Controlled Flight Into Terrain (CFIT) Accidents' Analysis

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Presented by Blessing Kavai
Assistant Director Safety & Flight Operations-Africa & Middle East
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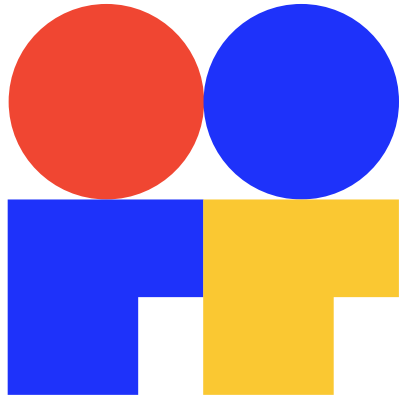
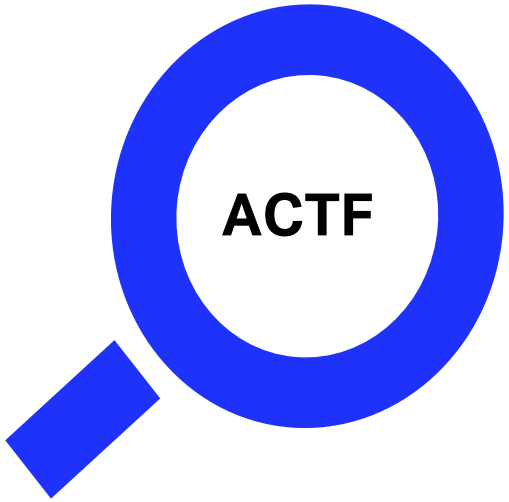
IATA Accident Classification Task Force

The ACTF is….

- Worldwide Safety Group with expert representation from:
  - Manufacturers
  - Airlines
  - Pilots Associations
  - Data Service providers
  - Equipment manufacturers, and
  - IATA
- Responsible, to IATA, for classifying accidents
- Charged with developing refined safety metrics and recommendations



IATA ACTF



How does the ACTF do its work?

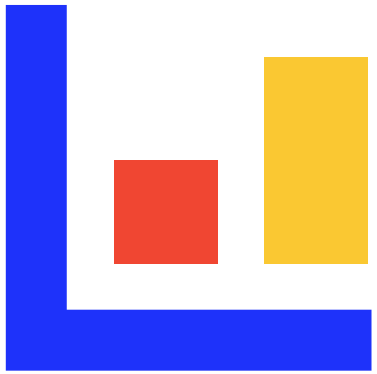
- Accident classification is based on
  - Threat and Error Management (TEM) taxonomy
  - Expert opinion
  - Use of assumptions
  - Processing the data
- Metrics and recommendations

- For a full list of TEM – refer to Safety Report 57th edition

Safety Performance

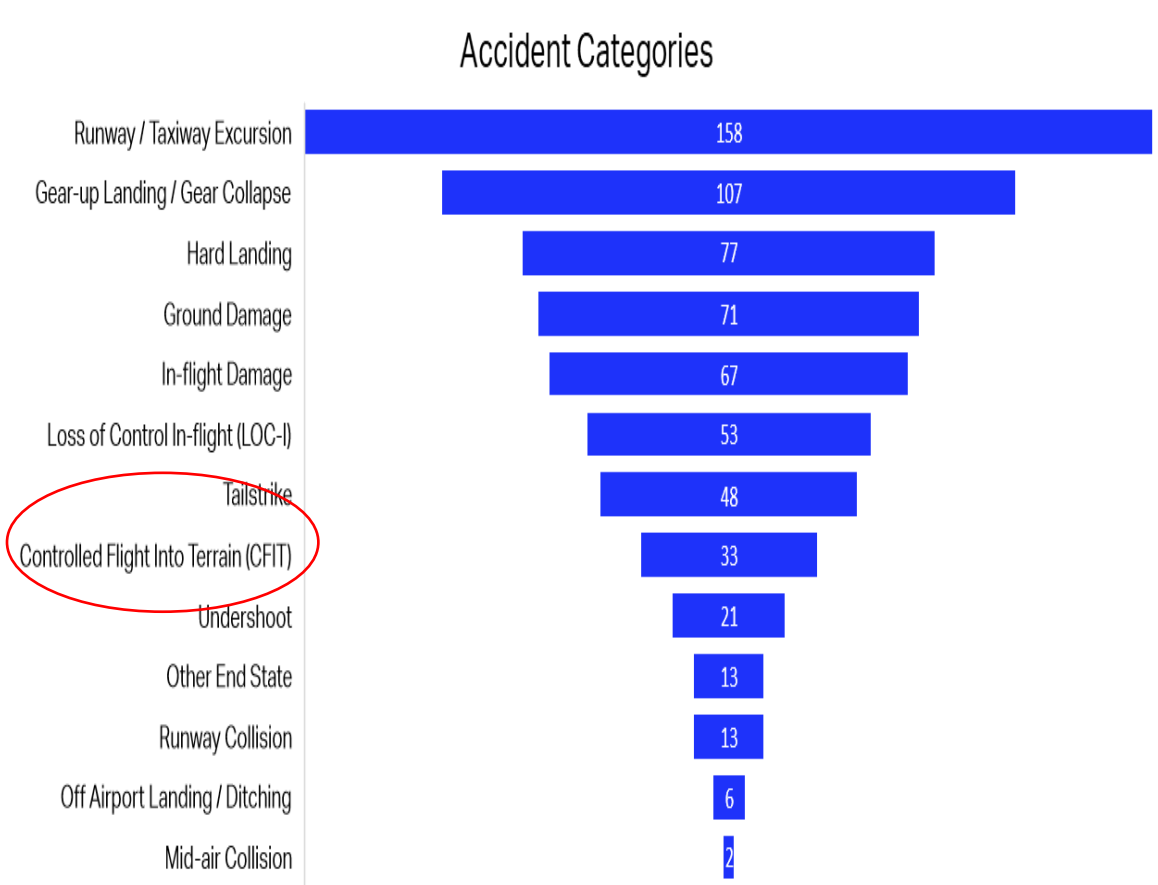
Review where safety performance is today compared with last 10 years

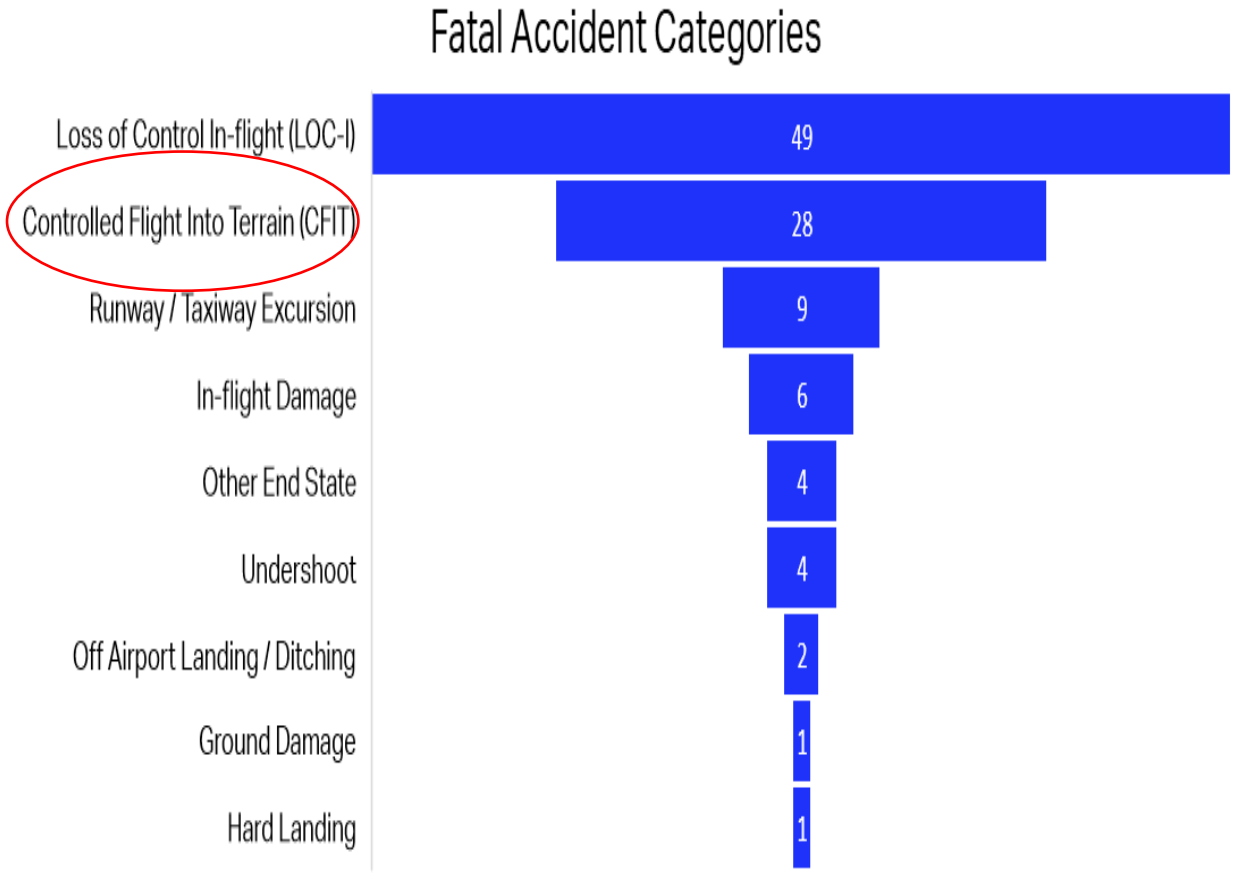
- Data analyzed from 2011-Half Year (HY) 2021 is used in this presentation
  - Data source: Global Aviation Data Management Accident Database eXchnage (GADM ADX)
- Loss of control inflight (LOC-I) and Controlled flight into terrain (CFIT) accidents continue to be the main source of fatal accidents
- This presentation focuses on analysis of CFIT accidents from
  - Global perspective
  - AFI based operators



