

Threat and Error Management (TEM) and Line Operations Safety Assessment (LOSA) Training

February 2012 (v3)



Threat and Error Management

Learning Objectives



- **After this training, you should be able to:**
 - **Describe what threats are and how to identify and manage them.**
 - **Describe what errors are and how to identify and manage them.**
 - **Describe the threat and error management process.**

What is a Threat?

- **Any condition that increases the complexity of the operation.**
- **Threats, if not managed properly, can decrease safety margins and can lead to errors.**
- **“Threats should serve as a Red Flag.”**
 - **Watch out!**
 - **Something bad can happen!**



Types of Threats

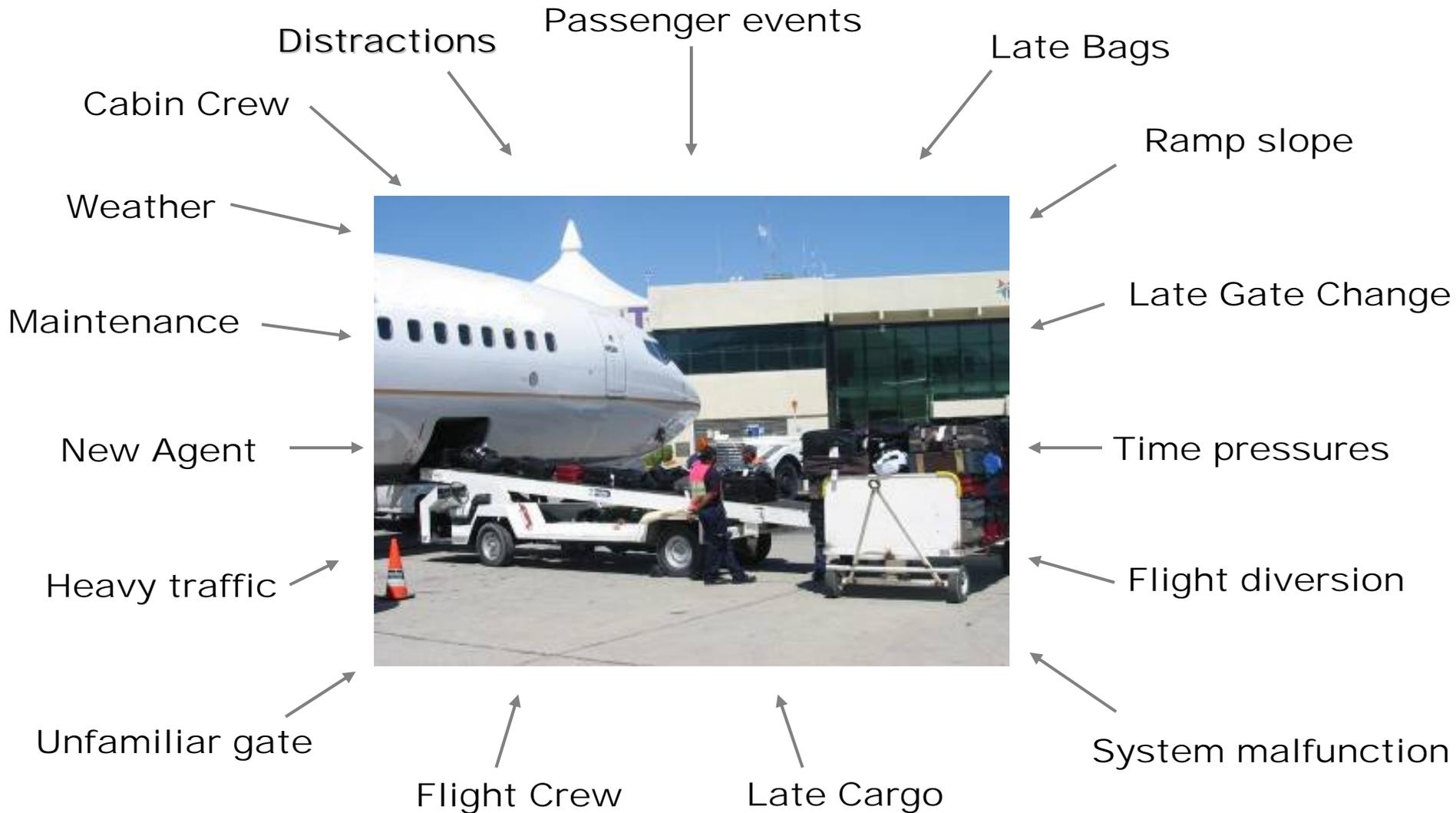
- **There are two types of threats**
 - **External Threats** – Those outside of your control (e.g., weather, lack of equipment, hard to understand documentation, system errors, inadequate lighting)
 - **Internal (Human) Threats** – Those within our control (e.g., fatigue, loss of situation awareness, stress, disregard for following procedures)

What is an Error?

