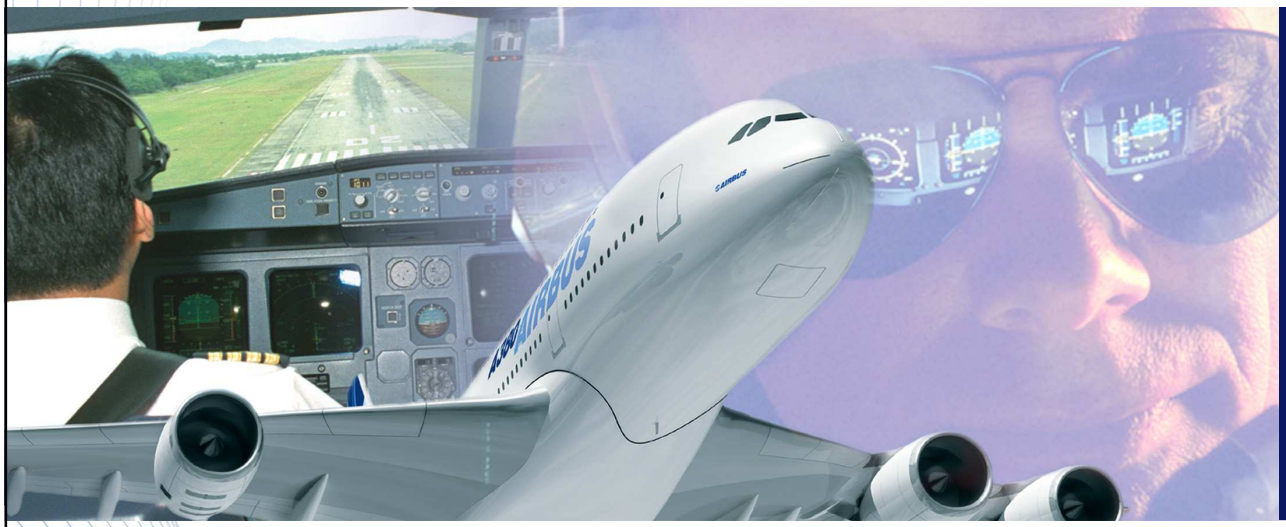


Michel TREMAUD
Retired, Airbus / Aerotour /
Air Martinique / Bureau Veritas

Guidelines for Management of Complex Situations

An Operational and Human Factors View

Foreword - 1 / 2

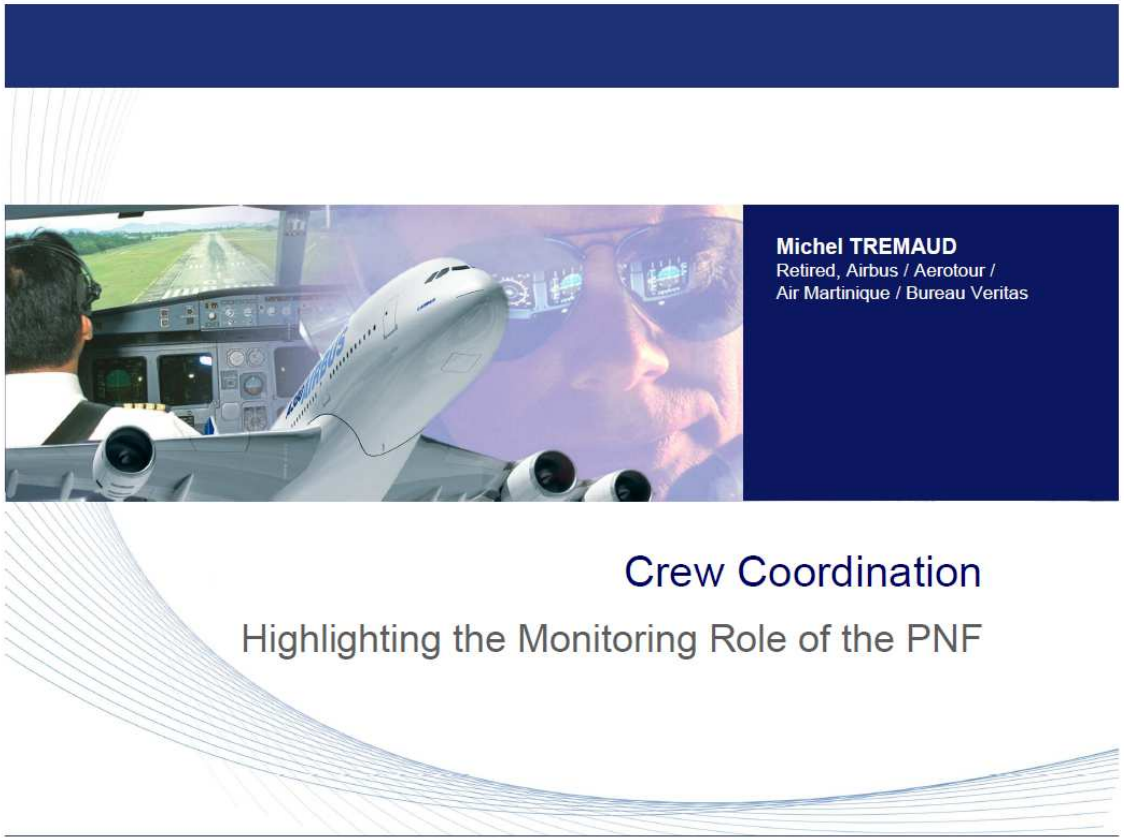
- This presentation is based on the operational and human factors analysis of events involving complex situations …