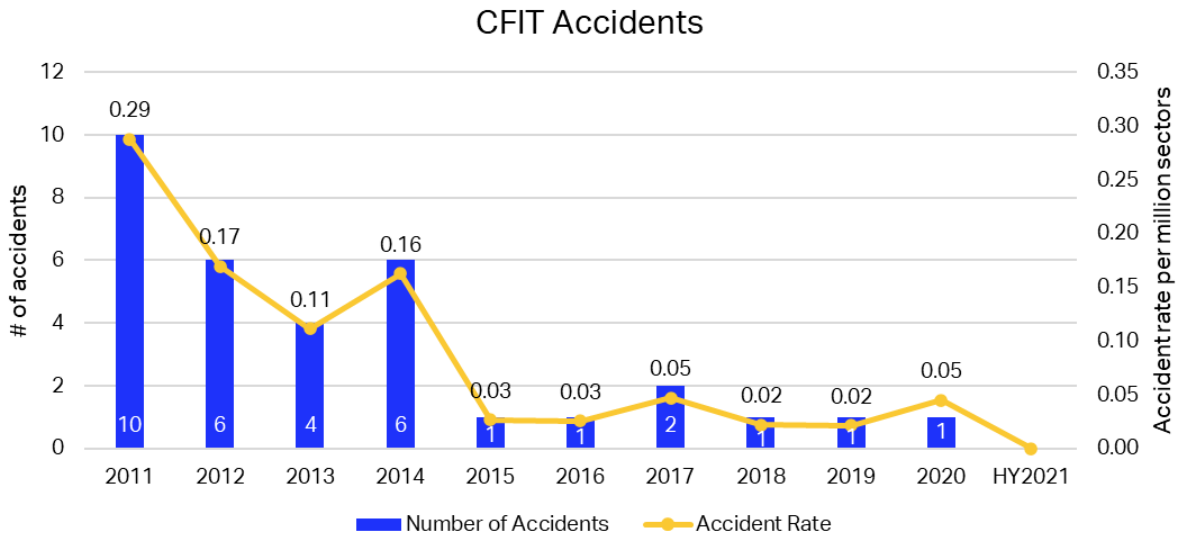
Accident Categories

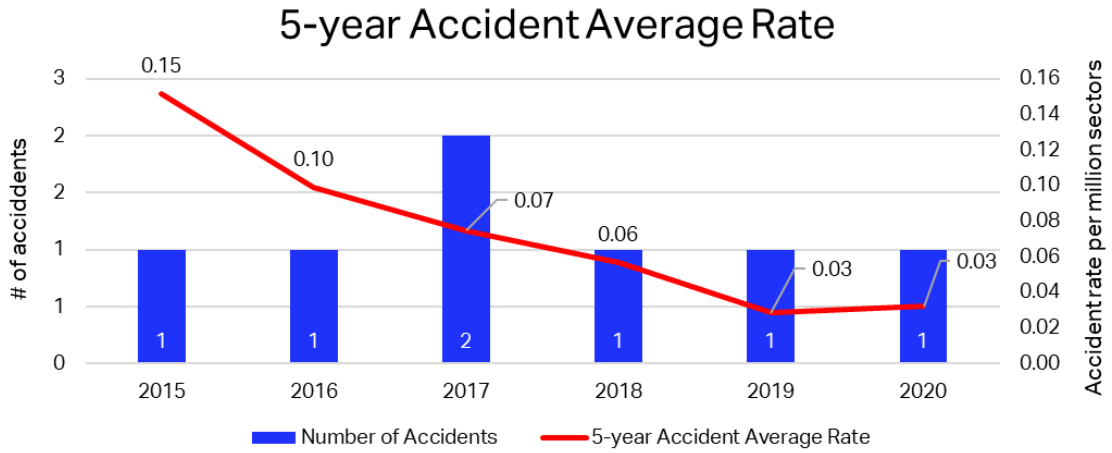
Accident Data: 2011-HY2021





CFIT Accidents - 5-Year Rolling Average





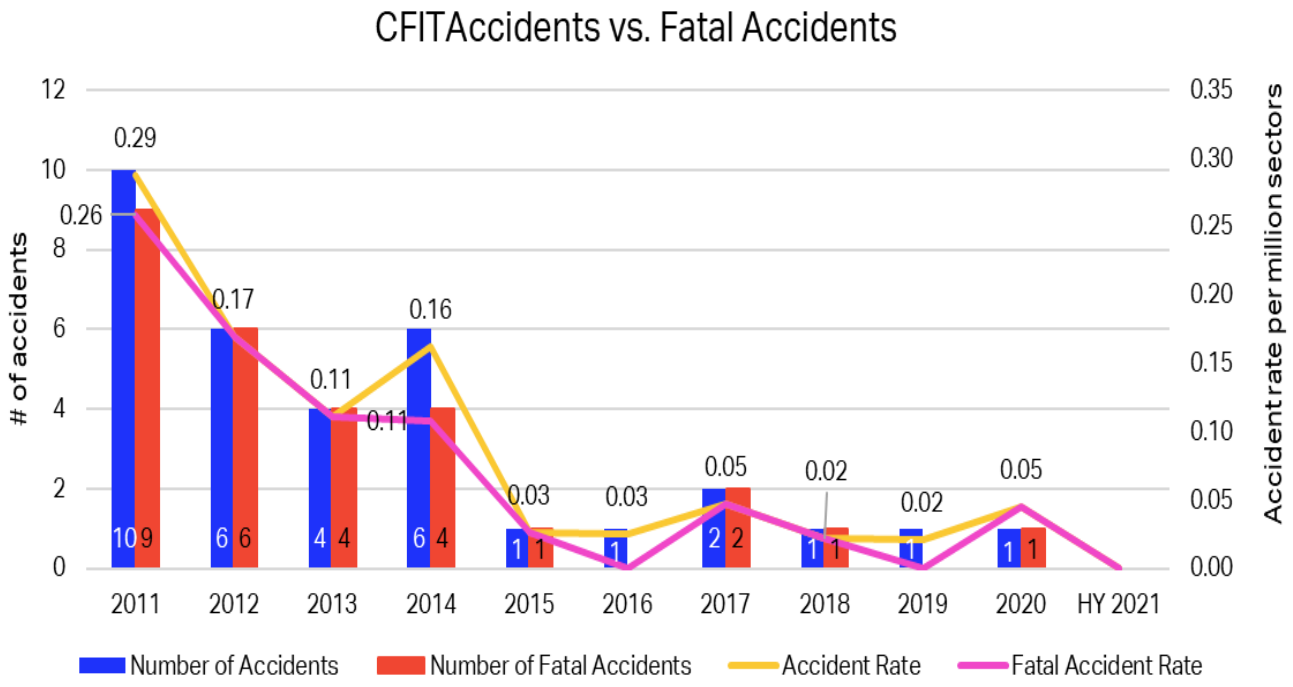
- 33 accidents from 2011-HY 2021
- Zero CFIT accidents in the first half of 2021
- 28 of which were fatal, resulting in 447 fatalities
- 3 involved IATA members and 5 involved IOSA carriers
- 17 operated on passenger flights and 15 on cargo flights

