



CREW RESOURCE MANAGEMENT AND HUMAN FACTOR - KEY ELEMENTS IN OPERATIONAL SAFETY

“CRM IMPLEMENTATION - NCAA READINESS”

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WHY WE NEED CRM?

WORLD AIRLINE FATAL ACCIDENTS AND FATALITIES

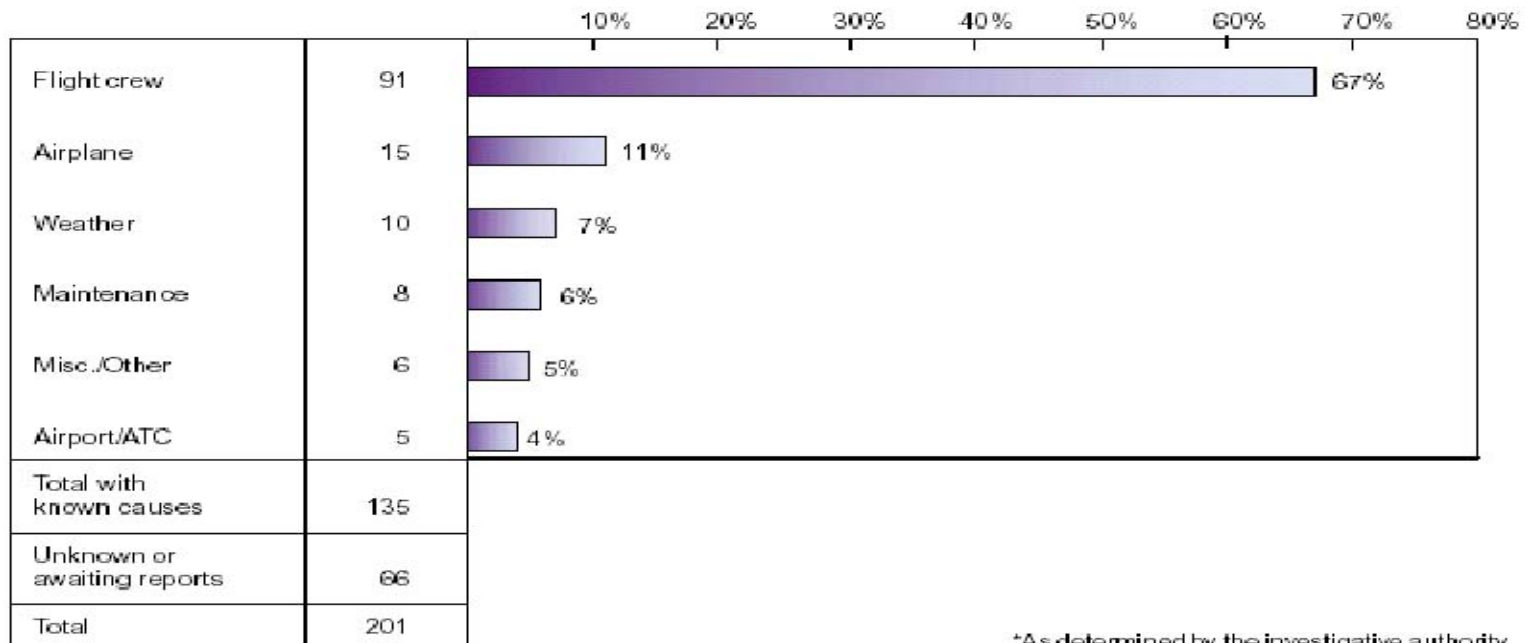




Why We Need CRM?

Accidents by Primary Cause*

Hull Loss Accidents — Worldwide Commercial Jet Fleet — 1990 Through 1999



*As determined by the investigative authority.