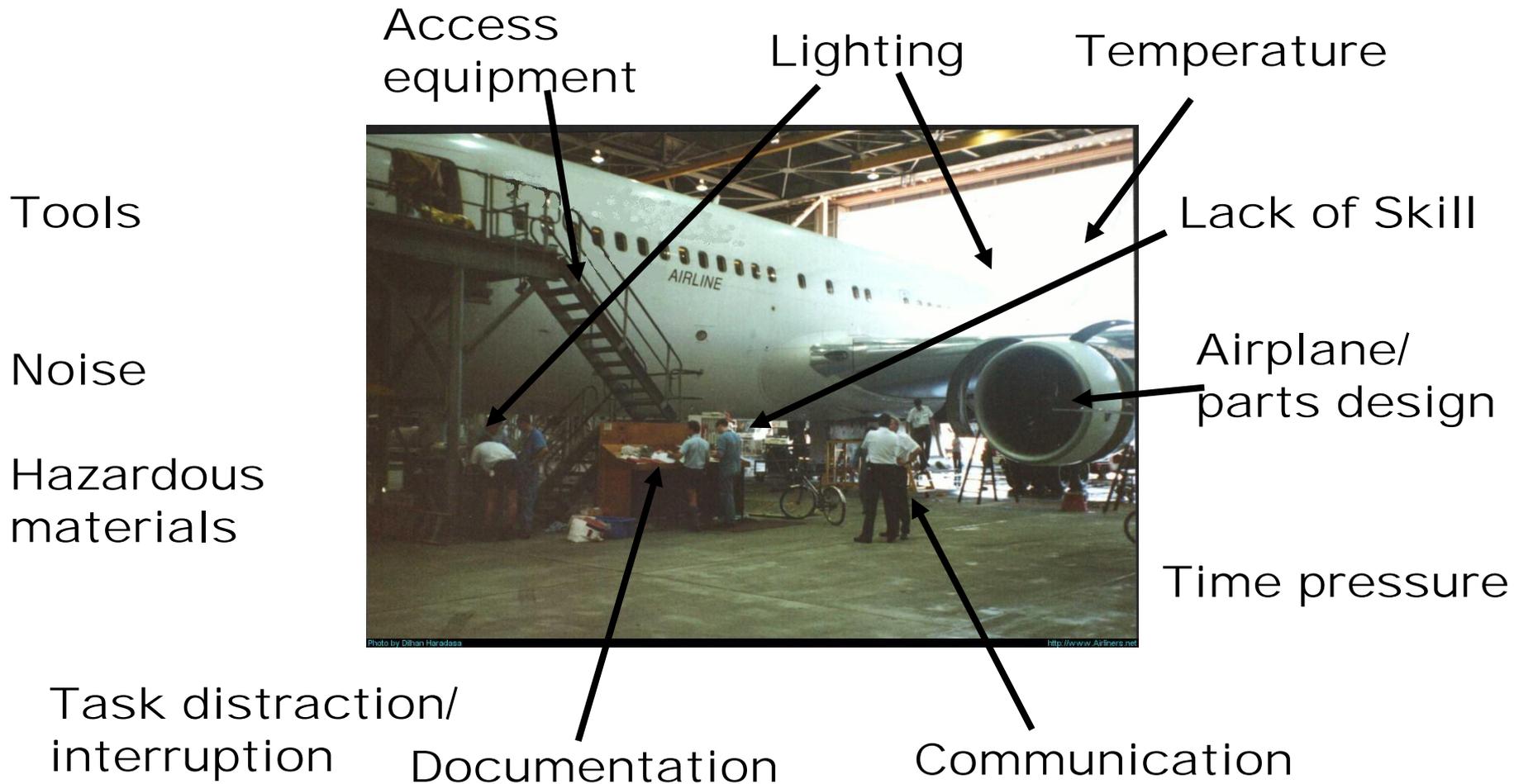
- **The mistake that is made when threats are mismanaged.**
- **There are 5 types of errors:**
 1. **Intentional non-compliance errors**
 2. **Procedural errors**
 3. **Communication errors**
 4. **Proficiency errors**
 5. **Operational decision errors**



Threats That Can Lead to Ramp Agent Error



Threats That Can Lead to Mechanic Error



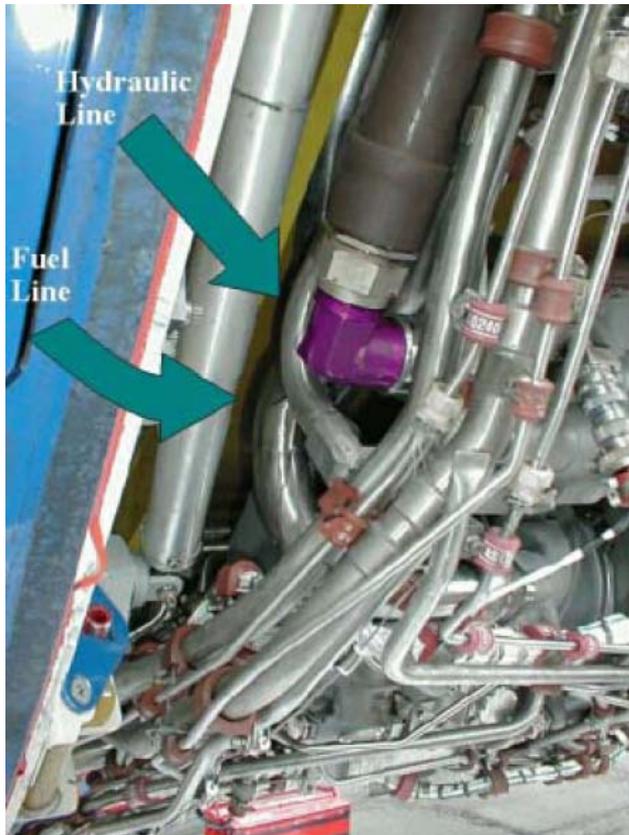
Example 1: Air Transat Flight 236

- **August 24, 2001: TS 236, an Airbus A330, departed from Toronto, Canada bound for Lisbon, Portugal with 293 passengers and 13 crew members.**
- **Flight ran out of fuel over the Atlantic Ocean**
- **Glided to emergency landing in the Azores**
- **0 fatalities; 18 injuries, most minor, none life-threatening**
- **8 of 12 tires are blown out**



Air Transat Flight 236 Investigation

- **The fuel leak was caused by an incorrect part installed in the hydraulics system.**
- **The replacement engine was supposed to be in the same configuration as the one removed.**
- **Initially the mx technicians left both the fuel line and the hydraulic line attached to the airplane. Due to differences in the configuration, the rigid fuel line had to be replaced but the flexible hydraulic line was retained.**
- **A mismatch between the fuel and hydraulic tubes resulted from the installation of the post-mod hydraulic pump and fuel tube assembly with the pre-mod hydraulic tube.**
- **Over time, chafing from vibration in the hydraulic line degraded the fuel line and caused the leak.**



Right Engine Pipe Contact



Fuel Pipe Crack and Scratches

Photo Courtesy of Aviation Accidents Prevention and Investigation Department, Government of Portugal

Threats of Flight 236

- **Maintenance Related**

- No requirements for conducting a pre-installation, configuration parity check.
- Time pressure to complete the work in time for a scheduled flight and to clear the hangar for an upcoming event.
- Due to the ill-fit hydraulic pump, the lead technician realized existence of both pre- and post-Service Bulletin (SB) configurations through searching Airbus Illustrated Parts Catalogue (IPC). However, the computer system used to access technical information was inoperative creating difficulty in accessing the Trent 772B and related SB's.

Threats of Flight 236 (cont'd)

- **Maintenance Related**

- No readily available, effective, commonly accepted method to compare the SB (configuration) status of engines, placing reliance on other processes to detect configuration differences.
- The post-installation quality control checks following the engine change did not specify checking the installation of the hydraulic pump, hydraulic tube, and fuel tube.

Threats of Flight 236 (cont'd)

- **Maintenance Related**
 - Neither the engine-receipt nor the engine-change planning process identified the differences in configuration between the removed and installed engine.

Threats of Flight 236 (cont'd)

- **Maintenance Related**

- The lead technician was unaware of the availability of standalone IPC CDs in the MCC.
- A mismatch resulted from the installation of the post-mod hydraulic pump and the post-mod fuel tube with the pre-mod hydraulic tube assembly.

Threats of Flight 236 (cont'd)

- **Maintenance Related**

- Fuel tube and hydraulic tube contacted with each other due to the mismatch. The fuel tube sustained a 3-by-1/8-inch fracture, which caused fuel leak and eventually fuel exhaustion.
- Despite the knowledge of the optional Rolls-Royce SB RB.211-29-C625, the SB was not reviewed during or following the installation of the hydraulic pump.