- Positive improvement if we look at the 5-year rolling average

- Insufficient data detracts from accurate safety analysis!
  - Need to encourage better data provision

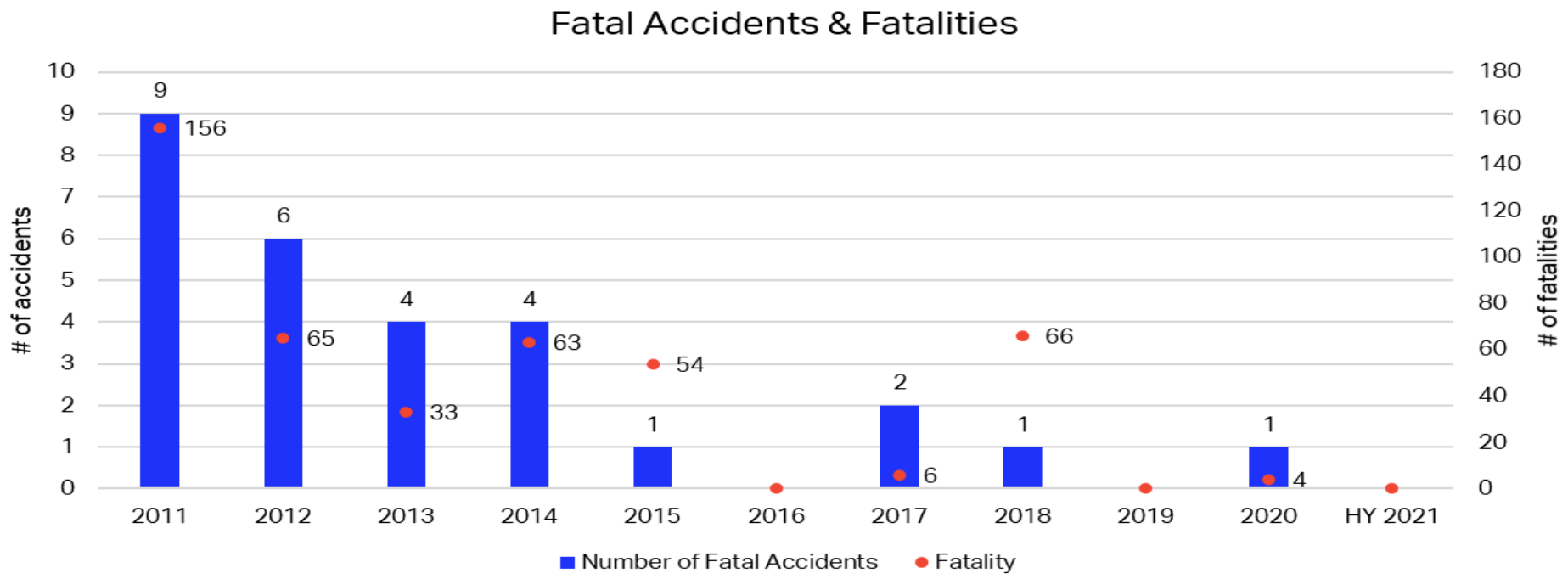
- 8 accidents (24%) could not be classified due to insufficient data

CFIT Accidents vs. Fatal Accidents

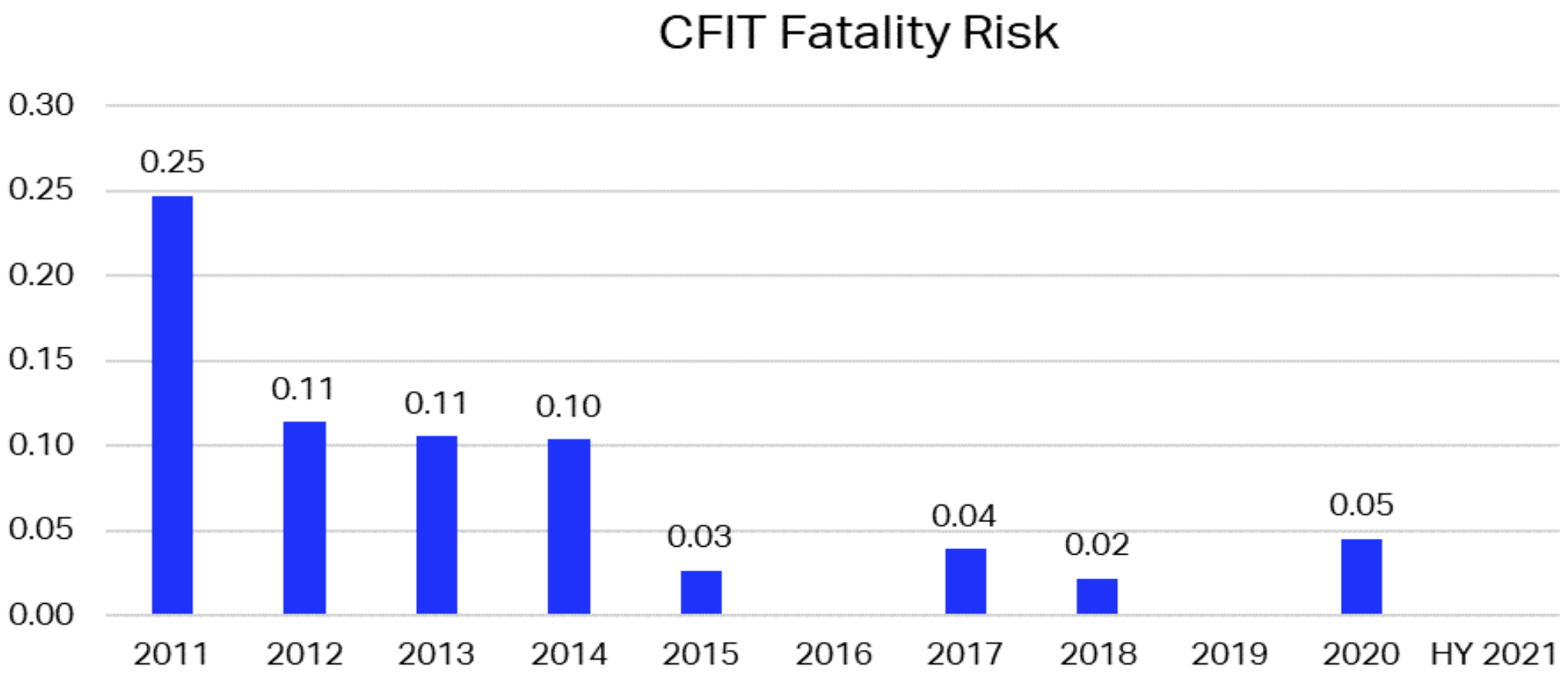


- All CFIT accidents occurring in 2012, 2013, 2015, 2017, 2018, and 2020 were fatal accidents
- The CFIT accidents in 2016 and 2019 were non-fatal accidents
- There were zero CFIT accidents reported in the first half of 2021