  … within or beyond the scope of published procedures

- This synthesis provide an overview of observed factors and related prevention strategies in terms of :
  - Situation recognition / crew diagnosis (warnings / cockpit effects)
  - Procedures (access / contents / execution)
  - Crew performance (actions / flight-path control)

Foreword - 2 / 2

- Crew coordination :



Contents

- Defining Complex Situations
- What do Statistics Tell Us ?
- General Prevention Strategies
- Quotes from your Peers
- Situation Recognition / Crew Diagnosis
- Procedures Access / Contents
- Crew Performance

Defining Complex Situations

Defining Complex Situations - 1 / 2

- Unusual combination of abnormal / emergency procedures
- Absence of related procedure
- Absence of related or equivalent training
- Absence of alert or cockpit effect
- Alerts or cockpit effects disabled by the prevailing condition
- Alert or cockpit effect not reflecting the prevailing condition

Defining Complex Situations - 2 / 2

- Situation not solved by existing procedure
- Aircraft system or ground equipment (e.g., navaid) left in maintenance mode
- Situations resulting from :
  - Seemingly unrelated multiple alerts involving several systems
  - Electrical transients (affecting multiple systems)
  - Maintenance errors
  - Common-cause beyond assumptions of system safety assessment
  - Inadvertent interaction with aircraft controls

What do Statistics Tell Us ?

Factors in Approach and Landing Accidents

Factor	% of Events
Inadequate decision making	74 %
Omission of action or inappropriate action	72 %
Inadequate CRM practice (crew coordination, cross-check and backup)	63 %
Insufficient horizontal or vertical situational awareness	52 %
Inadequate or insufficient understanding of prevailing conditions	48 %
Slow or delayed crew action	45 %
Flight handling difficulties	45 %
Incorrect or incomplete pilot / controller communication	33 %
Interaction with automation	20 %

Source : Flight Safety Foundation - 1999

Errors in Decision Making

Note

Errors are listed in their time sequence during a typical event

Phase of Decision Process	Error Ranking
Perception and information gathering	3
Information decoding	6
Situation representation	2
Knowledge of and adherence to procedure	7
Incorrect or untimely decision making	1
Untimely or incorrect action	5
Absence of monitoring of action feedback	4

Source : InfoPilote - 1996

General Prevention Strategies

Assessing Exposure

- Identify and minimize influence factors and exposure :
  - Company factors
  - Personal factors
  - ATC factors
  - Airport factors and hazards
  - Weather and environmental hazards

Early Detection and Correction

- Provide recommendations for early detection and correction of possible non-normal conditions :
  - Anticipate
  - Detect
  - Correct
  - Decide