Threats of Flight 236 (cont'd)

- **Maintenance Related**

- The logbook entry detailing the installation of the fuel line from the replaced engine was not recorded.
- The technicians were not trained on the risk associated with the application of force while installing mixed-construction (including both rigid and flexible sections) lines.

Threat and Error Management Model

What is Threat Management?

- **Threat Management – There are two aspects to Threat Management:**
 1. **Recognizing that a threat exists**
 2. **Coming up with a strategy to deal with the threat, so that it does not reduce safety margins or contribute to an error**

Threat Management

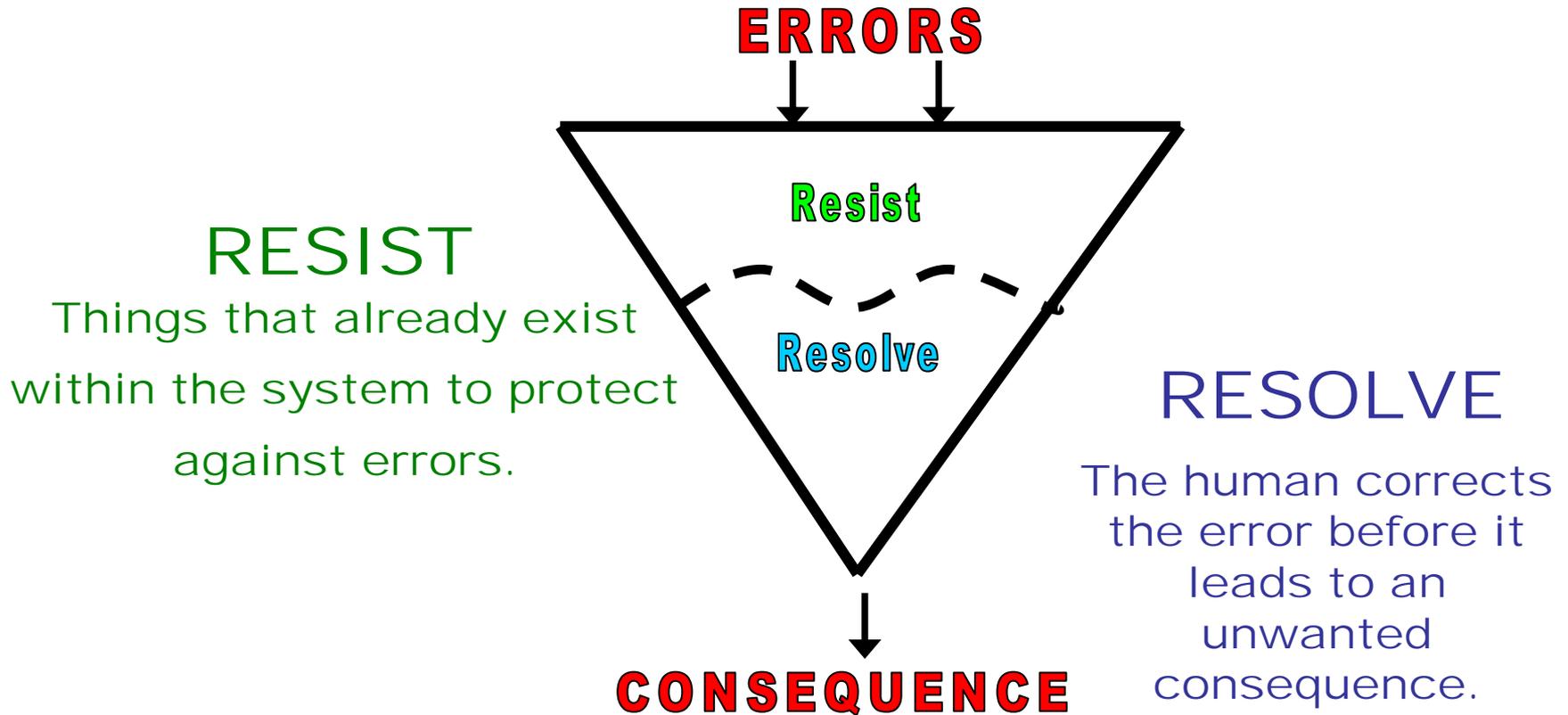
↓ **THREATS** ↓

Strategies

What is Error Management?

- **Error Management** – The mitigation or reduction in seriousness of the outcome.
 1. The resist and resolve filters or defense mechanisms may be applied to an existing error before it becomes consequential to safety.
 2. By applying the resist and resolve filters in the analysis of an error, you may:
 - **Improve strategies or counter-measures** to identify and manage both internal and external threats, like fatigue, condition of ground equipment, etc.