CFIT Fatal Accidents & Fatalities

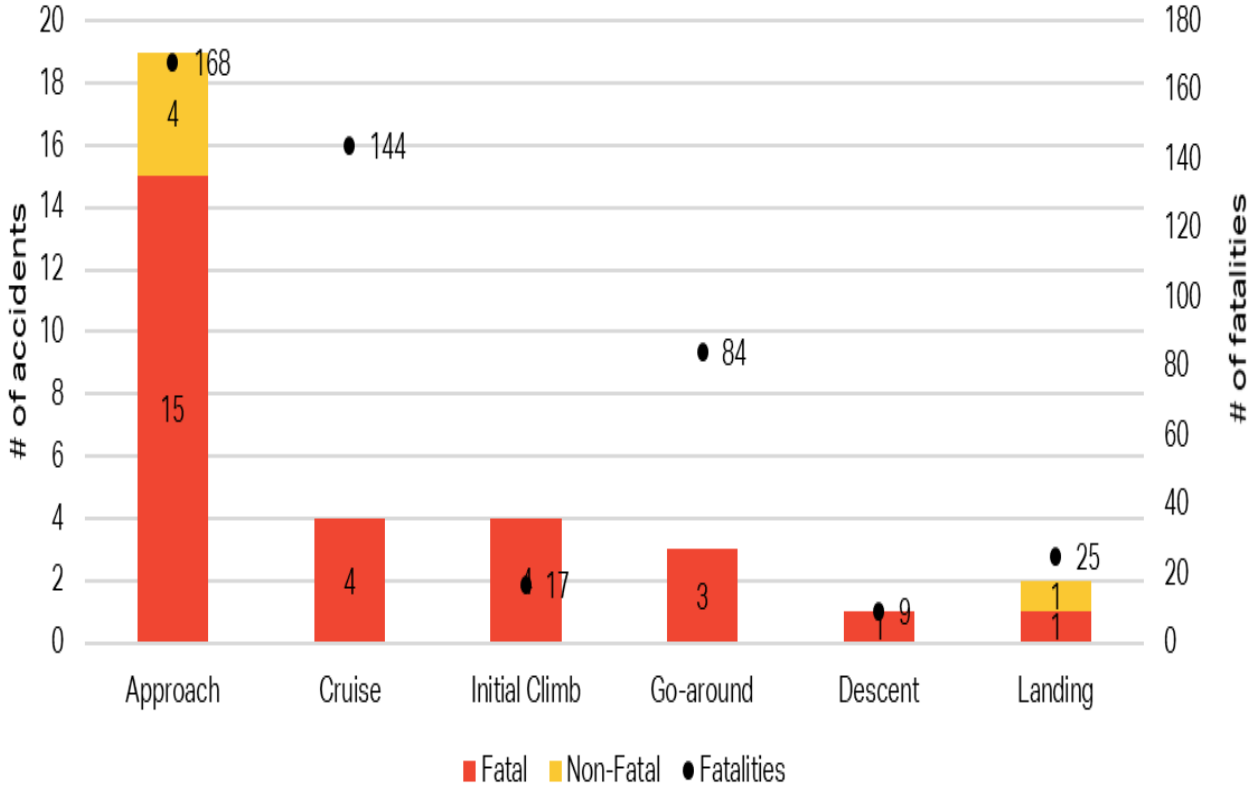


CFIT Fatality Risk
Accident Data: 2011-HY2021

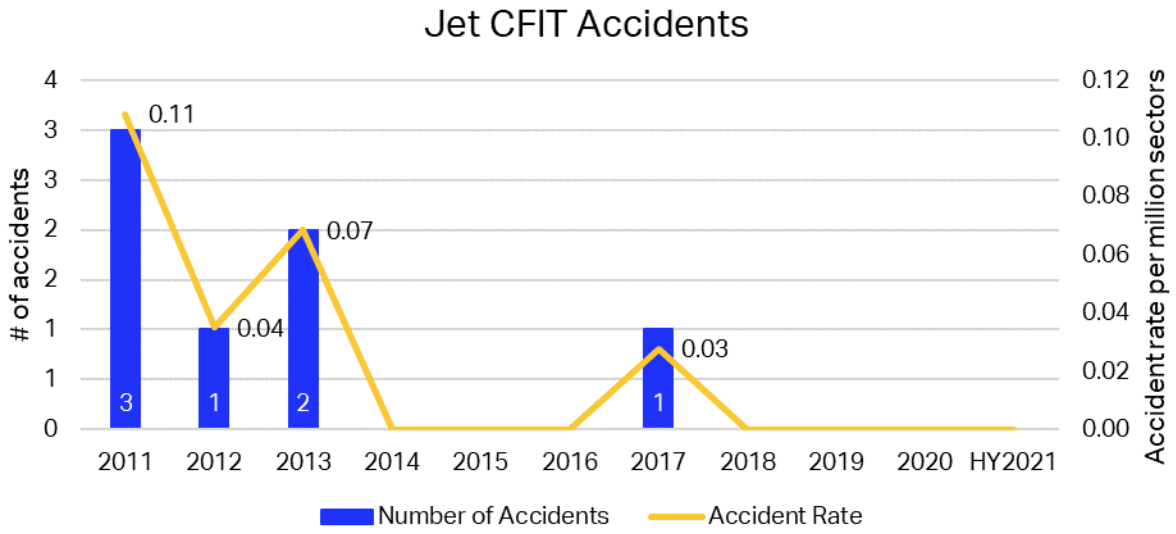


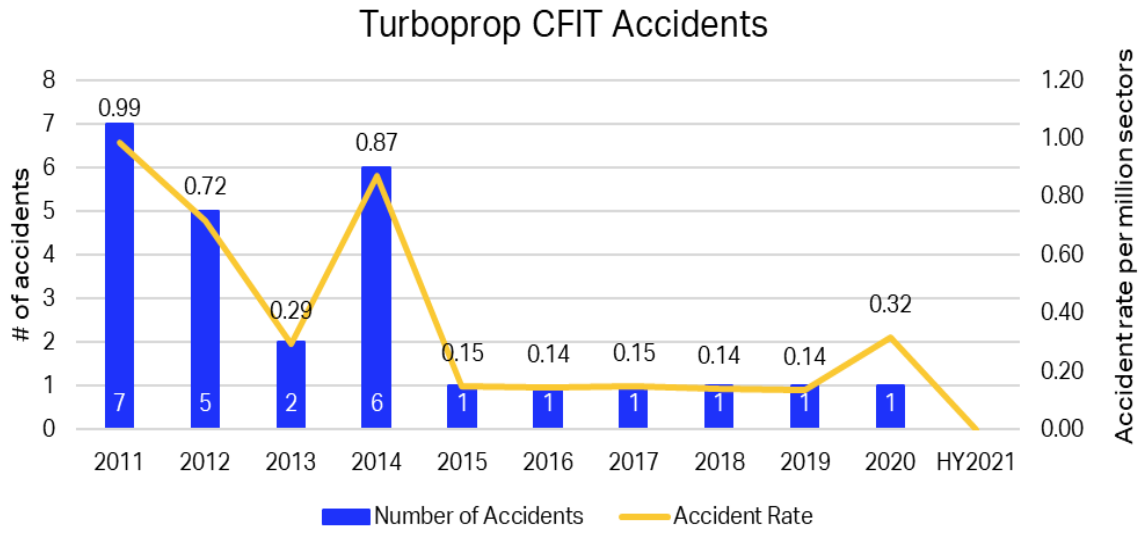
CFIT by Flight Regime
Accident Data: 2011-HY2021

- Fatalities were identified in CFIT accidents that occurred on approach, cruise, initial climb, go-around, descent and landing
- 5 non-fatal CFIT accidents occurred, 4 of which were on approach and one on landing
- Approach incurred the highest number of fatal accidents and fatalities
- Of the 28 CFIT fatal accidents, 3 involved IATA members and 4 involved IOSA carriers
- 15 CFIT fatal accidents involved passenger flights and 13 cargo flights



