



BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

CONTRIBUTING FACTORS AND PRECURSORS in LOC-I Accidents/Incidents

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What is a LOC-I?



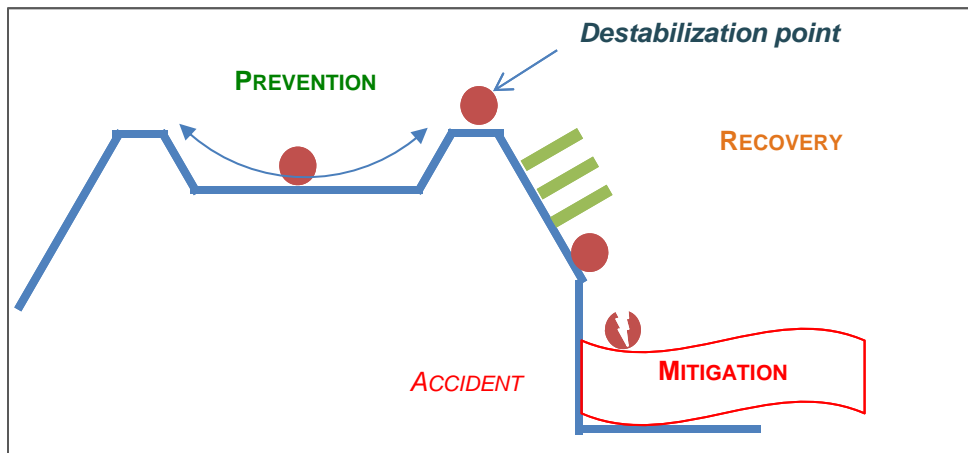
- Loss of aircraft control, or deviation from intended flight path
 - ➔ Source: CAST ICAO Common Taxonomy Team (CICTT)
 - ➔ Stalls are considered loss of control and are included here.

- Loss of aircraft control, or deviation from intended flight path
 - ➔ Source: CICTT
 - ➔ Stalls are considered loss of control and are included here.

- Aircraft Upset as defined below:
 - ➔ Pitch attitude greater than 25° (NU), 10° (ND)
 - ➔ Bank angle greater than 45°
 - ➔ Speed/AOA... well above/below accepted operational tolerances

Accidents vs. Incidents

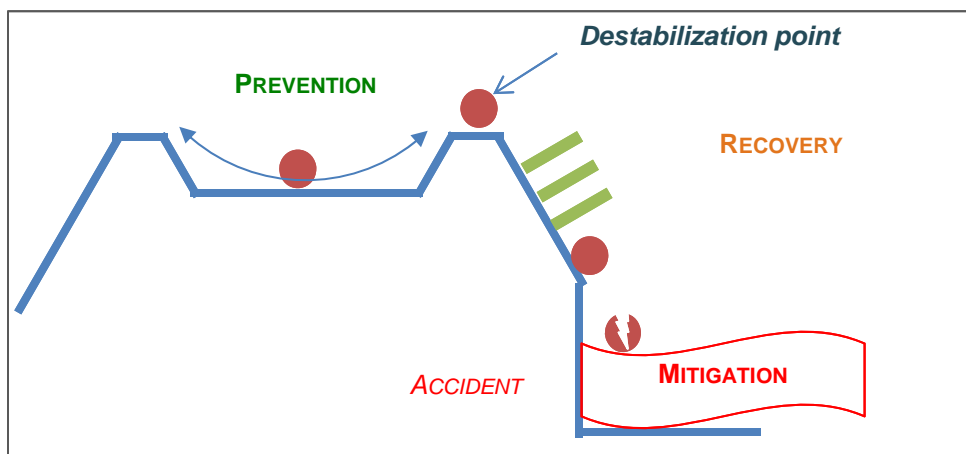
- Accident Model:



- Accidents: all prevention and recovery measures failed

Accidents vs. Incidents

■ Accident Model:



- Accidents: all prevention and recovery measures failed
- Incidents: part or all prevention measures failed
- Investigation of Incidents allow reinforcement of :
 - ➔ Prevention measures to keep the ball in the bowl
 - ➔ Recovery measures

- 2 Accidents:
 - ➔ AF447: A330 in June 2009
 - ➔ West Caribbean: MD-82 in August 2005

- 3 Incidents investigated by the BEA
 - ➔ One A340 in 2011 during Cruise
 - ➔ Two A320s in 2012 during Approach

SOP

**AUTOMATION
UNDERSTANDING**

COMMUNICATION
ISSUES

DISTRACTION

MONITORING

STARTLE
LOSS OF SA

RECOVERY
ACTIONS

**F/C PROT
ENGAGED**



SOP

PITCH & PWR
NOT SET WHEN LOSS OF
AUTOMATION

AUTOMATION
UNDERSTANDING

?

COMMUNICATION
ISSUES

LACK OF PRECISION
AND EFFICIENCY

DISTRACTION

ECAM

MONITORING

PITCH +15°
VS 7000ft/mn

STARTLE
LOSS OF SA

YES

RECOVERY
ACTIONS

PITCH UP VS
STALL

F/C PROT
ENGAGED

NO
PROT LOST



A330 CRZ

MD82 CRZ

A340 CRZ

A320 APP

A320 APP

SOP

PITCH & PWR
NOT SET WHEN LOSS OF
AUTOMATION

ACFT ABOVE MAX ALT,
DUE ANTI-ICE

**AUTOMATION
UNDERSTANDING**

?

?