Anticipate - 1 / 2

- Define a common plan for the flight phase
- Identify and discuss factors such as :
  - Non-standard altitude or speed restrictions, environmental hazards, system malfunctions
- Define agreed strategies (common objectives) for :
  - Flight / energy management (**next targets**)
  - Possible flight-phase-related contingencies
- Brief several scenarios in readiness for anticipated ATC requests or other needs to change initial plans

Anticipate - 2 / 2

- Define **next targets** along the flight path :
  - distance (position) markers
  - defined objectives for next target :
    - Altitude, time, speed, configuration, vertical speed or flight path angle, power setting
  - approaching the next target :
    - Monitoring, confirmation, decision-making, corrective action(s)

Detect

- Make time availability and reduce workload by avoiding :
  - Late briefings, unnecessary radio calls, non-pertinent intra-crew communications
- Monitor systems, using ECAM system pages
- Monitor flight path for early detection of deviations
- Provide timely and precise deviation callouts
- Be alert to adapt to changing weather conditions, approach hazards or system malfunctions

Correct

- Backup PF for effective corrective actions
- Take action, as required (e.g., during approach) :
  - Use speedbrakes to correct excessive altitude
  - Extend landing gear to correct excessive airspeed
  - Extend outbound leg or downwind leg to provide more distance for approach stabilization

Decide

- Be **action-minded** (e.g., go-around) :
  - Let's be prepared for a go-around and we will land if :
    - the approach is stabilized, and
    - we have adequate visual references to make a safe approach and landing
- Be **action-prepared** (e.g., go-around) :
  - Descent preparation, approach briefing, descent monitoring, task sharing, ...
  - Be ready to challenge initial plans and change plans as necessary

Know and Use Safe Reference Values

- Pitch / power relationship
- High and low buffet speeds
- Altitude capability for gross-weight (buffet margin)
- Gravity-feed altitude
- Engine-out level-off altitude versus MEA / MORA
- Windmilling and starter-assisted relight envelops (altitude, speed or N2)
- Sector / segment MSA during approach
- Maximum recommended cross-wind for runway condition

Quotes from your Peers

About Taking Time to Make Time

- In an emergency, doing something wrong can be worse than doing nothing
- Whatever the situation or dilemma, hurry can be an unwelcome trouble-maker
- Emphasis should be on skill and composure instead of speed, and on avoiding being spring-loaded for disaster

Credit : PIA Safety Magazine

About Anticipation and Mitigation

- Prepare for the worst and hope for the best
- Declaring an emergency is an exceptional tool for a Captain, do not hesitate to use it when considered appropriate
- The first priority is to maintain or regain aircraft control, this is the bottom line
- Remember, you are not alone, time and conditions permitting, Dispatch can muster considerable help in dealing with [a complex situation]

Adapted from ACA Flightline

Situation Recognition / Crew Diagnosis

Warning / Cockpit Effects - Factors

- Absence of action feedback
- Mismatch between action and action feedback / cockpit effects
- Ambiguity between commanded function and function availability
- Difficulty in understanding system operation under unfamiliar conditions
- Not-announced and undetected entry errors
- Not-announced and undetected navigation deviations

Warning / Cockpit Effects - Strategies

- Monitor systems per SOP’s during cruise
- Heighten alertness and monitoring when in doubt
- Be ready for the most probable in-context and / or flight-phase-related scenario
- Look for more information to counter sparse, weak or ambiguous cues (cockpit effects)

Crew Diagnosis - Factors - 1 / 2

- Difficult interpretation of warnings involving several systems that have apparently nothing in common :
  - Electrical causes
  - Multiple smoke warnings
  - Failures caused by loss of common data source or logic condition

Crew Diagnosis - Factors - 2 / 2

- Difficult assessment of exact prevailing condition :
  - Engine damage ?
  - Fuel leak location ?
- Delayed recognition due to fatigue, distraction, preoccupation or lack of flight progress monitoring