CFIT Accidents by Aircraft Propulsion

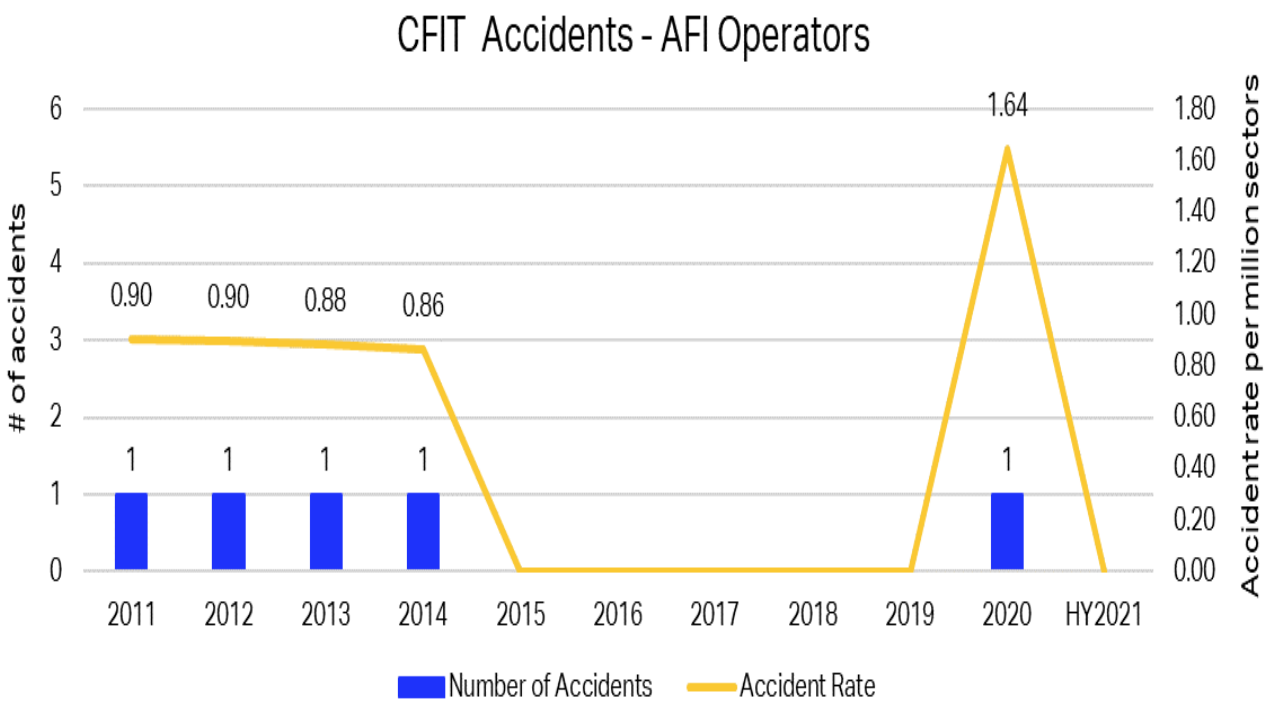




- 7 of the 33 CFIT accidents involved jet flights
- All 7 were fatal accidents, resulting in 96 fatalities
- 1 of which was IATA member and 2 IOSA carriers
- 3 of which were cargo flights and 4 Passenger flights

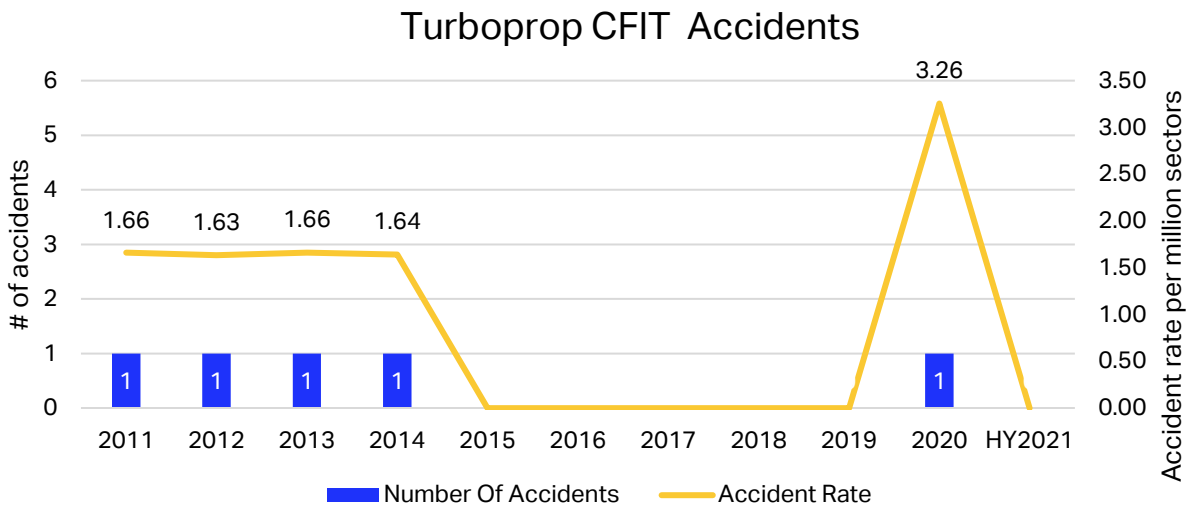
- 26 of the 33 CFIT accidents involved turboprop fleet
- 21 accidents were fatal, resulting in 351 fatalities
- 2 of which were IATA members and 3 IOSA carriers
- 12 of which were cargo flights and 13 Passenger flights

CFIT Accidents – Operators Based in Africa



- 15% (5) of CFIT accidents involved AFI Operators
- 4 accidents were fatal, resulting in 17 fatalities
- All 5 were operated on turboprop cargo flights
- Looking at the phase of flight, approach incurred the highest accident with a total of 4 accidents (80%). 3 of which were fatal accidents, resulting in 15 fatalities

CFIT Turboprop Accidents – AFI Operators



- 100% (5) of CFIT accidents involved turboprop fleet
- They were neither IATA members nor IOSA Carriers
- All 5 of were cargo flights

Threat and Error Management (TEM)

T
E
M

Prevention

Prevention

Definition - Threats

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 a flight crew error.

There are two types of threats:

- Environmental Threats – (e.g., methodology, lack of visual reference, birds and foreign objects, etc…)
- Airline Threats – such as aircraft malfunction, flight controls, MEL Items, etc…)

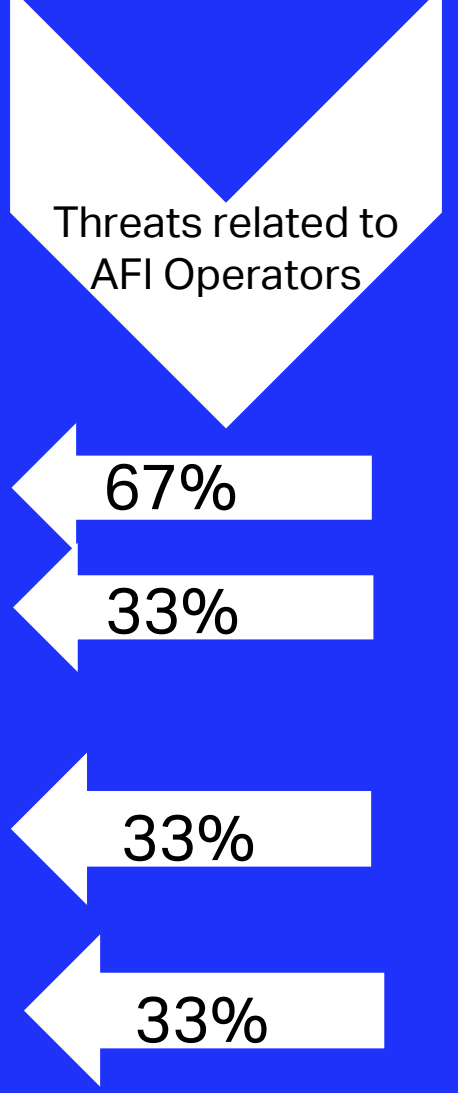
CFIT Threats

Accident Data: 2011-HY2021

The top contributing factors under this category:

- Methodology (60% of total CFIT accidents)
  - Poor visibility / IMC (52% of total CFIT accidents)
  - Wind/Windshear/Gusty wind (12% of total CFIT accidents)
  - Thunderstorms (8% of total CFIT accidents)

- Air Traffic Services (28% of total CFIT accidents)



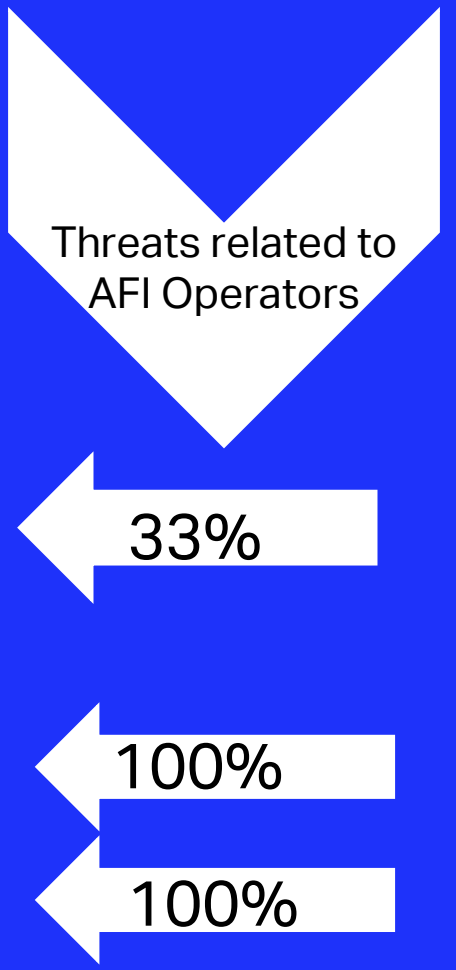
CFIT Threats

Accident Data: 2011-HY2021

The top contributing factors under this category:

- Terrain / Obstacles (28% of total CFIT accidents)

- Navigational Aids (60% of total CFIT accidents)
- Ground navigation aid malfunction (60% of total CFIT accidents)



Definition - Flight Crew Errors

An observed flight crew deviation from organizational expectations or crew intentions.

Mismanaged error: An error that is linked to or induces additional error or an undesired aircraft state.

