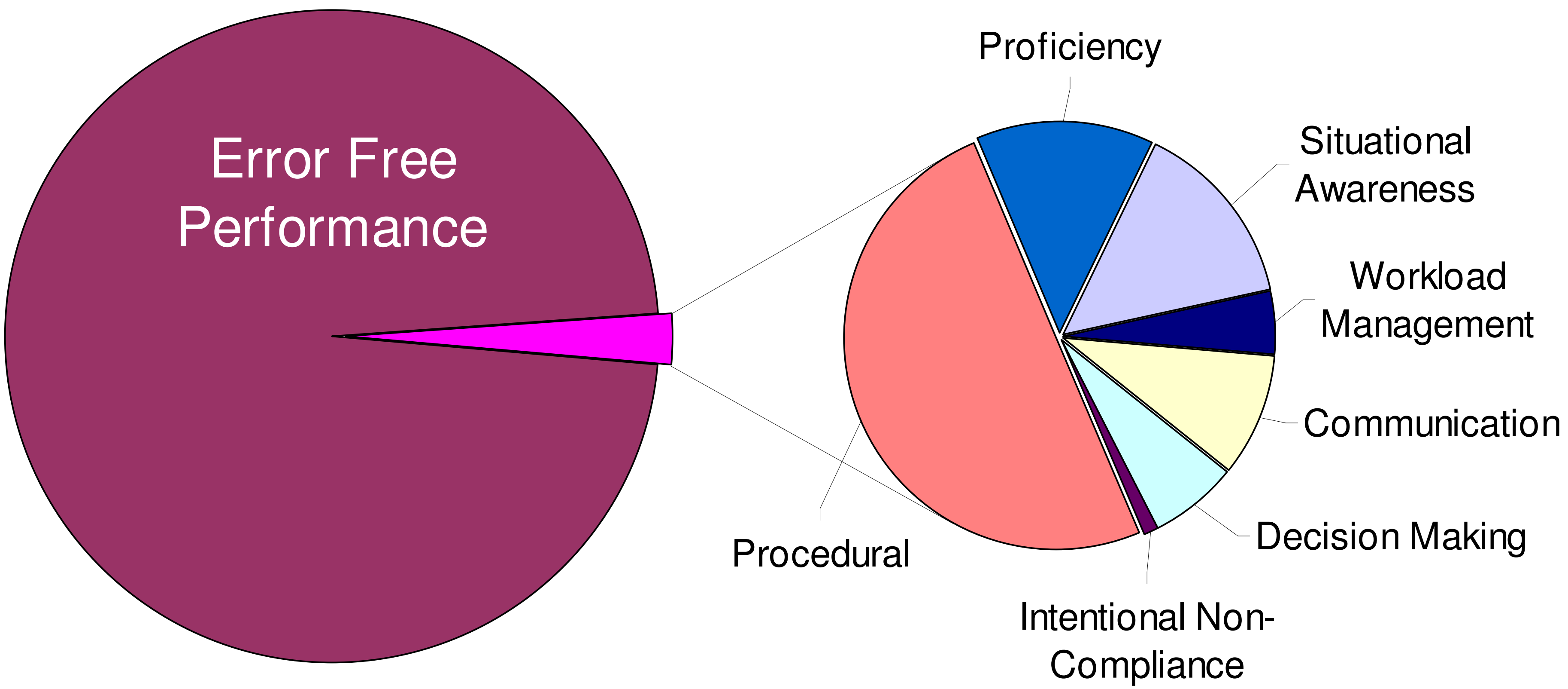


AQP Database



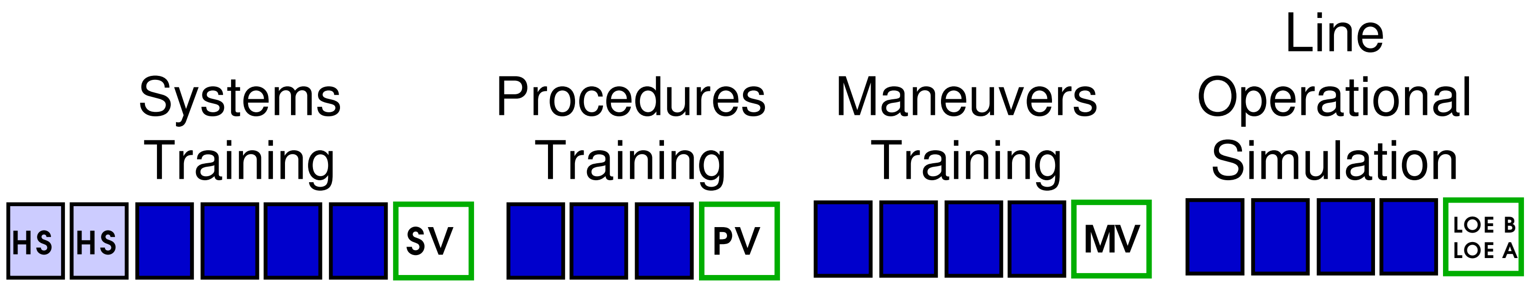
2Q04 Line Check

All Fleets



Observer Program

- Ensure quality of training program
- Reinforce TEM techniques with I/E's



Continuous Improvement Process

- Review findings from LOSA and incorporate into our processes
- Communicate TEM (model)
  - Instructor/Evaluators
  - Crews
  - Dispatchers
  - Maintenance

Delta's TEM Model

Threats/Errors

Normal Operations

Threats

External Errors

Operational Control Center (OCC)

Technical Management Center (TMC)

Based on Helmreich's TEM Model

Next Step

- Review findings from LOSA and implement into our processes
- Communicate TEM (model)
  - Instructor/Evaluators
  - Crews
  - Dispatchers
  - Maintenance
- Continue data collection and analysis


Delta
7004
Delta

History of the Line Operations Safety Audit at Delta Air Lines

Captain L.A. "Bud" Sittig
Director – Flight Safety

LOSA History at Delta

Delta enjoys long, successful relationship with the University of Texas Human Factors Research Project and the LOSA Collaborative

- 1994: International and Domestic CRM Audits
- 2000: First TEM-based LOSA
- 2004: Second TEM-based LOSA

1994: International and Domestic CRM Audits

- Formal LOSA developed at the request of Delta to validate operational impact of Human Factors (CRM) training
- The focus of the initial LOSA was systematic assessment of CRM-related crew behaviors
- Long-haul (international) flying increased dramatically after acquisition of Pan Am in 1991
  - Focus on crew fatigue, introduction of relief crews, complex international operations, language challenges, weather changes during long flights

2000: First TEM-based LOSA

- Purpose: Document and evaluate "normal" line operations
  - Get a "snapshot" of the Delta safety culture
  - Use UT LOSA methodology
  - Look at specific focus areas
    - Stabilized approaches
    - Runway crossing awareness
    - Altitude awareness
    - Flight Crew/Cabin Crew interface
    - Ramp safety

2000: First TEM-based LOSA

- Outstanding Results
  - 362 Cockpit Observations
    - No crew rejections
  - Domestic and International Operations observed
  - Delta Express observed