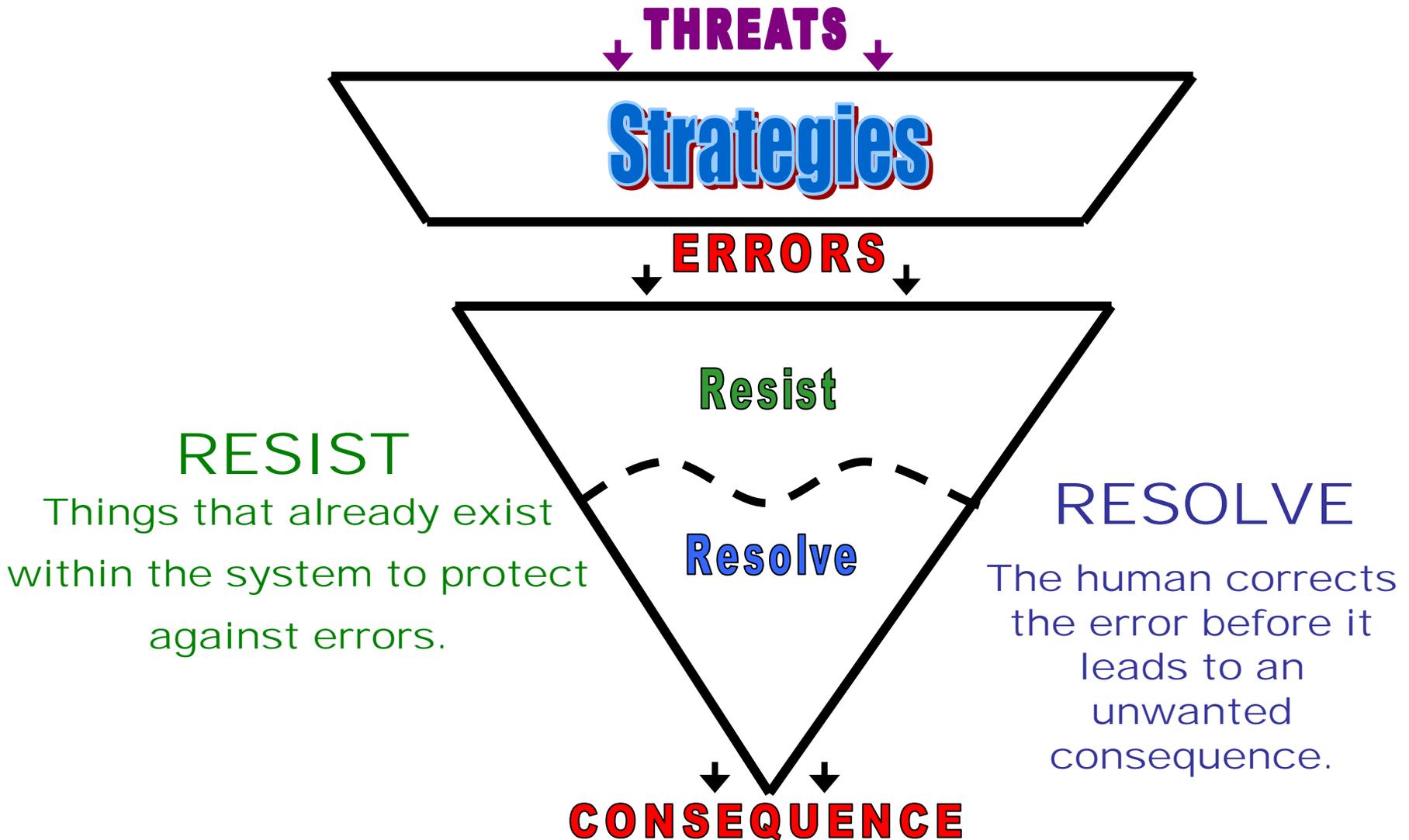
Error Management



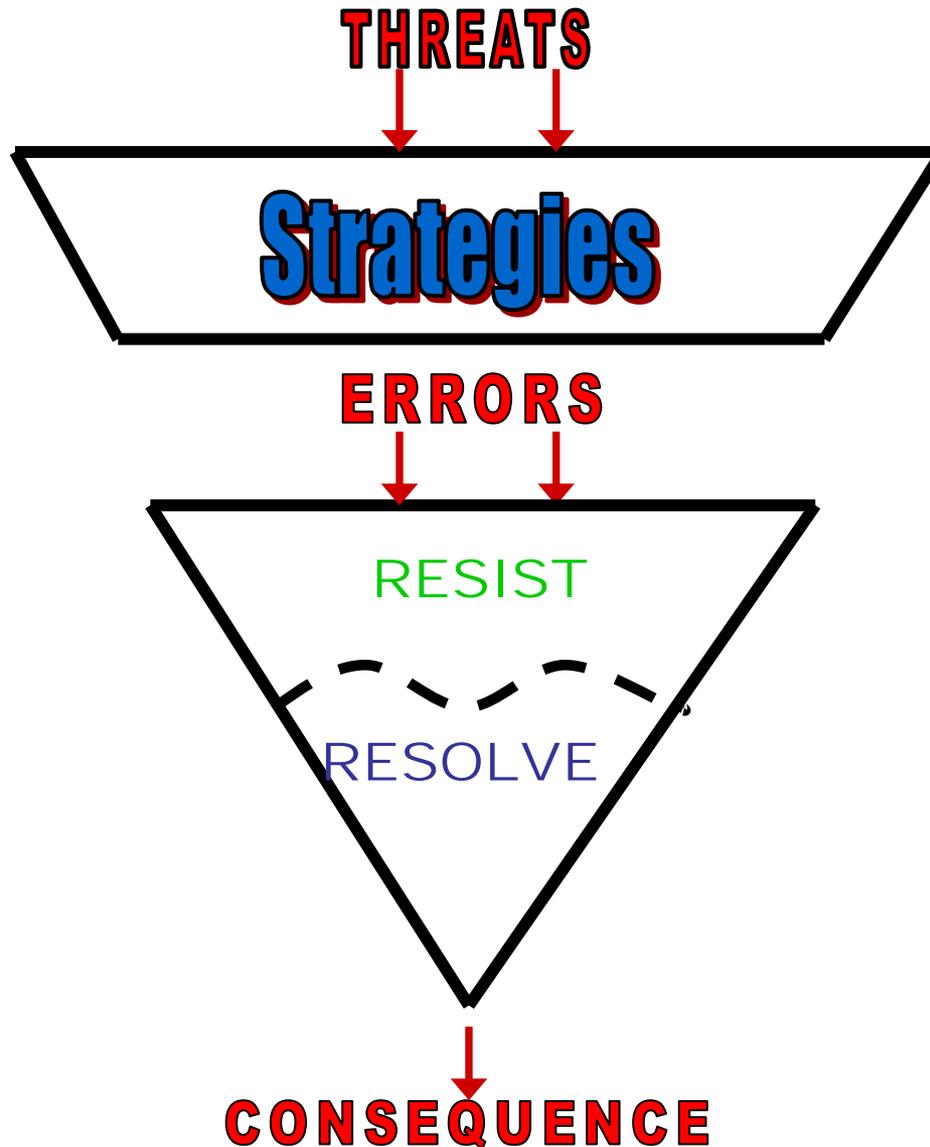
Error Outcome

- **There are three types of error outcomes:**
 1. **Inconsequential** – The error has no immediate effect on safety.
 2. **Undesired State** – Risk or unsafe operational conditions are increased.
 3. **Additional Error** – The error causes another error(s).

Threat & Error Management Model



Threat & Error Management Model



Requirements of TEM Analysis

- **Be Specific**
- **Use TEM language in reporting**
- **Identify Threats, Errors and Error Outcomes**
- **Identify “Resolve and Resist”
Strategies/Counter Measures already in place**
- **Recognize Human Factors affecting behavior
choices and decision making**
- **Recommend solutions for changes that lead
to a higher level of safety awareness**

Analyze the Failures

Consequences



Conclusions

- **Become a better Threat Manager**
 - Learn to actively identify threats in your operation
 - Learn strategies for managing threats
- **Become a better Error Manager**
 - Learn to look for errors that you have made and correct them before they lead to unwanted consequences
 - Understand why the Resist and Resolve aspects of Error Management did not work, and...
 - Find better strategies to deal with the threats that lead to the error, or
 - Fix threats (like broken equipment) that lead to the error
- **Continue building a Safety Culture by encouraging open, honest communications**

Quiz – Question #1

Which is an internal threat?