CFIT Flight Crew Errors
Accident Data: 2011-HY2021

The top contributing factors are:

- Noncompliance to Standard Operating Procedures (56% of total CFIT accidents)
  - Intentional failure to follow SOPs (40% of total CFIT accidents)
  - Unintentional failure to follow SOPs (12% of total CFIT accidents)
- Callouts (20% of total CFIT accidents)
- Aircraft Handling Errors
  - Manual handling / Flight Controls Errors (16% of total CFIT accidents)

Flight Crew Errors
Accident Data: 2011-HY2021

- Failure to GOA (16% of total CFIT accidents)
  - Failure to GOA after destabilization on approach (4% of total CFIT accidents)

Definition - Undesired Aircraft State (UAS)

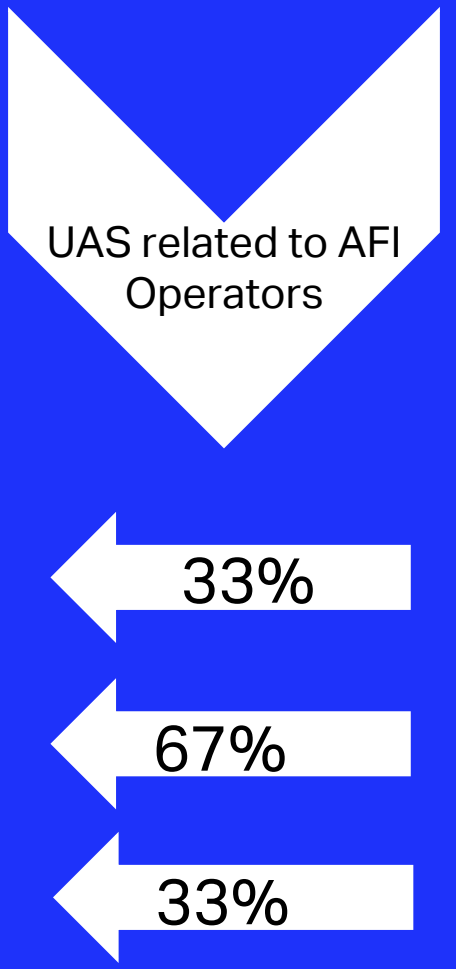
Flight-crew-induced aircraft state that clearly reduces safety margins; a safety-compromising situation that results from ineffective error management

An UAS is recoverable

CFIT Undesired Aircraft State (UAS)
Accident Data: 2011-HY2021

The top contributing factors:

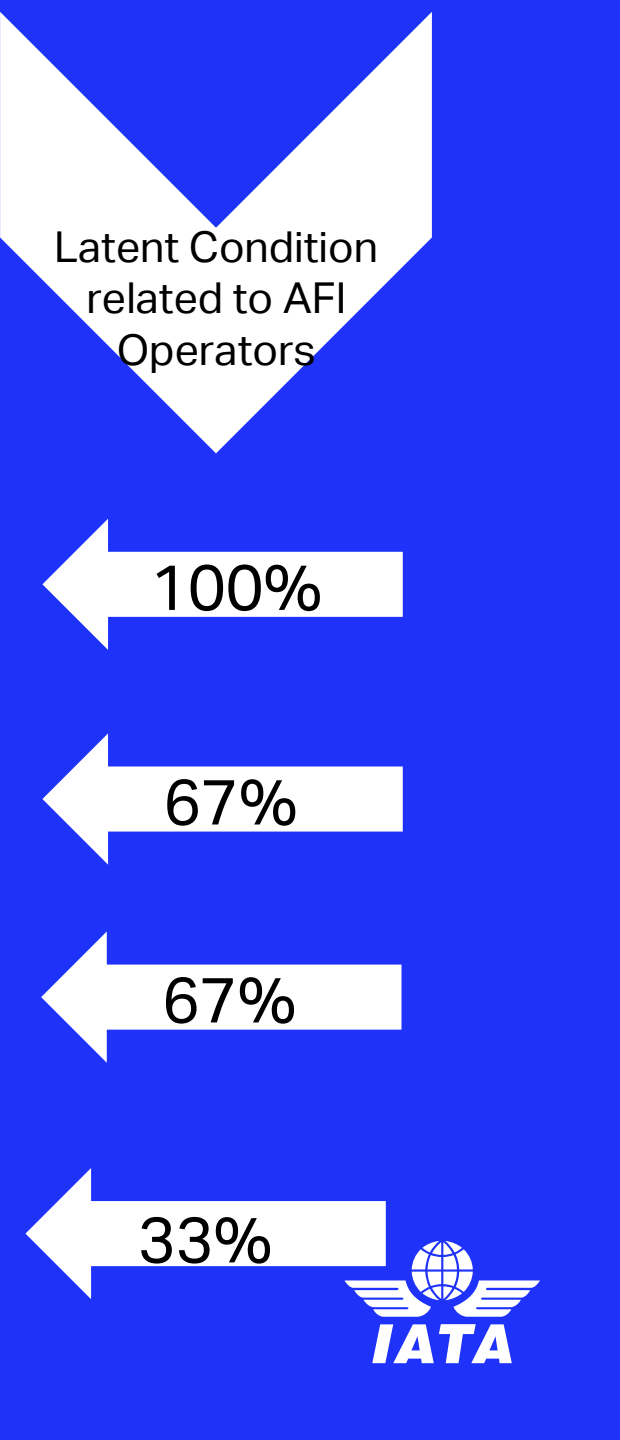
- Aircraft Handling
  - Controlled Flight Toward Terrain (56% of total CFIT accidents)
  - Vertical, Lateral or speed deviation (52% of total CFIT accidents)
  - Unnecessary weather penetration (28% of total CFIT accidents)
  - Unstable Approach (12% of total CFIT accidents)
  - Continued landing after unstable approach (8% of total CFIT accidents)
  - Abrupt Aircraft Control (8% of total CFIT accidents)



CFIT Latent Condition
Accident Data: 2011-HY2021

The top contributing factors:

- Deficient regulatory oversight by the state or lack thereof (92% of total CFIT accidents)
- Technology & Equipment where available safety equipment not installed (64% of total CFIT accidents)
- Absent or deficient Safety Management (60% of total CFIT accidents)
- Inadequate Management decision, including cost cutting, stringent fuel policy, etc… (16% of total CFIT accidents)

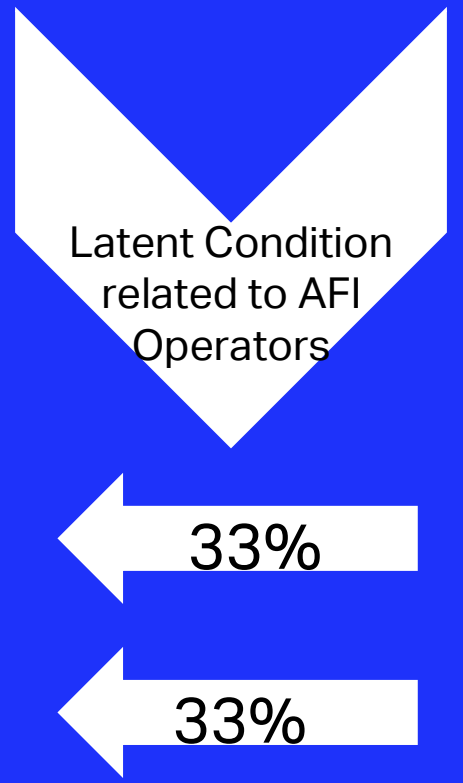


CFIT Latent Condition
Accident Data: 2011-HY2021

- Deficient or absent selection standards (16% of total CFIT accidents)

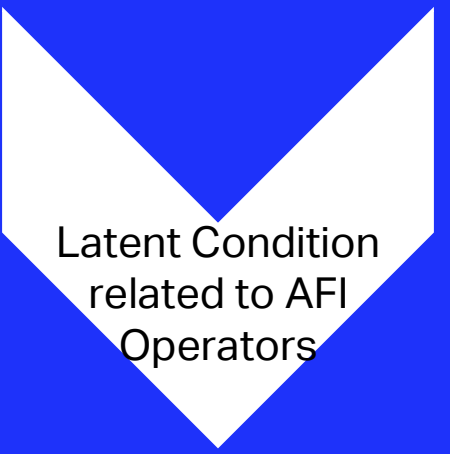
- Flight Operations (36% of total CFIT accidents)
  - Deficient or absent SOPs, company policy, etc… (28% of total CFIT accidents)