  - 1,231 Written crew surveys received (51% return rate)
    - Pilot contract negotiations were in progress

2000: First TEM-based LOSA

- 15 "Targets for Improvement"
  - Joint Flight Operations/Flight Safety working group established to address targets
  - Safety Action included improvements in training, standards, and communication programs

LOSA 2004

- Second TEM-based LOSA and first LOSA utilizing the LOSA Collaborative
  - Built on success of 2000 LOSA
  - Seamless integration with the LOSA Collaborative
  - Cockpit Observation phase concluded on 10/31/04
    - 340-360 Cockpit observations completed
    - International and Domestic operations observed
    - All Delta fleets observed

LOSA 2004

- Reasons for success:
  - Utilized recently-retired Delta pilots as observers
    - Highly motivated and cost-effective
    - Other high quality observers from ALPA, Flight Ops and Flight Safety management, LOSA Collaborative
  - Intensive Promotional Campaign
    - Pilot group understood and embraced LOSA concepts well prior to the "kickoff" date
    - As in 2000, no crew rejections
  - LOSA Data Collection Tools
    - Efficient design; shortens the overall process
    - Observers were computer-literate

Summary

- Delta embraces LOSA as an industry-proven, proactive safety tool (complements FOQA and ASAP)
- LOSA is effective only if the "targets" are acted upon and the data is used to enhance current programs (training, standards, communications)


Questions?
Thanks for your time…

Use of TEM in Safety Research

by
J-J Speyer
Airbus
Customer Services
Director Operational Evaluation,
Human Factors and Communication

SECOND ICAO-IATA LOSA & TEM CONFERENCE

Second ICAO-IATA
LOSA and TEM Conference

Enhancing Flight Crew Monitoring and Cross-checking Skills

Captain Robert Sumwalt
Chairman, Human Factors and Training Group
Air Line Pilots Association, International

October 25, 2002 Eveleth, Minnesota

According to NTSB

- "during the later stages of the approach, the flight crew failed to monitor the airplane's airspeed and allowed it to decrease to a dangerously low level (as low as about 50 knots below the company's recommended approach airspeed) and to remain below the recommended approach airspeed for about 50 seconds."