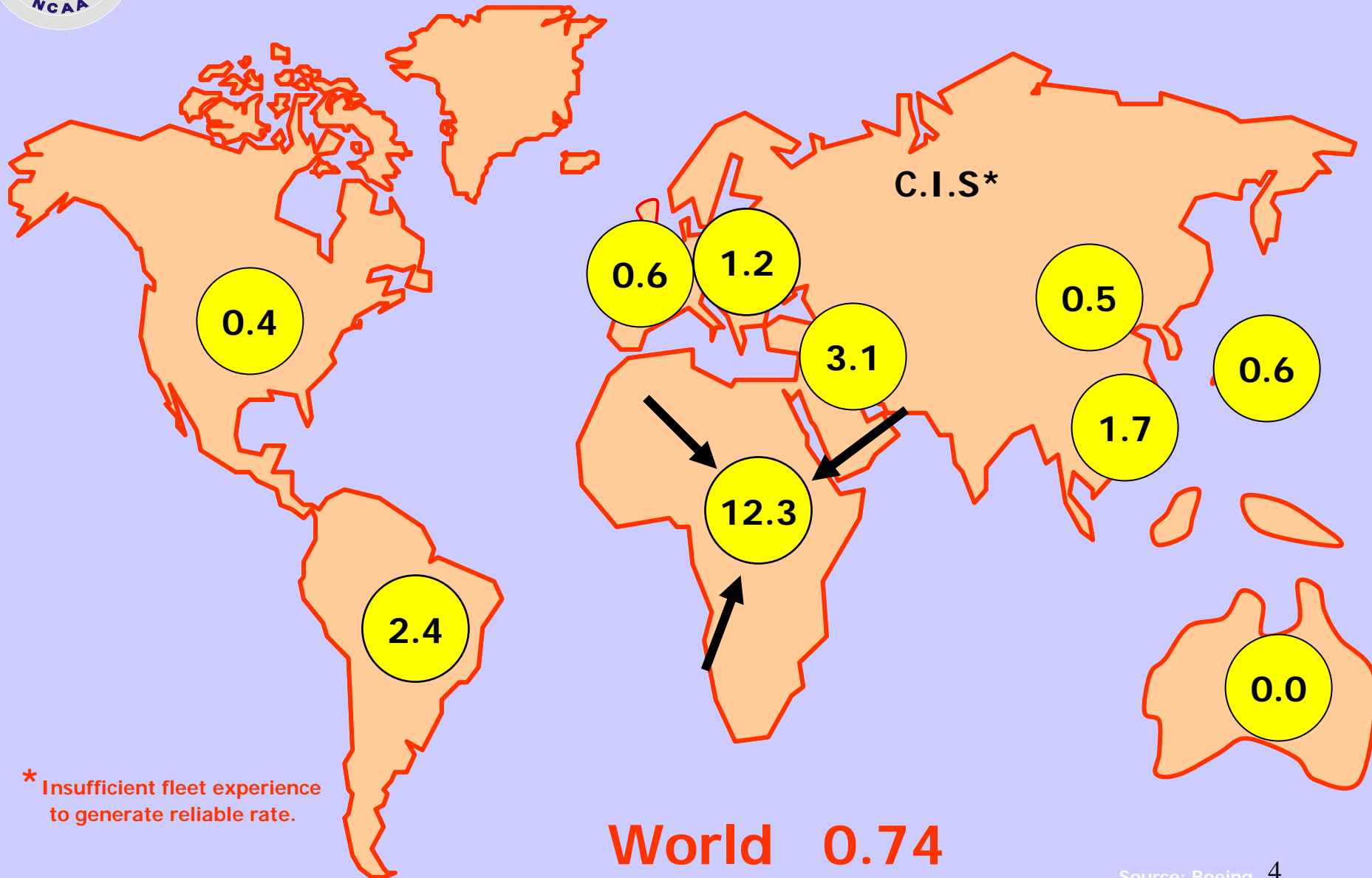


1999 STATISTICAL SUMMARY, JUNE 2000, REV 'A



Regional Perspective

Accident Rates Vary by Region of the World



* Insufficient fleet experience to generate reliable rate.

World 0.74

Source: Boeing 4

Hull loss accidents per Million Departures. Western Built Jets 1995 - 2004



Possible Reasons for Regional Accident Rate Differences

- **Infrastructure Decay**
 - Air traffic control
 - Navigation aids
 - Airport equipment
 - Weather services
- **Unsafe Airline operations**
 - Procedures
 - **Training CRM/Human Factor**
 - Maintenance
 - Dispatch
- **Ineffective Regulatory oversight**
 - Aviation law
 - Regulation
 - Personnel
 - Resource constraints

Competition with Limited Resources

- **Health**
- **Education**
- **Road**
- **Water**
- **Food**
- **Welfare and Social Services**
- **Poverty Alleviation Programs**



Crew Resource Management

- Human Factor
- Communication
- Team Work
- Error Management
- Decision Making
- Situation Awareness
- ...