  - Omitted training, language skills deficiencies, crews, operational needs leading to training reductions, deficiencies in assessment qualifications and experience of flight of training or training resources such as manuals or CBT devices (16% of total CFIT accidents)



CFIT Latent Condition
Accident Data: 2011-HY2021

- Flight watch/following/support (4% of total CFIT accidents)
- Dispatch (4% of total CFIT accidents)



33%

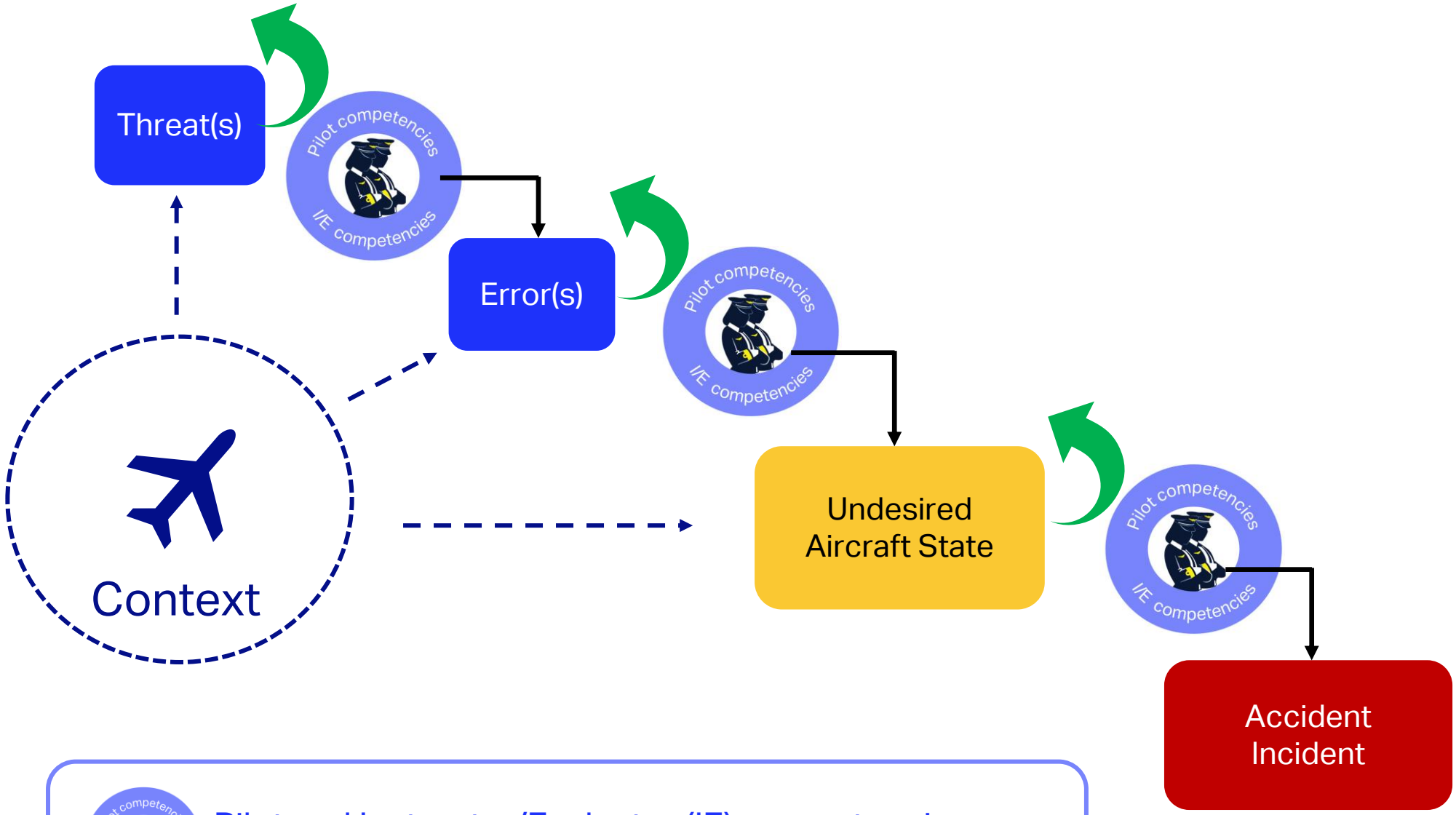
33%

Definition – Flight Crew Countermeasures

Countermeasures that the flight crew can take. Countermeasures from other areas, such as ATC, ground operations personnel and maintenance staff, are not considered at this time.

From a competency-based training and assessment perspective, the competencies of the approved adapted competency model provide individual and team countermeasures to threats and errors and undesired aircraft states. CRM skills are embedded in the approved adapted competency model. Therefore, the CRM training supports the development of the competencies as countermeasures in the TEM concept.
ICAO PANS TRG- see the next slide for illustration

Threat and Error Management Model



Pilot and Instructor/Evaluator (IE) competencies are the individual and team counter measures

CFIT Countermeasures

Accident Data: 2011-HY2021

The top contributing factors:

- Planning
  - Inflight Decision making /contingency management where the crew members should develop effective strategies to manage threats to safety: (24% of total CFIT accidents)
    - Reactive: Contingency management (4% of total CFIT accidents)
  - Plans Stated where operational plans and decisions should be communicated and acknowledged (8% of total CFIT accidents)

Countermeasures related to AFI Operators

33%

CFIT Countermeasures
Accident Data: 2011-HY2021

- Execution
  - Monitor/Cross check where crew members should actively monitor and cross-check flight path, aircraft performance, systems and other crew members (60% of total CFIT accidents)
  - Automation Management (12% of total CFIT accidents)
  - Workload Management (4% of total CFIT accidents)

- Team Climate
  - Communication Environment (12% of total CFIT accidents)

CFIT Countermeasures
Accident Data: 2011-HY2021

Countermeasures related to AFI Operators

0%

- Overall Crew Performance where crew members should perform well as risk managers (56% of total CFIT accidents)

- Leadership (20% of total CFIT accidents)
  - Captain should show leadership and coordinate flight deck activities (16% of total CFIT accidents)
  - or First Officer (FO) is assertive when necessary and is able to take over as the leader (20% of total CFIT accidents)

Measures to enhance the effectiveness of Enhanced Ground Proximity Warning System / Terrain Avoidance and Warning System (EGPWS/TAWS)

CFIT/EGPWS Detailed Implementation Plan

From the data presented, it shows that

- CFIT accidents are much lower than a decade ago
- The number of aircraft that have landed safely after EGPWS warning is growing
- Nevertheless, CFIT accident continues to occur
- CFIT ranked the second fatal accident category

Objective / Scope

- IATA developed a Detailed Implementation Plan (DIP) for reducing the risk of CFIT events. This DIP
  - Facilitates the execution of the proposed recommendations
  - Identifies and communicates with the concerned resources for the execution of the plan
  - Reports progress against the plan
  - Measures the implementation and the effectiveness of the plan

CFIT/EGPWS Detailed Implementation Plan

What is required from Operators' perspective:

Safety Management System

- Dedication and commitment from leadership and everyone
- Establishing a positive safety culture
- Encourage operators to use FOQA data to monitor proper responses by flight crew to EGPWS events
- Increase awareness and visibility on the implications of deviating from established procedures
- Consult with and promote the performance assessment of EGPWS Guidance Material (GM) and its recommendations

What is required from Operators' perspective:

Training

- Training Departments should perform gap analysis against the latest EGPWS training guidance available from IATA, EASA, FAA, ICAO, OEMs, and others.
- Enhancing flight crew training by implementing Operators should enhance flight crew training by implementing Competency-based Training and Assessment (CBTA) to include Evidence Based Training program
- Consult with the performance assessment of EGPWS Guidance Material (GM) and its recommendations

CFIT/EGPWS Detailed Implementation Plan

What is required from Operators' perspective:
Flight Operations • Use of Terrain display in order to enhance full situational awareness and ensure timely and appropriate pilot response. • Encourage pilots and operators to report instantly to the relevant ATC Units and authorities all incidents related to GPS interference • Encourage Flight crew to immediately respond to EGPWS warning • Consult with and promote the performance assessment of EGPWS GM and its recommendations

What is required from Operators' perspective:
Technical Operations (Engineering & Maintenance) • Ensure the EGPWS software / terrain database are kept up to date and highlight the safety benefits that can be obtained by keeping the software/database up to date • Ensure the use of GPS/GNSS for the position source to EGPWS. • Consult with the performance assessment of EGPWS GM and its recommendations