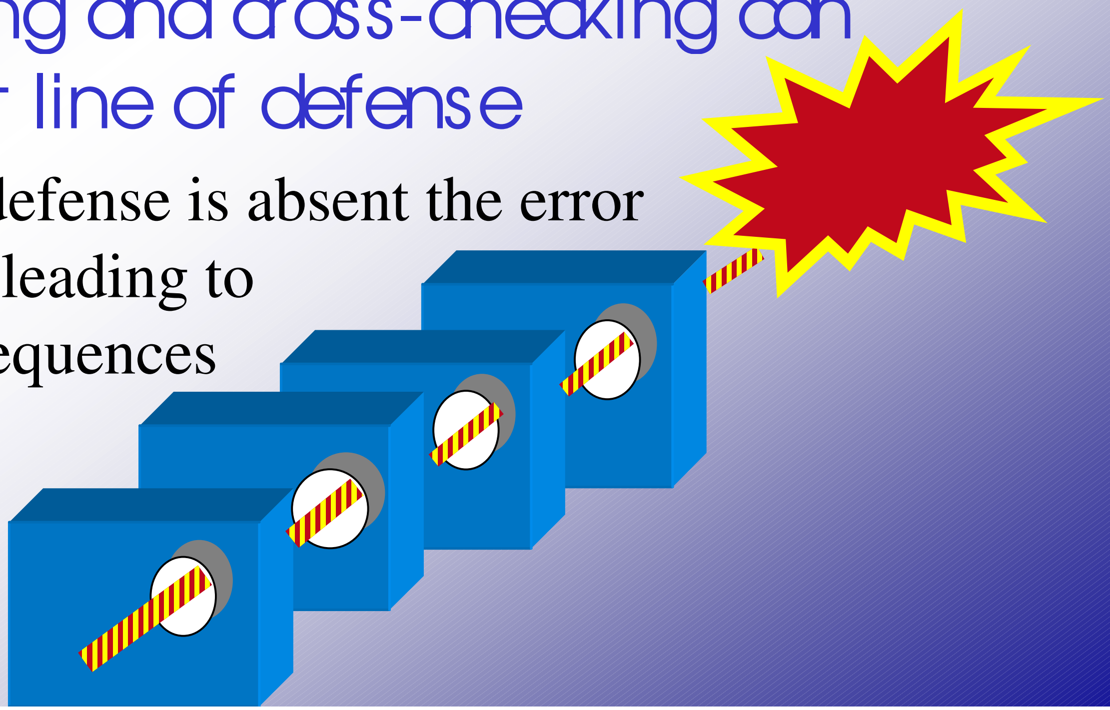
Source: NTSB/AAR-03/03.

- "If the First Officer had monitored the approach on the instruments…he would have been better able to notice and immediately call the Captain's attention to the altitude deviation below the minimum descent altitude."

Source: NTSB/AAR-96/05.

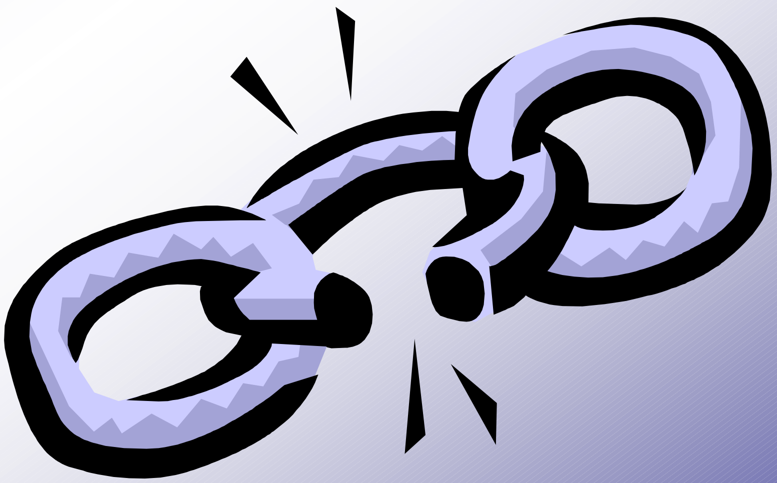
Introduction

- Each crewmember must carefully monitor the aircraft's flight path and systems, and actively cross-check the actions of each other.
- Effective monitoring and cross-checking can literally be the last line of defense
  - When this layer of defense is absent the error may go undetected, leading to adverse safety consequences