- A Stormy Weather**
- B Dark Night**
- C Fatigue**
- D Late arriving aircraft**

Quiz – Answer #1



- **That is correct, fatigue is one of the many internal threats. Other examples are distractions, lack of knowledge, and complacency**
- **Stormy weather, dark night, and late arriving aircraft are examples of external threats.**

Quiz – Answer #1



- **That is incorrect, stormy weather is an external threat. The correct answer would be fatigue.**
- **Example of internal threats would be fatigue, distractions, lack of knowledge, and complacency.**
- **Examples of external threats would be stormy weather, lack of communication, poor lighting conditions, and delayed aircraft.**

Quiz – Answer #1



- **That is incorrect, dark night is an external threat. The correct answer would be fatigue.**
- **Example of internal threats would be fatigue, distractions, lack of knowledge, and complacency.**
- **Examples of external threats would be stormy weather, lack of communication, poor lighting conditions, and delayed aircraft.**

Quiz – Answer #1



- **That is incorrect, late arriving aircraft is an external threat. The correct answer would be fatigue.**
- **Example of internal threats would be fatigue, distractions, lack of knowledge, and complacency.**
- **Examples of external threats would be stormy weather, lack of communication, poor lighting conditions, and delayed aircraft.**

Quiz – Question #2

A threat is anything that increases operational complexity and, if not managed properly, can decrease safety margins and can lead to errors.

A True

B False



Quiz – Answer #2



- **That is correct, a threat is anything that increases operation complexity and, if not managed properly, can decrease the safety margins.**
- **These could be External Threats (weather, system errors, working environment) or Internal (human) Threats (fatigue, preoccupation, disregard for procedures)**

Quiz – Answer #2



- That is incorrect, a threat is anything that increases operation complexity and, if not managed properly, can decrease the safety margins.
- These could be External Threats (weather, system errors, working environment) or Internal (human) Threats (fatigue, preoccupation, disregard for procedures)

Quiz – Question #3

Errors are mistakes that are made when threats are managed incorrectly.

A True

B False

Quiz – Answer #3



- **That is correct, errors are mistakes that are made when threats are mismanaged.**
- **There are 5 types of errors**
 - **Intentional non-compliance errors**
 - **Procedural errors**
 - **Communication errors**
 - **Proficiency errors**
 - **Operational decision errors**

Quiz – Answer #3



- **That is incorrect, errors are mistakes that are made when threats are mismanaged. If threats are correctly managed they would not turn into errors.**
- **There are 5 types of errors**
 - **Intentional non-compliance errors**
 - **Procedural errors**
 - **Communication errors**
 - **Proficiency errors**
 - **Operational decision errors**

Quiz – Question #4

Which is an error outcome?

A Inconsequential

B Undesired State

C Additional Error

D All of the above

Quiz – Answer #4



- **That is correct, all of the above are possible outcomes to an error.**
- **The three types of error outcomes are: Inconsequential, Undesired State, and Additional Errors.**

Quiz – Answer #4



- **That is incorrect, because it is incomplete. Inconsequential is only one of the possible outcomes. The correct answer would be all the above, because inconsequential, undesired state, and additional error are all possible outcomes to an error.**

Quiz – Answer #4



- **That is incorrect, because it is incomplete. Undesired state is only one of the possible outcomes. The correct answer would be all the above, because inconsequential, undesired state, and additional error are all possible outcomes to an error.**



Quiz – Answer #4



- **That is incorrect, because it is incomplete. Additional error is only one of the possible outcomes. The correct answer would be all the above, because inconsequential, undesired state, and additional error are all possible outcomes to an error.**



Line Operation Safety Assessment (LOSA)

Learning Objectives



- **After this training you will be able to:**
 - **Define LOSA**
 - **Describe the characteristics and benefits of LOSA**
 - **Identify the goals of LOSA**
 - **Outline the steps necessary to integrate LOSA into your organization**
 - **Understand how LOSA fits into a SMS**

LOSA Background

What is LOSA?



- **Line Operations Safety Assessment**
 - A tool for collecting safety data
 - Organizational self-assessment
 - Observing routine operations for both safe and at risk behaviors
 - Voluntary, non-threatening, non-punitive observation

Threat and Error Management & LOSA?

- LOSA is grounded within the threat and error management (TEM) framework.
 - Threats increase the complexity and can decrease the safety margins.
 - Errors reduce the safety margin and increase the chances of adverse events.