Crew Diagnosis - Strategies - 1 / 2

- Adopt a structured pattern for problem recognition
- Be aware that warnings involving several systems result from a non-obvious common cause
- Take time to gather cues and information to understand the prevailing condition
- Understand available cues to build-up a representation of the prevailing condition
- Attempt to validate genuine warnings from spurious indications

Crew Diagnosis - Strategies - 2 / 2

- Be skeptical of your own actions :
  - What may I have done that would have resulted in the observed condition ?
- Be aware of time factor in decision-making and action-taking
- Perform a thorough damage assessment and , as applicable, a controllability check

Procedure Access / Contents / Execution

Procedure Access / Contents - Factors

- Reference to and coordination of multiple related or seemingly unrelated procedures
- Absence of related procedure, i.e. :
  - Absence of guidance on priorities, sequence of actions, safe values and limitations
  - Absence of condition-related information for approach and landing (under degraded conditions)

Procedure Access / Contents - Strategies

- Refer to QRH any time there is no ECAM procedure or ECAM does not appear to relate to or fully address the perceived condition
- If situation develops, carefully consider any additional alert or cockpit effect
- Be aware of possible conditional actions associated with advisory conditions
- Consider crew-awareness messages in decision-making process
- Be aware of the applicable pre-condition(s), if any, before resetting an affected system

Procedure Execution - Factors

- Condition not solved by existing procedure
- Correct action resulting in unanticipated response / condition
- Confusion on action sequence in case of lack of action feedback or unanticipated action feedback
- Absence of training on similar condition

Procedure Execution - Strategies

- Adhere to the long-known concept :
  - Understand … Act … Verify
- Validate / confirm results of actions (with available indications and cockpit effects) before proceeding with next action
- If procedure does not appear to relate to situation or to solve situation, start all over again to identify possible ambiguity or incorrect sequence

Crew Performance

Crew Actions - Factors - 1 / 2

- Delayed (late) response to warning or cockpit effect
- Late takeover from automation
- Absence of practice in operating aircraft systems in certain degraded conditions
- Cockpit activities at inappropriate times resulting in reduction in flight path monitoring
- Incorrect use of systems
- Inadvertent interaction with systems or automation

Crew Actions - Factors - 2 / 2

- Undetected action slips / lapses
- Undetected entry errors
- Untimely or inappropriate use of controls
- Rushed actions (i.e., without checking pre-conditions)

Crew Actions - Strategies - 1 / 2

- Attempt to **stabilize the situation** and limit further consequences, even if the prevailing condition is not fully identified and / or understood
- Always adopt a **what if ?** attitude
- Be aware that the **best** response to an undocumented condition is a **prudent** response
- Consider that :
  - A **correct** action is an action that is fully understood
  - A **timely** action is an action that is performed taking into account the time factor (i.e., no rush / no delay)

Crew Actions - Strategies - 2 / 2

- Be aware of possible inordinate actions that may amplify the prevailing condition
- Be alert to recognize the results of incorrect data entries or selections
- Strive at understanding the interrelation between systems and their operational implications
- Revert to the system basic mode of operation if automated operation is not understood or doubtful
- Adhere to threats and errors management principles

Flight Path Control - Factors

- PF involvement in assessing situation … and not monitoring / maintaining aircraft attitude and trajectory
- Excessive flight control inputs (over control)

Flight Path Control - Strategies - 1 / 2

- Maintain / restore aircraft control (first priority for PF)
- Be aware of the aircraft response following crew action (i.e., trajectory, energy)
- Remember the **3-P's rule** :
  - Pitch … Power … Performance
- Be aware of applicable low / high buffet speeds, buffet margin, altitude capability
- Be aware of applicable MEA / MORA / MSA
- Be aware of nearest suitable airport

Flight Path Control - Strategies - 2 / 2

- Make careful and appropriate flight controls inputs (avoiding over control)
- If controllability may be affected :
  - Consider performing a controllability check
  - Limit bank angle to 15 degrees
  - Prefer an extended straight-in approach with an early configuration set-up

Closing Remark

" Be Aware to Be Mentally Prepared "

Adapted from Captain Neil JOHNSTON - Aer Lingus


AIRBUS