Good monitoring is important

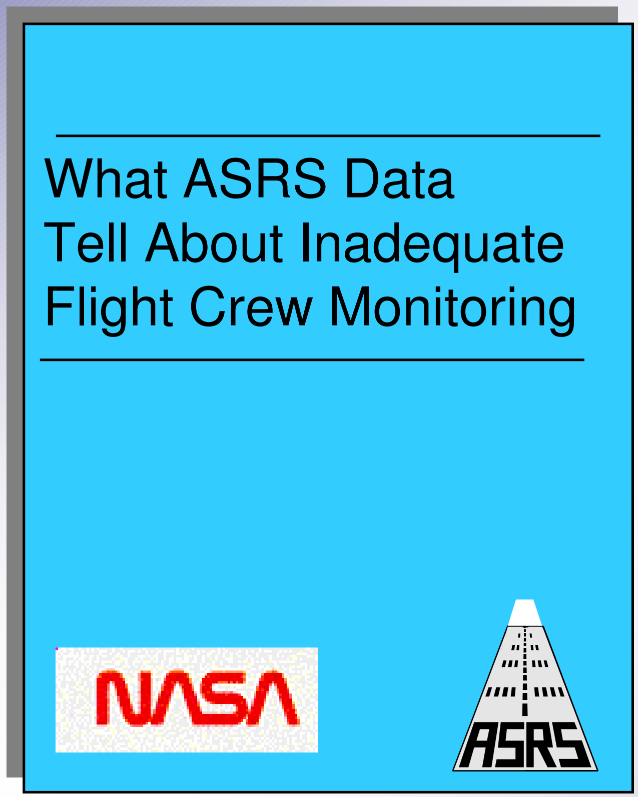
- By better monitoring and cross-checking, a crewmember will be more likely to catch an error or unsafe act
- This detection may break a chain of events leading to an accident scenario



Why improve monitoring? - Accident Data -

- Inadequate crew monitoring or challenging was a factor in 84% of 37 crew-caused air carrier accidents reviewed in a NTSB safety study.
  - 76% of the monitoring/challenging errors involved failure to catch something that was causal to the accident
  - 17% of the monitoring/challenging errors were failure to catch something that contributed to the accident's cause
- Poor monitoring was a factor in 63% of the ALA accidents reviewed by the FSF ALAR working groups.
- 50% of the CFIT accidents reviewed by ICAO to support the FSF CFIT efforts involved poor monitoring.

Why improve monitoring?
- Incident Data -


What ASRS Data Tell About Inadequate Flight Crew Monitoring

- Researchers examined 200 incident reports submitted to NASA ASRS
- They found evidence that inadequate monitoring can lead to adverse safety consequences
  - Altitude deviations
  - CFTT
  - Stall
  - Loss of aircraft control
  - Course/heading/track deviations

Why improve monitoring? - LOSA Data -

- Roughly 64% of "unintentional errors" in the University of Texas LOSA archive were undetected by flight crew.
- In a recent LOSA, 19% of errors could have been eliminated by more effective crew monitoring and cross-checking.
- In that same LOSA, 69% of "undesired states" could have been eliminated by more effective monitoring.

US Airways decided to actively work to improve pilot monitoring

This is a collaborative effort between US Airways, ALPA and NASA Ames Research Center

Underlying factors associated with poor monitoring

1. Until now, the industry has not made monitoring a primary task.
   - When listing PNF duties, we often list duties such as handling radio communications, keeping flight logs and operating gear and flaps.
   - Monitoring is not one of the duties primarily listed, but rather it seems to be treated as a secondary task, or not addressed at all.

Underlying factors associated with poor monitoring

2. Effective monitoring is not easy and intuitive
   - requires a skill and discipline

Underlying factors associated with poor monitoring

3. There is somewhat of a monitoring paradox that works against effective monitoring.
   – Serious errors do not occur frequently which can lead to boredom and complacency

> "A low-probability, high-criticality error is exactly the one that must be caught and corrected."

Underlying factors associated with poor monitoring

4. Although traditional CRM courses have generally improved the ability of crewmembers to challenge others when a situation appears unsafe or unwise…

- many of these courses provide little or no explicit guidance on how to improve monitoring.