CRM Implementation

- **Before 1980s, pilots paid great attention to:**
 - politics
 - collectivism
 - crew cooperation
 - CRM was not mentioned

In the 1980s

- **Emphasis:**
 - Quick Reference Handbook (**QRH**)
 - Standard Operating Procedure (**SOP**)



CRM Implementation conti..

By mid 80s

- Crew Resource Management concept was mentioned in the pilot training, Include:
 - SOP, QRH
 - standard call-out was also emphasized.

In the Early to mid 90s

- CRM concept was fully advocated and the CRM concept was emphasized in all trainings



REGULATION ON CRM TRAINING REQUIREMENTS

Nigeria Civil Aviation Regulations

(in compliance with ICAO Annex 1)

Part 1 - General Policies, Procedures and Definitions

- *CRM: defines as programme designed to improve the safety of flight operations by optimizing the safe, efficient and effective use of human resources, hardware and information through improved crew maintenance and co-ordination*



REGULATION ON CRM TRAINING REQUIREMENTS

Nigeria Civil Aviation Regulations conti..

(in compliance with ICAO Annex 1)

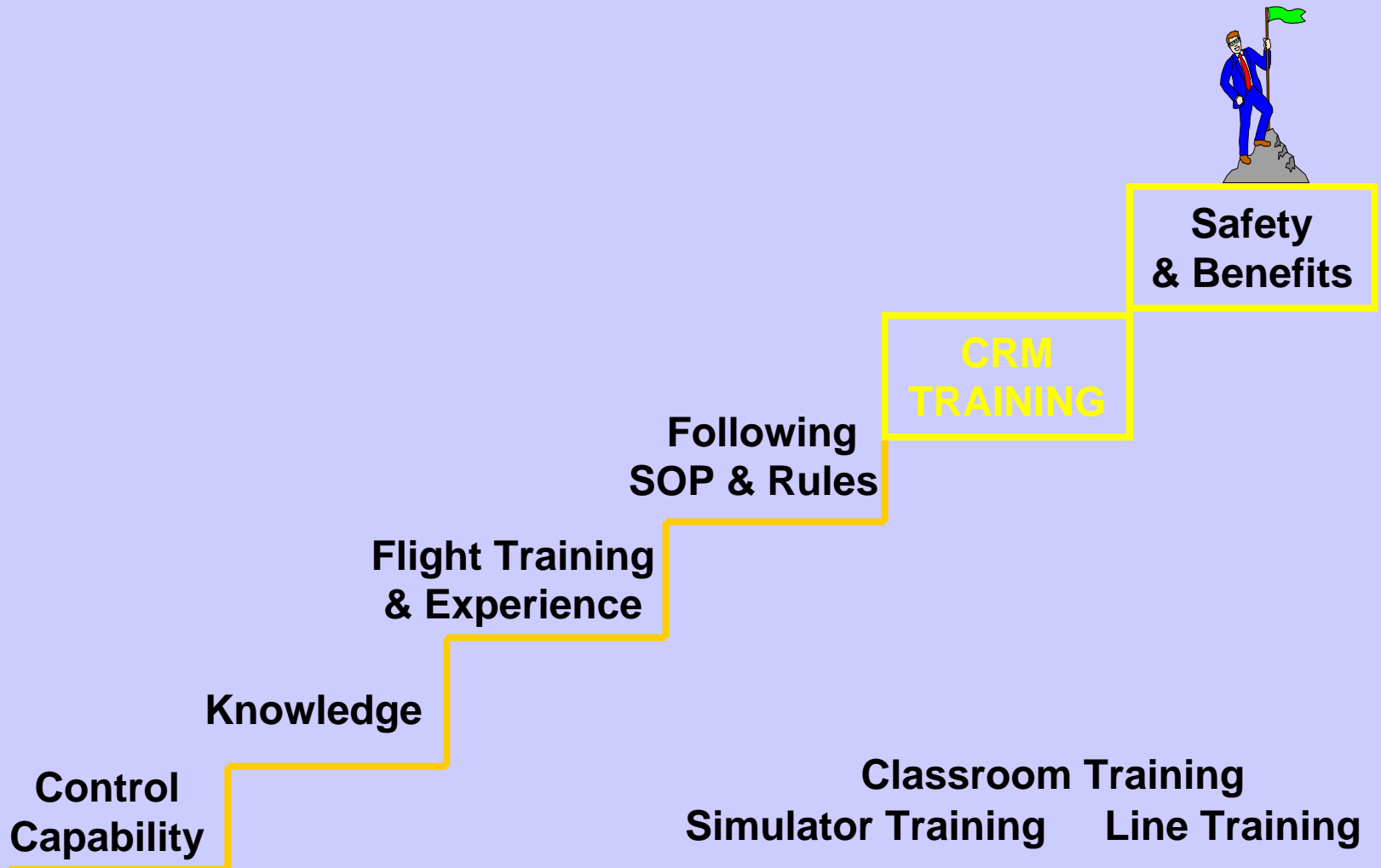
Part 8 - Operations

Section 8.10.2 Requires initial CRM:

- *No person may serve nor may any AOC holder use a person as a crewmember or flight operations officer unless that person has completed the initial CRM curriculum approved by the authority;*
- *Recurrent trainings are required for License renewal*



The Position of the CRM in training items





CRM TRAINING REQUIREMENTS

Minimum CRM training is defined by regulations.

In line with ICAO Annex 1 - Personnel Licensing

Guidance Material to design training programmes on Human Performance can be found in ICAO Human Factors Training Manual Doc 9683.

Companies however should consider customized CRS training for company-specific operations e.g. multicultural flight crews



CRM ROLE IN AVIATION SAFETY

Because CRM is a key factor in flight crew performance and in their interaction with automated systems

CRM has a role to some degree in most aircraft incidents and accidents

CRM Training must be supported from the TOP



SPECIFIC ASPECTS OF CRM IN TRAINING REQUIREMENTS



1. Company Safety Culture and Policies

Although flight crew is the last line of defense - and usually the last link in an error chain

Company safety culture should support CRM throughout the organization, as well as among the aircraft crewmembers



2. International Cultural Factors

As more companies have international ops and multi-cultural flight crews, cultural factors become an important part of customized CRM training