**Trusted &
Trained
Observers**



**Peer-to-Peer
Observations**



**Management &
Labor Agreement**



**Inform
Workforce**

**LOSA
Characteristics**



Non-punitive



**Targeted
Enhancements**



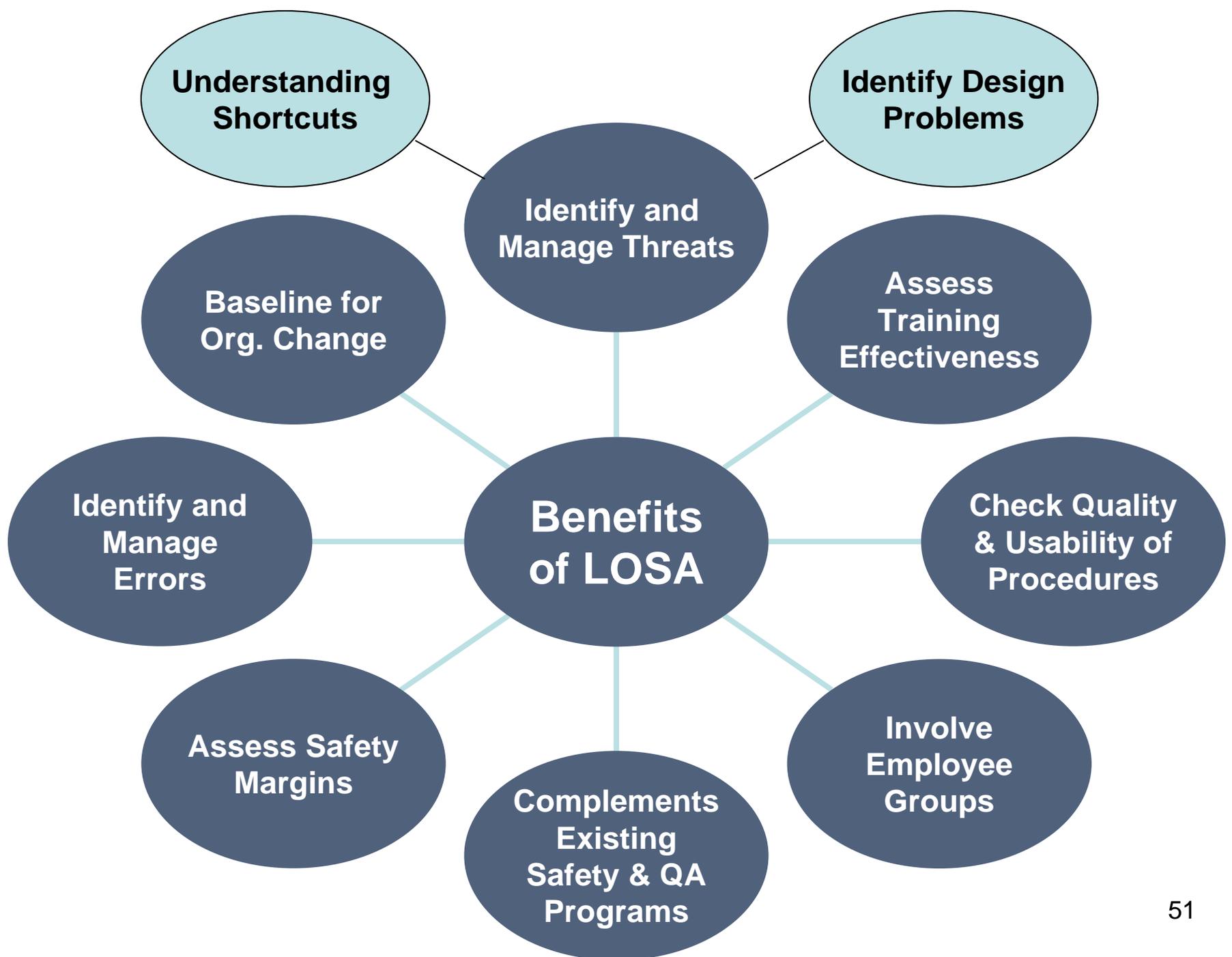
**Secure &
Private**



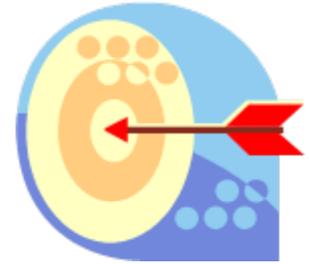
**Systematic
Observations**



Volunteers



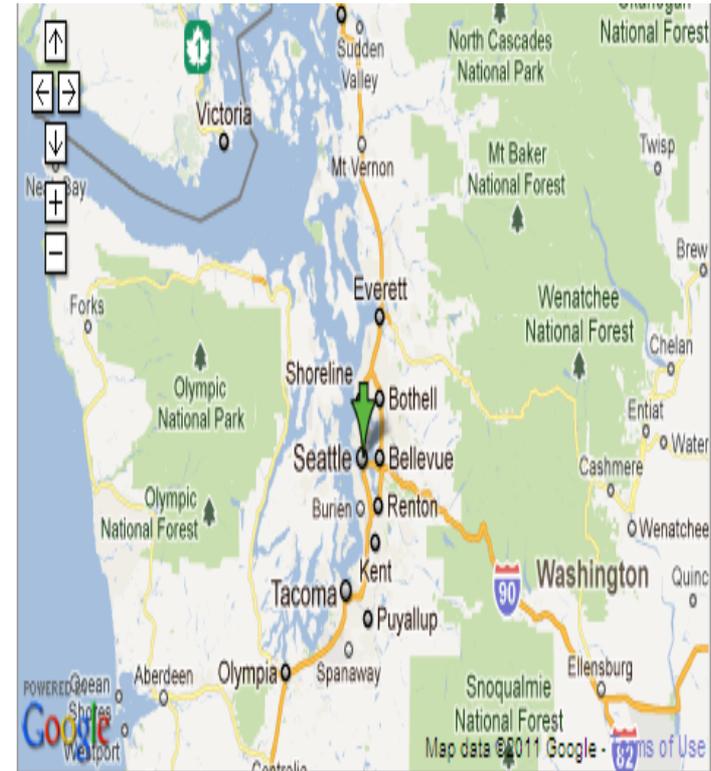
Goals/Intent of LOSA



- **Observe day-to-day work behaviors during normal operations**
- **Discover procedural and systemic threats and errors**
- **Reduce injuries & equipment and A/C damage**
- **Generate baseline data, implement new changes, and generate follow-up data to assess effectiveness**

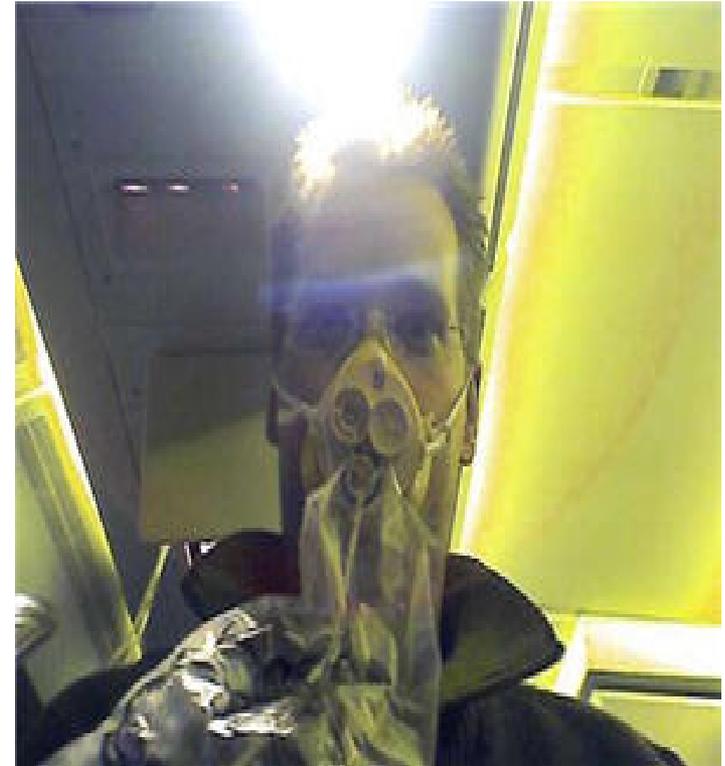
Example 2: Alaska Airlines Flight 536

- **December 26, 2005: Alaska Airlines Flight 536 departed from Seattle, WA bound for Burbank, CA with 136 passengers and 5 crew members.**
- **Probable Cause discovered by the NTSB: At Sea-Tac earlier that day, ramp worker hit A/C with a baggage loader.**
- **The contact from the above unreported incident caused a 12 by 6 inch hole in the A/C, which caused a decompression during the climb to cruise.**



Alaska Airlines Flight 536 (cont'd)

- **A/C did pressurize on climb out because baggage that got stuffed into the tear helped hold pressure.**
- **A/C experienced a rapid cabin depressurization during climb out at approximately 26,000 feet.**
- **Returned to airport with no injuries**



Alaska Airlines Flight 536 Investigation

- Post landing examination of the fuselage revealed a 12 by 6 inch hole between the middle and forward cargo doors on the right side of the airplane.
- Ramp worker said he did not know he had hit the A/C; however, after the occurrence, he confessed that he had “grazed the airplane” with a tug, while attempting to depart the vicinity of the airplane.