Underlying factors associated with poor monitoring

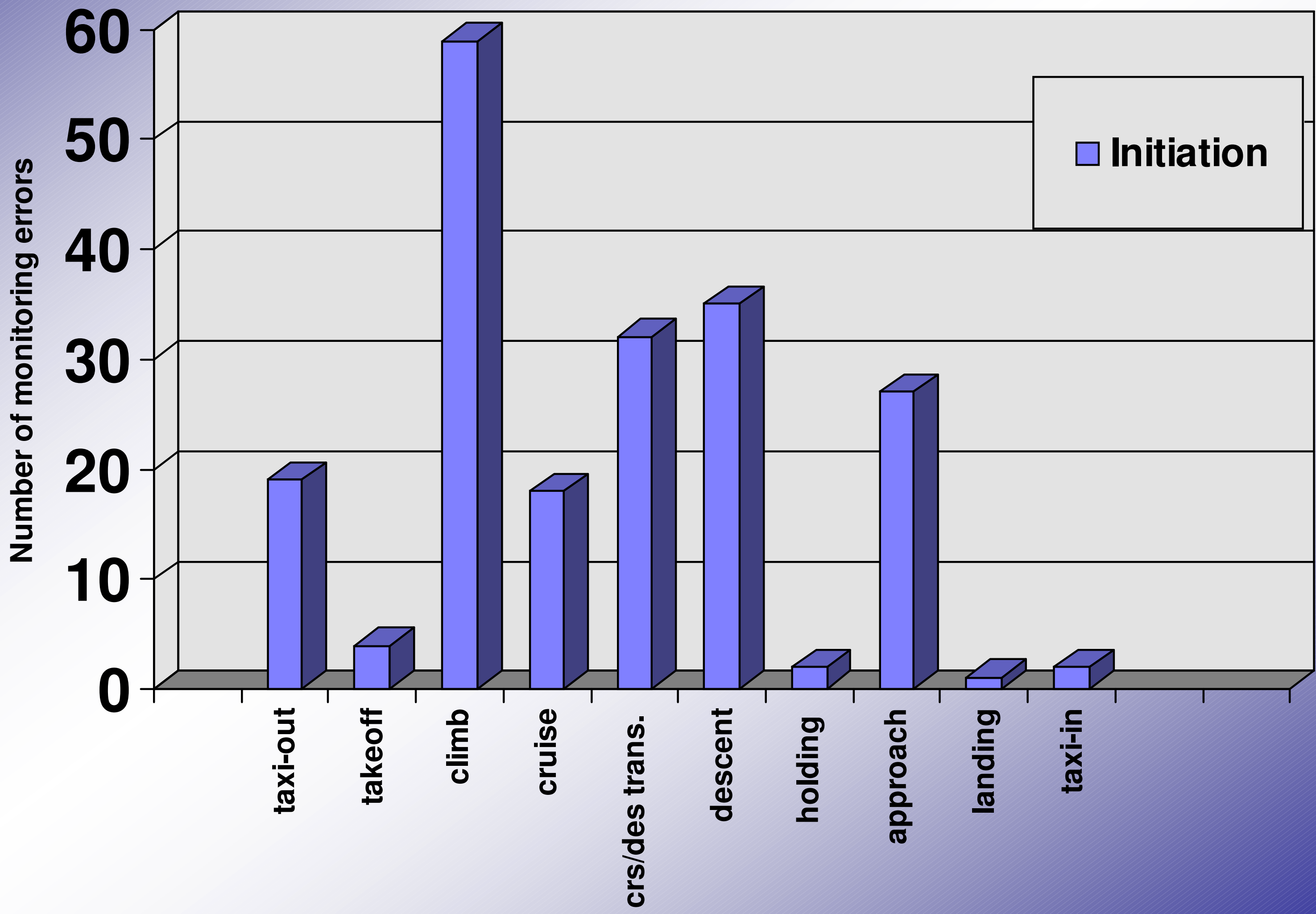
5. We seem satisfied that we cannot improve monitoring, and simply explain it as, "Humans just are not good monitors."
   – While it may be true that humans are not naturally good monitors, crew monitoring performance can be significantly improved through policy changes and crewmember training.