Understanding differences among cultures and recognizing the important of national sensitivities should be emphasized in CRM training

The importance of using standard phraseology as a common working language also should be emphasized in CRM training.



3. Leadership

The role of the pilot-in-command (PIC) in complex and demanding situations (e.g. an approach with marginal weather conditions, abnormal conditions or emergency conditions) is an integral part of CRM training



4. Teamwork

The captain's attitude in establishing communication with the first officer and flight attendants is essential to maintain open communication, thus ensuring effective:

- Human relations (effective crew communication)
- Teamwork (encouraging F/O to voice concern about safety and progress of flight)
- Crew coordination (cross-check and backup)

Conducting preflight briefing that includes flight crew and cabin crew is one method of establishing the basis for effective teamwork



4. Assertiveness

Incidents and accidents have revealed that when an option (such as conducting a go-around) has not been briefed, the flight crew may lack the information to make the go-around decision or to conduct the missed approach correctly.



6. Inquiry and Advocacy

Flight crews often receive ATC requests that are either:

- Not understood (instruction to fly below min safe altitude when min vectoring altitude is not known)
- Challenging (request to fly higher or faster than desired)

Flight crews should not accept instructions without asking for clarification or being sure that they can comply safely with the instructions.



7. Procedures

Deviations from SOP and from other procedures usually are not deliberate.

Understanding the human factors involved in such deviations is essential for the development of company accident-prevention strategies



8. Briefings

Conducting effective and interactive briefings requires adherence to SOPs to ensure crew coordination and preparation for planned or unexpected occurrences

9. Time Management

Taking time to make time, task-sharing and ensuring task prioritization are essential factors in staying ahead of the aircraft



9. Interruptions/Distractions

Coping with interruptions/distractions on the flight deck requires the flight crew “to expect the unexpected,” which lessens the effects of any disruption in the flow pattern of ongoing flight deck activities.



10. Error Management

Error management should be practiced at the company level and at the personnel level.