Threats of Alaska Airlines Flight 536

- **T/B. Ground Equipment**
 - T/B 5.1 Motorized equipment: Bag tug
- **T/E Ground Based**
 - T/E 6.1 Congestion: Equipment Parking
- **T/F Human Factors**
 - T/F 8 Knowledge/skills/experience level
 - T/F 16 Situational Awareness

Threats of Alaska Airlines Flight 536 (cont'd)

- **T/I Environmental Threats**
 - T/I 6 Rain
- **T/G Operational**
 - T/G 16 Perceived time pressure

Errors of Alaska Airlines Flight 536

- **E/A General Safety**
 - **E/A 8 Equipment contacting other equipment**
 - **E/A 38 Communication procedures not followed**

How does LOSA fit into a SMS?

LOSA

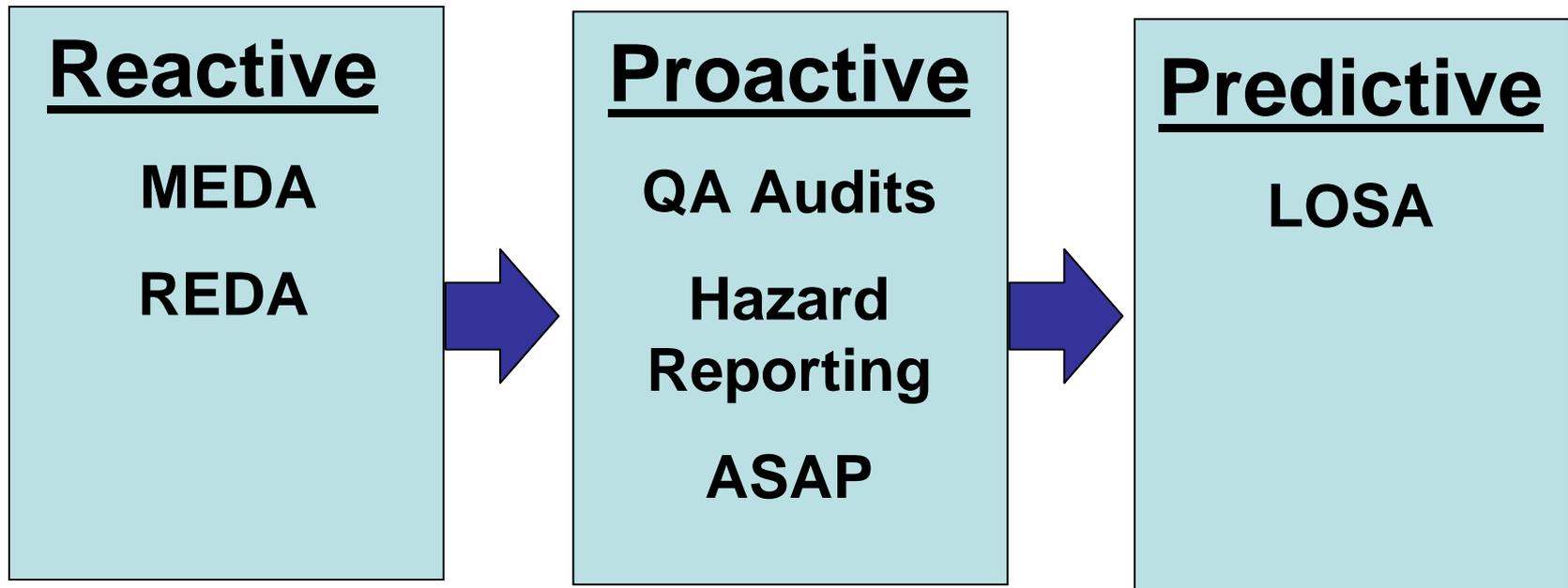
FOQA Your Safety ASAP
Programs

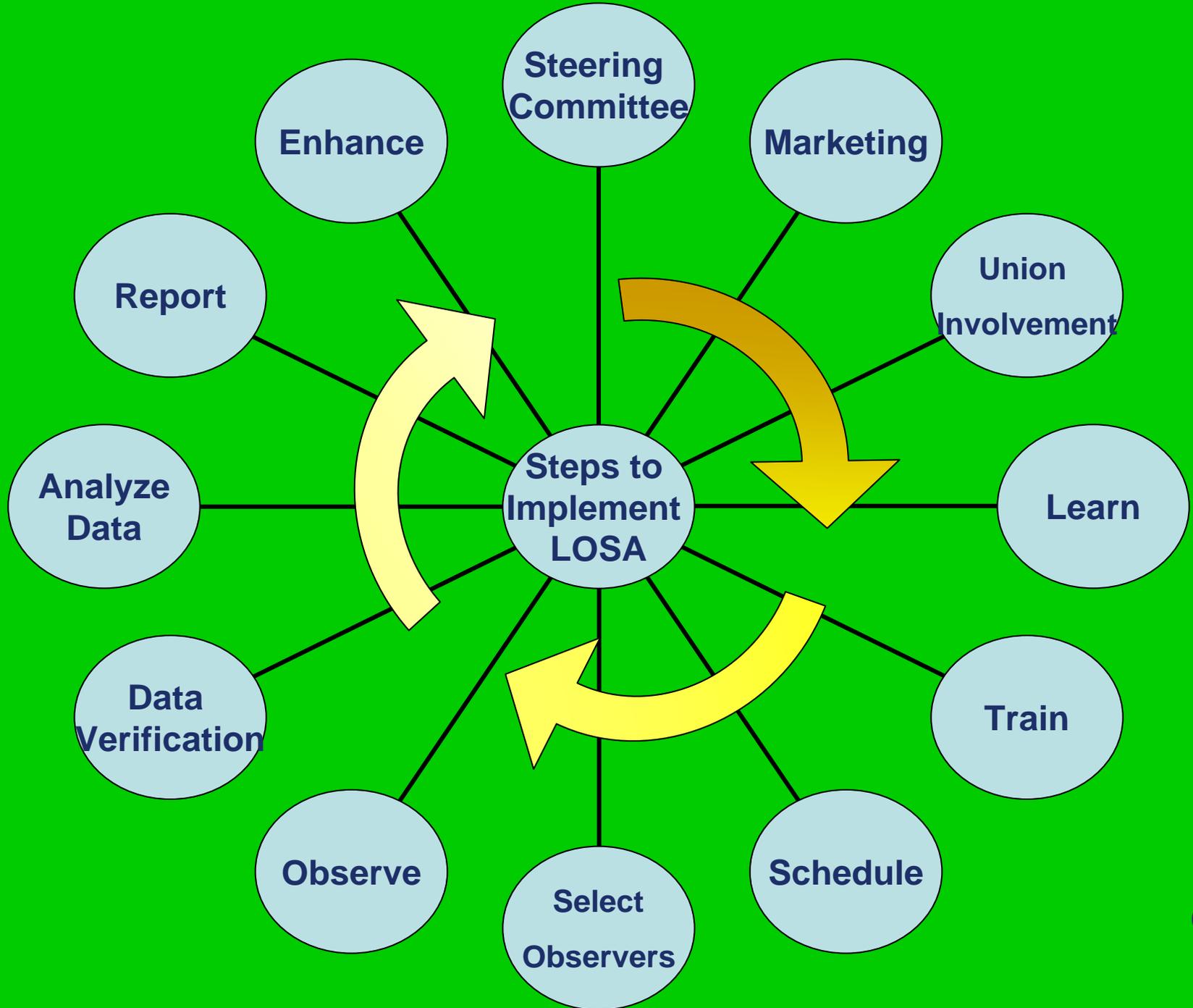
MEDA/
REDA



CASS

Safety Culture Shift for Hazard Identification





What to expect of LOSA observers?