NASA ASRS Monitoring Study

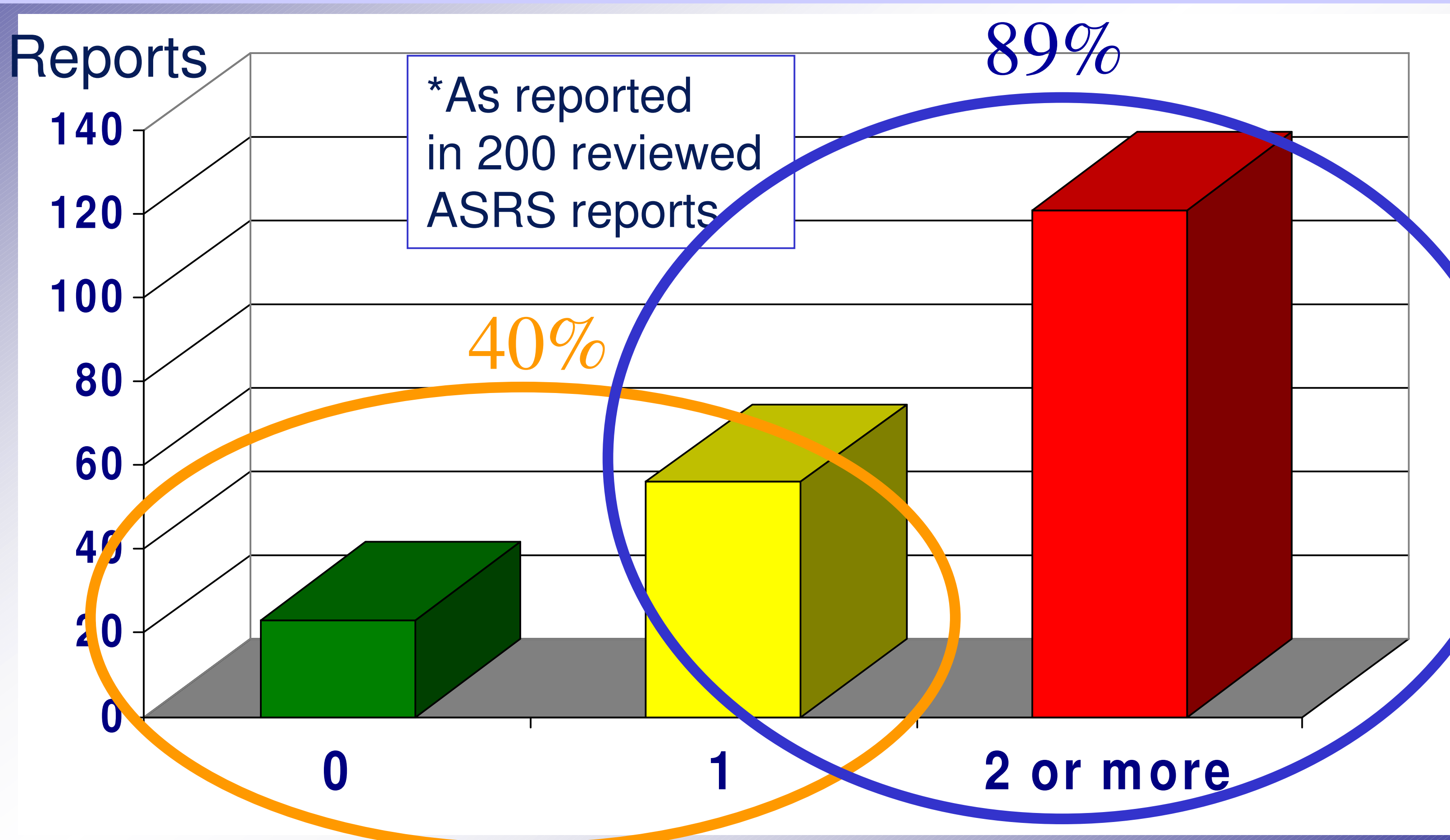
What ASRS Data
Tell About Inadequate
Flight Crew Monitoring

- This study was a good resource for helping us get stared and providing data
- The objectives of the study were to identify factors that contribute to monitoring errors, and
- Offer operationally-oriented recommendations to
  - increase awareness of this subject
  - improve crew monitoring

ASRS Monitoring Study: Flight Phase where Monitoring Errors Occurred



ASRS Study: Number of tasks crew was doing when error occurred*



Number of tasks crew was doing shortly before or during the initiation of the monitoring error.