To foster this practice, identifying and understanding the relevant factors that cause errors are necessary for the development of associated:

- Company accident-prevention strategies and
- Personnel lines of defense

The most critical aspect of assessing error management is not the error (deviation) but the failure to detect the error by cross-checking.



11. Risk Management

Risk management is the process of assessing potential safety hazards and finding ways to avoid the hazards or to minimize their effects on safety.

Risk management should be seen as *a balanced management of priorities*



12. Decision Making

SOPs sometimes are perceived as limiting the flight crew's judgment and decisions.

Without denying the captain's emergency authority,
SOPs are safeguards against biased decision making.

Effective flight crew decision making often requires a joint evaluation of options prior to proceeding with an agreed-upon decision and action.



12. Decision Making conti..

The effect of pressures (such as delays or company policies) that may affect how the flight crew conducts the flight and makes decisions should be recognized by the aviation industry.

Nevertheless, eliminating all pressures is not a realistic objective. Thus, CRM - incorporated with company accident-prevention strategies and personal lines of defense - should be used to cope effectively with such pressures.

COMMON CRM FACTORS THAT CAUSE ACCIDENT



The following CRM factors have been identified as contributing to approach-and landing incidents and accidents, including controlled flight into terrain:

- Risk associated with complacency (eg when operating at a familiar airport) or with overconfidence (eg resulting from a high level of experience with the aircraft)
- Inadequate preparedness to respond to changing situations or to an emergency (ie expecting the unexpected) by precise planning and by using all the available flight deck technical and human resources
- Crewmembers' personal factors (fatigue, spatial disorientation)
- Absence of specific training of instructors and check airmen to evaluate the CRM performance of trainees and line pilots



On the Whole

CRM alone is not the answer or universal remedy for preventing accidents

Nevertheless CRM is a powerful tool to optimize flight crew performance

Good CRM Skills, however

- Relieve the effects of pressures, interruptions and distractions
- Provide benchmarks for timely decision making and
- Provide safeguards for effective error management



In Summary

Crew Resource Management should be

- An embedded operational behaviour
- It should be introduced at the earliest (ab initio) stage of a pilot's education and then integrated into the routine of training throughout the pilot's career.

Experience with CRM has demonstrated its value in reducing operational risk, when properly taught and applied.

Some cultural factors may require special adaptation of CRM techniques, but overall, the use of all resources to operate with high safety levels is the desired goal.



In Summary *conti..*

Crew Resource Management should be

The early assimilation of CRM philosophy into a pilot's behaviour and subsequent reinforcement through recurrent training effectively counteracts the carelessness and complacency that are part of the human condition.



Recommendations

Aviation Training Institutions and research organization:

- Should continue to promote safety among educators to facilitate assimilation of safety philosophies by their students, who will take their own places in the operational world.

Regulatory Authorities and manufacturers:

- Should encourage embedding CRM into training programs in accordance with ICAO (Annex I) to achieve more standardization and to address cultural aspects of CRM implementation.

HUMAN FACTOR



Statistical Data Confirms:

- That human error is involved in more than 70% of aviation accidents
- Human factors identified in accidents should be used to assess a company's risk exposure and develop corresponding company accident-prevention strategies, or to assess an individual's risk exposure and develop corresponding personal lines of defense
- Whether involving crew, ATC, maintenance, organizational factors or aircraft design, each link of the error chain involves human beings and therefore, human decisions and behaviours

LET US EXAMINE CASES WHERE TRAINING IN HUMAN FACTORS ISSUES ARE CRITICAL



1. Standard Operating Procedures (SOPs):

1. Training must stress ensure adherence to published SOPs and associated normal checklists and standard call. It is also important to teach and understand why pilots may deviate from SOPs
2. Pilots sometimes deviate intentionally from SOPs; some deviations occur because the procedure that was followed in place of the SOP seemed to be appropriate for the prevailing situation. Other deviations are usually unintentional



SOP conti..

The following factors often are cited in discussing deviations from SOPs

1. Task saturation;
2. Inadequate knowledge or failure to understand the rule, procedure or action because of:
 - Inadequate training
 - Printed information not easily understood and/or
 - Perception that a procedure is inappropriate



SOP conti..