**COMMUNICATION
ISSUES**

LACK OF PRECISION AND
EFFICIENCY

NO COM DUE
HI GRADIENT

DISTRACTION

ECAM

WEATHER& ATC/MEAL

MONITORING

PITCH +15°
VS 7000ft/mn

M0.60 vs
M0.75

**STARTLE
LOSS OF SA**

YES

YES
DUE PWR DROP/STALL

**RECOVERY
ACTIONS**

PITCH UP VS
STALL

PITCH UP VS
STALL

**F/C PROT
ENGAGED**

NO
PROT LOST

NO





A330 CRZ

MD82 CRZ

A340 CRZ

A320 APP

A320 APP

SOP

PITCH & PWR
NOT SET WHEN LOSS OF
AUTOMATION

ACFT ABOVE MAX ALT,
DUE ANTI-ICE

W/X AVOIDANCE
(RADAR TILT)

**AUTOMATION
UNDERSTANDING**

?

?

?

**COMMUNICATION
ISSUES**

LACK OF PRECISION AND
EFFICIENCY

NO COM DUE
HI GRADIENT

**NONE ON CRITICAL
ACTION
(PM INPUT ON
SIDESTICK NOT CALLED)**

DISTRACTION

ECAM

WEATHER& ATC/MEAL

**OVER SPEED &
TURBULENCE**

MONITORING

PITCH +15°
VS 7000ft/mn

M0.60 vs
M0.75

ALT+3000ft

**STARTLE
LOSS OF SA**

YES

YES
DUE PWR DROP/STALL

YES
AP DISC vs OVR SPD

**RECOVERY
ACTIONS**

PITCH UP VS
STALL

PITCH UP VS
STALL

PM PITCH UP

**F/C PROT
ENGAGED**

NO
PROT LOST

NO

YES
AOA PROT





A330 CRZ

MD82 CRZ

A340 CRZ

A320 APP

A320 APP

SOP

PITCH & PWR
NOT SET WHEN LOSS OF
AUTOMATION

ACFT ABOVE MAX ALT,
DUE ANTI-ICE

W/X AVOIDANCE
(RADAR TILT)

AP ON/ATHR OFF + NOT
CALLED

**AUTOMATION
UNDERSTANDING**

?

?

?

F/C AOA PROT

**COMMUNICATION
ISSUES**

LACK OF PRECISION AND
EFFICIENCY

NO COM DUE
HI GRADIENT

NONE ON CRITICAL
ACTION
(PM INPUT ON
SIDESTICK NOT CALLED)

**COMPLACENT DUE
LOW GRADIENT**

DISTRACTION

ECAM

WEATHER& ATC/MEAL

OVER SPEED &
TURBULENCE

TRAFFIC

MONITORING

PITCH +15°
VS 7000ft/mn

M0.60 vs
M0.75

ALT+3000ft

SPD VLS-31

**STARTLE
LOSS OF SA**

YES

YES
DUE PWR DROP/STALL

YES
AP DISC vs OVR SPD

YES

**RECOVERY
ACTIONS**

PITCH UP VS
STALL

PITCH UP VS
STALL

PM PITCH UP

**PITCH UP VS
LOW SPD**

**F/C PROT
ENGAGED**

NO
PROT LOST

NO

YES
AOA PROT

YES
AOA PROT





A330 CRZ

MD82 CRZ

A340 CRZ

A320 APP

A320 APP

SOP

PITCH & PWR
NOT SET WHEN LOSS OF
AUTOMATION

ACFT ABOVE MAX ALT,
DUE ANTI-ICE

W/X AVOIDANCE
(RADAR TILT)

AP ON/ATHR OFF + NOT
CALLED

**FULL FLAPS + Vapp
Downwind**

**AUTOMATION
UNDERSTANDING**

?

?

?

F/C AOA PROT

F/C AOA PROT
A/THR

**COMMUNICATION
ISSUES**

LACK OF PRECISION AND
EFFICIENCY

NO COM DUE
HI GRADIENT

NONE ON CRITICAL
ACTION
(PM INPUT ON
SIDESTICK NOT CALLED)

COMPLACENT DUE
LOW GRADIENT

**FO FEEDBACK LOW
CPT LEAD WEAK**

DISTRACTION

ECAM

WEATHER& ATC/MEAL

OVER SPEED &
TURBULENCE

TRAFFIC

RWY

MONITORING

PITCH +15°
VS 7000ft/mn

M0.60 vs
M0.75

ALT+3000ft

SPD VLS-31

Vapp-16kt

**STARTLE
LOSS OF SA**

YES

YES
DUE PWR DROP/STALL

YES
AP DISC vs OVR SPD

YES

YES

**RECOVERY
ACTIONS**

PITCH UP VS
STALL

PITCH UP VS
STALL

PM PITCH UP

PITCH UP VS
LOW SPD

**OVERSPEED
DUE TOGA LK**

**F/C PROT
ENGAGED**

NO
PROT LOST

NO

YES
AOA PROT

YES
AOA PROT

YES
AOA A-FLOOR





Summary

SOP

INADEQUATE

**AUTOMATION
UNDERSTANDING**

NOT SYSTEMATIC

**COMMUNICATION
ISSUES**

YES

DISTRACTION

YES

MONITORING

INADEQUATE

**STARTLE
LOSS OF SA**

YES

**RECOVERY
ACTIONS**

INADEQUATE

**F/C PROT
ENGAGED**

NOT SYSTEMATIC



■ Training

- ➔ Improve knowledge in handling characteristics & flight mechanics (FRAN-2012-039, -040, -041)
- ➔ Improve automation understanding (FRAN 2013-086)
- ➔ CRM & Communication skills under stress (FRAN-2012-042 et 2012-043)
- ➔ Monitoring (FRAN-2014-002)
- ➔ Simulator Scenarios including startle (FRAN-2012-046 & FRAN-2012-021)

■ Aircraft design

- ➔ Enhance information, automation and F/C protections to provide pilots with better situational awareness (FRAN-2012-047,049, 050, FRAN 2014-001, 003)