ASRS study significant findings

- 76 percent of monitoring errors occurred when aircraft was climbing, descending or on approach ("vertical flight phase")
- 30 percent of the reports indicated that pilots were programming the FMS shortly before or during the monitoring error

ASRS Study Cornerstones for Improving Monitoring

- Management and regulatory officials must provide crews with clearly thought-out procedures and guidelines to maximize monitoring.
- Flight crews must constantly exercise monitoring discipline and use operational guidelines designed to improve monitoring.

US Airways Approach to Improving Monitoring

Developing well thought-out SOPs

Training monitoring skills

Practicing those skills

US Airways Approach to Improving Monitoring

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Developing SOPs

AC 120-71A "Standard Operating Procedures"

- Revised in February 2003, this AC contains template SOPs that can be adopted by operators to improve monitoring.

www.aviatrends.com

Developing SOPs

- Change title of "Pilot-Not-Flying" (PNF) to "Pilot Monitoring" (PM)
  - Describes what the pilot should be doing (monitoring) versus what he/she is not doing (not flying)

Developing SOPs

Monitoring Responsibility

– The PF will monitor/control the aircraft, regardless of the level of automation employed.

– The PM will monitor the aircraft and actions of the PF.

Monitoring is a <u>primary responsibility</u> of each pilot.

Developing SOPs

- **Both pilots** will have taxi charts available, when necessary
- **Both pilots** will monitor taxi clearance
- Captain will verbalize to FO any hold short instructions
  - FO will request confirmation from Captain if not received

Developing SOPs

- When approaching an entrance to an active runway, **both pilots** will ensure the hold short or crossing clearance is complied-with before continuing with non-monitoring tasks (FMS programming, ACARS, company radio calls, etc.)

Developing SOPs

- During high workload, FMS inputs will be made by PM, upon the request of PF.

  High workload examples

  – below 10,000 feet

  – within 1000 feet of level off or Transition Altitude.

Developing SOPs

- Perform non-essential duties/activities during lowest workload periods (e.g., cruise altitude or level flight)
- When able, brief anticipated approach prior to top-of-descent
- PF will brief PM where or when delayed climb or descent will begin
- During the last 1000 feet of altitude change, both pilots will focus on making sure the aircraft levels at the assigned altitude
- US Airways eliminated "10,000 ft announcements" and specified that the pre-arrival announcement be conducted just after leaving cruise altitude.

US Airways Approach to Improving Monitoring

Developing well thought-out SOPs

Training monitoring skills

Practicing those skills

Training monitoring skills

"First, we must change our approach to monitoring. Instructors must (teach and) insist that the non-flying crewmember monitors the flier effectively."

"Good monitoring skills are not inherent in pilots as they progress in their careers. Therefore, effective monitoring techniques must be trained and rewarded."

- Captain Frank J. Tullo

"Aviation Week and Space Technology," May 21, 2001

Training monitoring skills

- NTSB safety study states that simulator training provides a good opportunity to teach and practice monitoring and crosschecking.
  - – NTSB Safety Study of Crew-caused Accidents

Training monitoring skills

- Starting from day 1 of training, ensure all monitoring/ crosschecking SOPs are followed.
- Discuss how barriers are cut in half with one pilot out of the loop.
- Train workload management so at least one pilot is always monitoring during low workload and both pilots are monitoring as much as possible during high workload.
- Acknowledge good monitoring.
  - Introduction of occasional subtle failures in simulator training, such as failure of automation to level-off at proper altitude

US Airways Approach to Improving Monitoring

Developing well thought-out SOPs

Training monitoring skills

Practicing those skills

Practicing monitoring skills

- Know and comply with SOPs
- Pilots must "actively monitor" the aircraft.
- This means that they must mentally fly the aircraft, even when the autopilot or other pilot is flying.
  - Monitor the flight instruments just as you would when hand flying.
  - If the aircraft (or other pilot) is not doing what it is supposed to do, actions should be taken to rectify the situation.