3. Insufficient emphasis on adherence to SOPs during transition training and recurrent training;
4. Inadequate vigilance (fatigue)
5. Interruptions (eg pilot-controller communication);
6. Distractions (eg flight deck activities);
7. Incorrect management of priorities (lack of decision-making model for time-critical situations)



SOP conti..

8. Reduced attention (tunnel vision) in abnormal conditions or high-workload conditions;
9. Incorrect CRM techniques (for crew coordination, cross-check and backup);
10. Company policies (eg schedules, costs, go-arounds and diversions
11. Other policies (eg crew duty time);



SOP conti..

12. Personal desires or constraints (schedule, mission completion);
13. Complacency and/or;
14. Overconfidence



2. Automation

- Errors in using Automatic Flight Systems (AFSs) and insufficient knowledge of AFS operation have been contributing factors in approach-and-landing accidents and incidents, including those controlled flight into terrain.



2. Automation conti..

The following common errors in using AFSs must be stressed during training:

1. Inadvertent selection of an incorrect mode;
2. Failure to verify the selection mode by reference to the flight-mode annunciation (FMA);
3. Failure to arm a mode (eg failure to arm the approach mode) at the correct time;



2. Automation conti..

The following common errors in using AFSs must be stressed during training :

4. Inadvertent change of a target entry (eg changing the target airspeed instead of a entering a new heading);
5. Failure to enter a required target entry `9eg failure to enter the correct final approach course);
6. Incorrect altitude entry and failure to confirm the entry on the primary flight display (PFD);



2. Automation conti..

The following common errors in using AFSs must be stressed during training:

7. Entering a target altitude that is lower than the final approach intercept altitude during approach;
8. Preoccupation with FMS programming during a critical flight phase, with consequent loss of situational awareness; and/or
9. Failure to monitor automation and cross-check parameters with raw data.



2. Automation conti..

Other frequent casual casual factors in accident include:

- Inadequate situational awareness;
- Incorrect interaction with automation;
- Inadequate effective crew coordination, cross-check and backup



3. Briefing Techniques

Human factor issues associated with briefing technique must be stressed during training;

1. The importance of briefing techniques often is underestimated, although effective briefings enhance crew standardization and communication.
2. Routine and formal reception of the same information on each flight may become counterproductive; adapting and expanding the briefing by highlighting the special aspect of the approach or the actual weather conditions will result in more effective briefings.



3. Briefing Techniques *conti..*

3. In short, the briefing should attract the attention of the pilot not flying (PNF).
4. Briefing should help the pilot flying (PF) and the PNF to know the sequence of events and actions, as well as the special hazards and circumstances of the approach.
5. An interactive briefing style provides the PF and the PNF with an opportunity to fulfill two important goals of the briefing:
 - Correct each other; and
 - Share a common mental image of the approach.⁴⁵



4. Crew-ATC Communication

Effective communication is achieved when our intellectual process for interpreting the information contained in a message accommodates the message being receive

Training must include:

- How to perceive the message?
- How to reconstruct the information contained in the message?
- How to link the information to an objective to an objective or to an expectations?
- What amount of bias or error is introduced in the process?



4. Crew-ATC Communication *conti..*

CRM must highlight the relevance of the *context* and the *expectations* in communication:

- High workload;
- Fatigue;
- Nonadherence to the “sterile cockpit rule”;
- Interruptions;
- Distractions; and/or
- Conflicts and pressures.



4. Crew-ATC Communication conti..

The results may include:

- Incomplete communication;
- Omission of the aircraft call sign or use of an incorrect call sign;
- Use of nonstandard phraseology; and
- Failure to listen or to respond.



5. Crew Communication

Training must emphasized how interruptions and distractions on the flight deck break the flow pattern of ongoing activities, such as:

- SOPs;
- Normal checklists;
- Communication (listening, processing, responding);
- Monitoring tasks; and
- Problem-solving activities.

The diverted attention resulting from the interruption or distraction usually causes the flight crew to feel rushed and to be confronted by competing task.



5. Crew Communication conti..

- Moreover, when confronted with concurrent task demands, the natural human tendency is to perform one task to the detriment of another.