CFIT/EGPWS Detailed Implementation Plan

What is required from Manufacturers' perspective:

- To ensure the timely update of the EGPWS Software & Terrain Database
- Consult with and promote within your organization the performance assessment of EGPWS GM and its recommendations

CFIT/EGPWS Detailed Implementation Plan

What is required from Pilots:

- The EGPWS is **NOT** to be used as a primary reference for terrain or obstacle avoidance and does **NOT** relieve the pilot from responsibility of being aware of the surroundings during flight. **Situational awareness must be maintained at all times**
- Pilots are directly responsible and are the final authority as to the operation and safety of the flight. **They are responsible for terrain, other aircraft, and obstacle clearance and separation**
- Once the pilot is cleared to conduct a visual approach, the pilot has the full responsibility to maintain separation from terrain or obstacle. **Safe separation with the terrain, obstacle or other aircraft must be maintained throughout the flight by using accurate navigation, especially during takeoff, decent and final approach briefings and proper checks.** If pilots are unable to maintain terrain/obstacle clearance or separation, the controller should be advised and pilots should state their actions

CFIT/EGPWS Detailed Implementation Plan

Importance of the briefing

- Through thorough briefing, the flight crew would be able to know
  - the main features of the departure route, descent, approach and missed approach;
  - terrain and hazard awareness

Briefing to include:

- Briefing should include
  - Significant terrain, obstacles along the intended departure route
  - Standard Instrument Departure (SID) and Minimum Safe Altitude (MSA)
- For the approach briefing, it should include
  - Descent profile Management and energy management
  - Terrain awareness and approach hazard awareness
  - Elements of unstable approach and Missed approach procedures
  - MSAs and applicable minimum (visibility, runway visual range, ceiling)
  - Go-around altitude

Recommendations

1. Ensure EGPWS Software and Terrain/Obstacle/Runway database are kept up to date

2. Ensure GPS/GNSS is used as a position source for the EGPWS

3. Ensure a policy is in place that at least one pilot selects terrain display during critical phases of flight (such as climb and descent below MSA) for additional situational awareness. If weather is not a threat, then both pilots could decide to select terrain display

4. Establish a training program to ensure flight crew is trained to respond to EGPWS alert effectively

5. Recommend airlines to have procedures to ensure that EGPWS equipment always remains activated and serviceable

6. Pilots and operators should promptly notify the respective authorities of the interference location and the relevant ATC if they experience GPS anomalies

7. Consult with the IATA/Honeywell Performance assessment of pilot response guidance material (GM) and recommendations

1: EGPWS Software & Terrain Database are kept up to date

IATA Regional Offices to

- Collaborate with ICAO regional office and States to ensure the navigation references are updated in accordance with WGS-84
- Ask regulators, though ICAO regional offices, to check if the airlines keep the database and software up to date
- Encourage airline Technical Operations dept. (Engineering & Maintenance) and highlight to them the safety benefit that can be obtained by keeping the EGPWS software / terrain database up to date

HQ to

- Engage the Technical Operations Working Group (TOWG) on the importance of updating the software/terrain database
- Work with IOSA oversight Council (IOC) to implement standards
- Collaborate with GADM department to develop KPIs to measure database out of date events in IDX
- Collaborate with Manufactures and Database / software providers to ensure that Terrain display updates are implemented

Safety Measurement

- The adoption of IOSA Standards and monitoring
- The establishment of KPIs in FDX/IDX and monitoring
- The number of CFIT Accidents in ADX

WIP | Delayed | Attention | Completed

2. GPS/GNSS is used as a position source for the EGPWS

IATA Regional Offices to

- Promote the use of GNSS/GPS to the airline Technical Operations departments
- Collaborate with ICAO regional office to check if regulators require the use of GNSS/GPS as a position source to EGPWS

HQ to

- Engage TOWG with a discussion on the use GPS (when applicable) for the position source to EGPWS
- If a global navigation satellite system (GNSS) is used as an alternative to GPS system, ensure the same recommendation as point 1 above applies
- Encourage manufactures to recommend the association of EGPWS operations with the use of GNSS for the position source
- Work with relevant IOSA Task Force to implement a guidance on this matter

Safety Measurement

- IATA HQ to create a list to monitor the status of the implementation by the manufactures
- IATA Regional offices to monitor the regulations that require the use of GPS as a position source to EGPWS
- Once a standard is developed in IOSA / ISSA audits, IATA HQ to monitor the standard.

WIP | Delayed | Attention | Completed

3. Terrain Display during Critical Phases of Flight Policy

IATA Regional Offices to

- Engage airline Flight Operational departments through our regional offices to adopt this recommendation
- Collaborate with ICAO regional office to ensure that regulators are checking if the Terrain display SOPs are implemented

HQ to

- Work with Flight Operations Group (FOG) to encourage operators to have SOPs for the use of terrain display
- Coordinate with IOSA FLT/DSP TF to include a standard on the Terrain display
- Collaborate with GADM department to develop KPIs to measure database out of date events in IDX
- Collaborate with Manufactures and Database / software providers to ensure that Terrain display updates are implemented

Safety Measurement

- IATA HQ to monitor SOP 's compliance
- Once a standard is implemented, monitor compliance through IOSA/ISSA Audits. IATA HQ to monitor
- The establishment of KPIs in IDX and monitoring

WIP | Delayed | Attention | Completed

4. Training for Flight Crew to respond to EGPWS Alerts

IATA Regional Offices to

- Encourage operators to consult with EGPWS training guidance available from IATA, EASA, FAA, ICAO, OEMs, and others
- Collaborate with ICAO regional office to ensure that regulators check if the EGPWS training is performed in compliance with regulations
- Encourage operators to use FOQA data to monitor proper responses by flight crew to EGPWS events

HQ to

- Ensure IOSA/ISSA standards are up to date with EGPWS training guidance (FLT 2.2.23)
- Promote the use of FOQA data to monitor proper responses by flight crew to EGPWS events
- Promote the EGPWS training guidance available from IATA, EASA, FAA, ICAO, OEMs, and others
- Collaborate with GADM department to develop KPIs in FDX and IDX on pilot response to EGPWS

Safety Measurement

- IATA HQ to monitor the performance of IOSA Standard FLT 2.2.23 , FLT 2.2.33, FLT 3.14.9, Table 2.3)
- Develop and monitor pilot response to EGPWS through IDX data
- Develop and monitor pilot response to EGPWS through FDX data

WIP | Delayed | Attention | Completed

5. EGPWS Equip. Always Remains Activated & Serviceable

HQ to

- Engage with IATA FOG to develop awareness and recommendations for airlines to keep the EGPWS always activated.
- Engage with IATA TOWG to ensure that EGPWS always serviceable
- Collaborate with GADM department to develop KPIs in FDX and IDX on failure events

Safety Measurement

- Monitor EGPWS failure events through IDX KPIs
- Monitor EGPWS failure events through FDX KPIs
- Monitor IOSA Standard MNT 2.5.3

WIP | Delayed | Attention | Completed

6. Notify Authorities of GNSS Interference Location & ATC of GPS Anomalies

IATA Regional Offices to

- Encourage Pilots and Operators to promptly notify the respective Authorities of the interference location and the relevant ATC if they experience GPS anomalies

HQ to

- IATA Air Traffic Management (ATM) colleagues to continue to intervene with ICAO to minimize events related to interference
- IATA ATM colleagues to increase awareness of the impact of GPS jamming and interference
- IATA safety to coordinate with GADM to develop and monitor KPIs in FDX and IDX to GNSS/GPS signal loss

Airspace Users and ANSPs

- To inform flight crews and air traffic controllers about the impact of GNSS interference and establish effective contingency procedures and capabilities as appropriate

Safety Measurement

- Monitor reporting GNSS/GPS signal loss though IDX
- Monitor reporting GNSS/GPS signal loss though FDX

WIP | Delayed | Attention | Completed

7. Consult with the IATA/Honeywell performance assessment of pilot response GM & recommendations

IATA Regional Offices to

- Promote the GM Material (GM) to all your contacts and encourage operators to consult with it

HQ to

- Make the Guidance Material (GM) document easy to find and available
- Highlight the GM in IATA's publications, including websites and documents
- Promote the GM at SIRM and other Conference, etc…
- Ask EGPWS software and Terrain Database providers and manufactures to promote this document to their clients
- Post the GM on IATA safety connect

Safety Measurement

- IATA HQs to track number of downloads
- IATA HQs to track region where it has been promoted

WIP | Delayed | Attention | Completed