Practicing monitoring skills

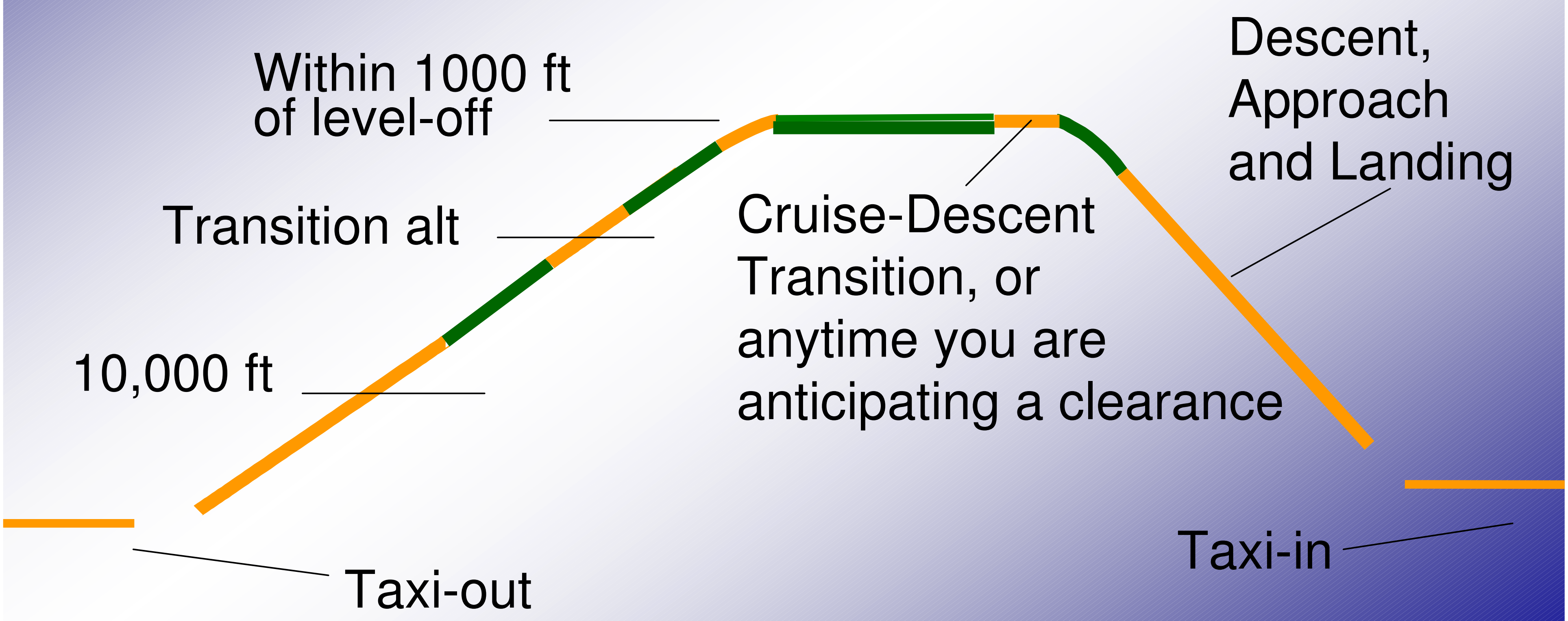
- In approximately one-third of the cases studied by researchers, pilots "failed to monitor errors, often because they had planned their own workload poorly and were doing something else at a critical time."
  - Jentsch, Martin, Bowers (1997)
- Threat and Error Management with a focus on monitoring and cross-checking is a good way to teach pilots better workload prioritization skills.

Practicing monitoring skills

- Pilots should recognize those flight phases where poor monitoring can be most problematic.
- Strategically plan workload to maximize monitoring during those areas of vulnerability (AOV)
  - Examples of non-monitoring tasks that should be conducted during lower AOV include stowing charts, programming the FMS, getting ATIS, accomplishing approach briefing, PA announcements, non-essential conversation, etc.

Practicing monitoring skills

Areas of Vulnerability



Practicing monitoring skills

- By pre-briefing the approach in low workload periods, greater attention can be devoted to monitoring/cross-checking during descent.
- In fact, US Airways LOSA data showed that crews who briefed the approach after Top-Of-Descent (TOD) committed 1.6 times more errors during the descent/ approach/land flight phase than crews who briefed prior to TOD.

Practicing monitoring skills

- One way of assessing your current monitoring ability is to ask: "How often do I miss making the 1,000' to level-off altitude callout?"
  - When this callout is missed, chances are that you are not actively monitoring the aircraft.

Paradigm shift

It must become accepted that monitoring is a "core skill," just as it is currently accepted that a good pilot must posses good "stick and rudder" and effective communicational skills.

Summary

- Inadequate flight crew monitoring has been cited by a number of sources as a problem for aviation safety.
- While it is true that humans are not naturally good monitors, crew monitoring performance can be significantly improved through policy changes, training and by pilots following an active monitoring concept.

The challenge

Take this concept home with you and implement a program to improve monitoring/cross-checking at your company.

"If I had been watching the instruments, I could have prevented the accident."

- FO after being involved in fatal CFIT accident