- **Observers will record and code:**
 - Threats
 - Whether the threats were managed or mismanaged
 - Errors
 - Identify the outcomes of the errors
- **Observers do not intervene unless there is an imminent safety issue or if an aircraft would be flown in a non-airworthy condition.**



What is expected of those being observed during a LOSA?

- **During a LOSA observation you should:**
 - **Continue normal duties and behaviors**
 - **Not be interrupted by the observer in the middle of a task**
 - **Answer a few demographics questions after being observed (optional)**

What makes LOSA successful?

- Involvement from Management & Labor to frontline employees
- Observer being a fly-on-the-wall
- Trusted/trained co-workers as observers
- Anonymity and non-punitive actions for those being observed (e.g., no tattletale)
- Feedback to employees



Quiz – Question #1

LOSA observations should take place during normal operations.

A True

B False



Quiz – Answer #1



- **That is correct, LOSA observations should take place during normal operations.**

Quiz – Answer #1



- **That is incorrect, LOSA observations should take place during normal operations.**

Quiz – Question #2

Which of the following is not a LOSA characteristic?

- A** Use trained company personnel as LOSA observers
- B** Follow any unsafe findings with disciplinary action
- C** Ensure top management support
- D** Protect anonymity of those observed

Quiz – Answer #2



- That is correct, following any unsafe findings with punitive action is NOT one of the characteristics of a LOSA program.
- The characteristics are: peer-to-peer observations, systematic observation instrument based on Threat and Error Management, anonymous, confidential, and non-punitive, secure data collection repository, trusted and trained observers, voluntary participation, joint management/labor sponsorship, data-derived targets for enhancement, data verification, feedback of results.

Quiz – Answer #2



- That is incorrect, using trained company personnel as a LOSA observer is one of the characteristics of a LOSA. The correct answer would be follow any unsafe findings with punitive action; this is NOT one of the characteristics of a LOSA program.
- The characteristics are: peer-to-peer observations, systematic observation instrument based on Threat and Error Management, anonymous, confidential, and non-punitive, secure data collection repository, trusted and trained observers, voluntary participation, joint management/labor sponsorship, data-derived targets for enhancement, data verification, feedback of results.

Quiz – Answer #2



- That is incorrect, ensuring top management support is one of the characteristics of a LOSA. The correct answer would be follow any unsafe findings with punitive action; this is NOT one of the characteristics of a LOSA program.
- The characteristics are: peer-to-peer observations, systematic observation instrument based on Threat and Error Management, anonymous, confidential, and non-punitive, secure data collection repository, trusted and trained observers, voluntary participation, joint management/labor sponsorship, data-derived targets for enhancement, data verification, feedback of results.

Quiz – Answer #2



- That is incorrect, protecting anonymity of those observed is one of the characteristics of a LOSA. The correct answer would be follow any unsafe findings with punitive action; this is NOT one of the characteristics of a LOSA program.
- The characteristics are: peer-to-peer observations, systematic observation instrument based on Threat and Error Management, anonymous, confidential, and non-punitive, secure data collection repository, trusted and trained observers, voluntary participation, joint management/labor sponsorship, data-derived targets for enhancement, data verification, feedback of results.

Quiz – Question #3

How is LOSA beneficial?

- A** Identify and manage threats
- B** Collect field data for safety management system
- C** Identify strengths and weaknesses of operation
- D** Provide a mechanism to check procedural compliance
- E** All of the above

Quiz – Answer #3



- **That is correct, all the above are benefits to LOSA.**
- **The benefits are: identify threats in the operating environment, identify threats from within the operations, assess the degree of effectiveness of training, check the quality and usability of procedures, identify design problems in the human/machine interface, understand shortcuts and workarounds, assess safety margins, provide a baseline for organizational change, provide a rationale for allocation of resources.**

Quiz – Answer #3



- That is incorrect, because it is incomplete. Identifying and managing threats is just one of the benefits of a LOSA. The correct answer would be all of the above.
- The benefits are: identify threats in the operating environment, identify threats from within the operations, assess the degree of effectiveness of training, check the quality and usability of procedures, identify design problems in the human/machine interface, understand shortcuts and workarounds, assess safety margins, provide a baseline for organizational change, provide a rationale for allocation of resources.

Quiz – Answer #3



- That is incorrect, because it is incomplete. Collecting field data for safety management system is just one of the benefits of a LOSA. The correct answer would be all of the above.
- The benefits are: identify threats in the operating environment, identify threats from within the operations, assess the degree of effectiveness of training, check the quality and usability of procedures, identify design problems in the human/machine interface, understand shortcuts and workarounds, assess safety margins, provide a baseline for organizational change, provide a rationale for allocation of resources.

Quiz – Answer #3



- **That is incorrect, because it is incomplete. Identifying strengths and weaknesses of the operation is just one of the benefits of a LOSA. The correct answer would be all of the above.**
- **The benefits are: identify threats in the operating environment, identify threats from within the operations, assess the degree of effectiveness of training, check the quality and usability of procedures, identify design problems in the human/machine interface, understand shortcuts and workarounds, assess safety margins, provide a baseline for organizational change, provide a rationale for allocation of resources.**

Quiz – Answer #3



- That is incorrect, because it is incomplete. Providing a mechanism to check procedural compliance is just one of the benefits of a LOSA. The correct answer would be all of the above.
- The benefits are: identify threats in the operating environment, identify threats from within the operations, assess the degree of effectiveness of training, check the quality and usability of procedures, identify design problems in the human/machine interface, understand shortcuts and workarounds, assess safety margins, provide a baseline for organizational change, provide a rationale for allocation of resources.

Conclusions



- **LOSA provides a means for your organization to identify external (outside our control) and internal (within our control) threats.**
- **It should be conducted during routine operations.**
- **LOSA should use trained volunteers from the organization to do the observations.**

Conclusions (cont'd)



- **No punitive action will be taken as a result of LOSA findings.**
- **LOSA is a predictive hazard identification system for your SMS that can**
 - **Reduce your costs,**
 - **Improve safety, and**
 - **Improve efficiency.**

This concludes the training
of the introduction to
Line Operation Safety
Assessment.

Visit the LOSA website: www.MRLOSA.com

Acknowledgements: ATA/FAA Maintenance and Ramp Human Factors Taskforce