5. Crew Communication conti..

3. Unless mitigated by adequate techniques to set priorities, interruptions and distractions may result in the flight crew:
- Not monitoring the flight path (possibly resulting in an altitude deviation, course deviation or CFIT);
 - Missing or misinterpreting an ATC instruction (possibly resulting in a traffic conflict or runway incursion)
 - Omitting an action and failing to detect and correct the resulting abnormal condition or configuration, if interrupted during a normal checklist and
 - Leaving uncertainties unresolved (eg an ATC instruction)



6. Altimeter-setting Error

Human factor issues causing errors in altimeter setting have also been scited in some accidents.

An incorrect altimeter setting often is the result of one or more of the following factors:

- High workload;
- Incorrect pilot-system interface;
- Incorrect pilot-controller communication;
- Deviation from normal task-sharing;
- Interruptions and distraction and/or
- Insufficient backup between crewmembers



6. Altimeter-setting Error conti..

- Adherence to the defined task-sharing (for normal conditions or abnormal conditions) and use of normal checklist are the most effective lines of defense against altimeter-setting errors

These **MUST** be emphasized during training



7. Unstabilized Approaches

The following often are cited when discussing unstabilized approaches and must covered during training

1. Fatigue in short-haul, medium-haul or long-haul ops (which highlights the need for developing countermeasures to restore vigilance and alertness for the descent, approach and landing);
2. Pressure of flight schedule (making up for delays);



7. Unstabilized Approaches conti..

3. Any crew-induced circumstance or ATC-induced circumstance resulting in insufficient time to plan, prepare and conduct a safe flight particularly during approach (including accepting requests from ATC to fly higher, to fly faster or to fly shorter than desired);
4. Inadequate ATC awareness of crew capability or aircraft capability to accommodate a last-minute change;



7. Unstabilized Approaches

5. Late takeover from automation (eg after the autopilot fails to capture the localizer or glideslope, usually because the crew failed to arm the approach mode);
6. Inadequate awareness of adverse wind conditions
7. Incorrect anticipation of aircraft deceleration characteristics in level flight or on a three-degree glide path;



7. Unstabilized Approaches

8. Failure to recognize deviations or to remember the excessive-parameter-deviation limits;
9. Belief that the aircraft will be stabilized at the minimum stabilization height (ie 1,000 feet above airport elevation in instrument meteorology conditions or 500 feet above airport elevation in visual meteorology conditions) or short thereafter;



7. Unstabilized Approaches

10. PNF overconfidence in the PF to achieve timely stabilization;
11. PF/PNF overreliance on each other to call excessive deviations or to call for a go-around; and/or,
12. Visual illusions during the acquisition of visual references or during the visual segment.



8. Runway Excursions and Runway Overruns

1. No go-around decision when warranted;
2. Inaccurate information on surface wind, runway condition or wind shear;
3. Incorrect assessment of crosswind limit for prevailing runway conditions



8. Runway Excursions and Runway Overruns conti..

4. Incorrect assessment of landing distance for prevailing wind conditions and runway conditions, or for a malfunction affecting aircraft configuration or braking capability;
5. Captain taking over the controls and landing the aircraft despite the announcement or initiation of a go-around by the F/O (the PF);



8. Runway Excursions and Runway Overruns conti..

6. Late takeover from automation, when required (eg late takeover from autobrakes because of system malfunction);
7. Inoperative equipment not noted per the minimum equipment list (eg one or more brakes being inoperative; and/or
8. Undetected thrust asymmetry (forward/reverse asymmetric thrust condition).



9. Adverse Wind Conditions

The following human factors often cited in discussing events involving adverse winds (eg crosswind, tailwind) need special emphasizes during training

1. Reluctance to recognize changes in landing data over time (eg change in wind direction/velocity, increase in gusts);
2. Failure to seek evidence to confirm landing data and established options (ie reluctance to change plans)
3. Reluctance to divert to an airport with more favorable wind conditions; and/or
4. Insufficient time to observe, evaluate and control the aircraft attitude and flight path in a dynamic situation.



HUMAN FACTOR ISSUES

Summary

Addressing human factors in accidents must include:

1. Defined company safety culture;
2. Defined company safety policies
3. Company accident-prevention strategies;
4. SOPs;
5. CRM practices; and
6. Personal lines of defense

**SOLUTION LIES IN TRAINING, RETRAINING &
CONTINUOUS TRAINING**