

Emerging Aviation Safety Issues



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NTSB 101

- Independent federal agency, investigate transportation mishaps, all modes
- Determine probable cause(s) and make recommendations to prevent recurrences
- Primary product: Safety recommendations
 - Favorable response > 80%
- *SINGLE FOCUS IS SAFETY*
- Independence
 - Political: Findings and recommendations based upon evidence rather than politics
 - Functional: No “dog in the fight”



Some Future Concerns

- Pilot professionalism
- Overzealous criminalization of accidents
- Increasing automation



Pilot Professionalism

Problem

- Loss of military pilot pipeline
- Military: “Right Stuff” or out

Current Civilian System

- Written test: Knowledge
- Flying test: Skills and knowledge
- *Not tested: Judgment or professionalism*
- *No limit on how many times to take tests*



Lack of Professionalism

- Let's try FL 410 (2004)
- Takeoff without runway lights (2006)
- Stick shaker: PULL! (2009)
- Minneapolis over-flight (2009)

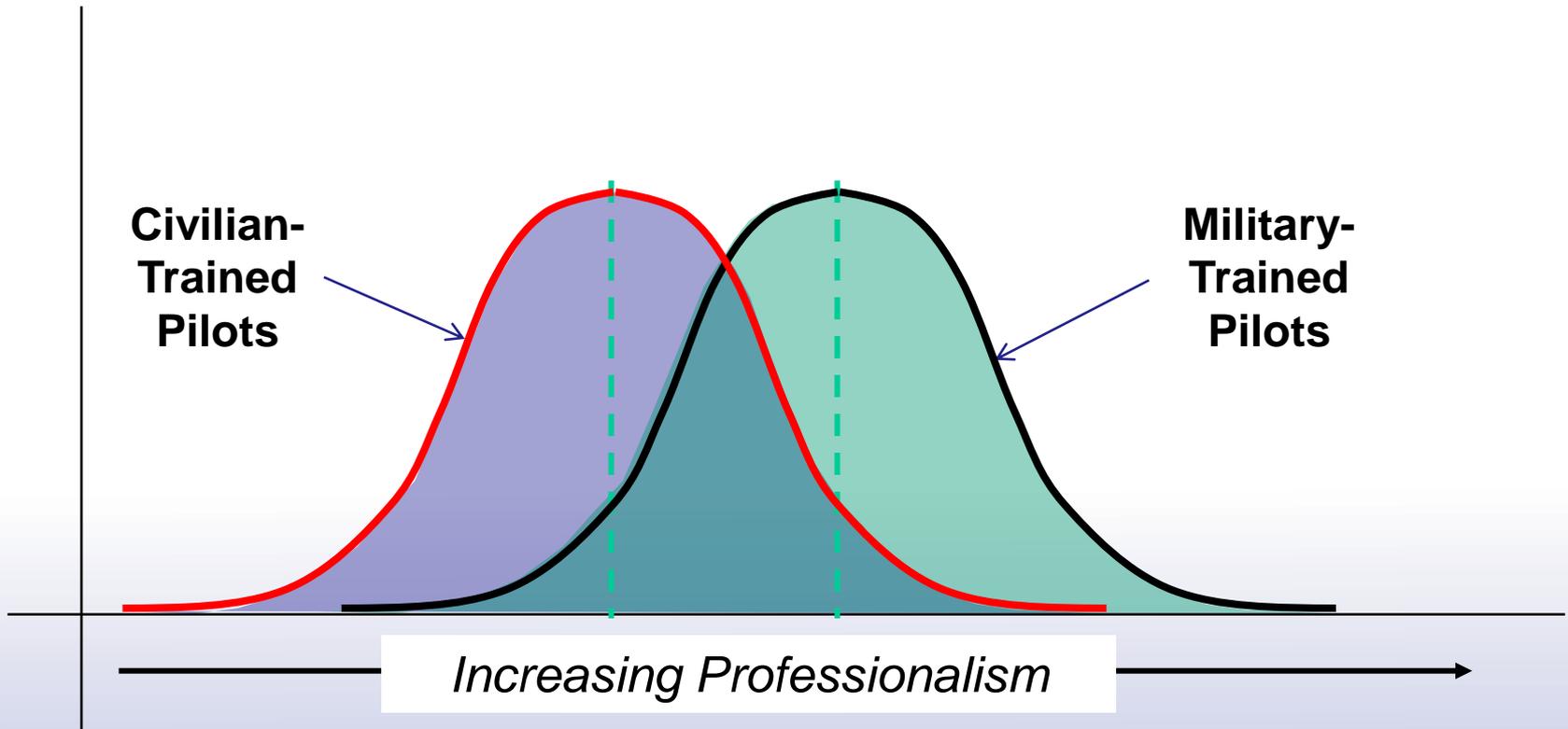


The Training Challenge

- Initial training must:
 - Develop knowledge and skills
 - Be evaluated by more than just (eventually) passing knowledge and skill tests
 - Also develop and instill good judgment and professionalism
- Recurrent training must:
 - Continue to develop and strengthen all of the above



Need to Shift the Bell Curve



Overzealous Criminalization

- Systems are getting more complex
- Most accidents involve good people trying to do the right thing
- Human error: Immediate response is to *PUNISH!*
- Issue: Best way to stop error that is *inadvertent?*



Undesirable Results

Possibility of criminalization:

- Chills willingness of front-line employees to participate in proactive information programs
- Hinders mishap investigations
- Reduces likelihood of investigating system issues



Recent Examples

- Concorde, Paris, France (2000)
- GOL 1907, Brazil (2006)
- Asiana 214, San Francisco (2013)?



Concorde

– Chain of Events

- Takeoff
- Piece of metal on runway from previous airplane
- Main gear tire shredded after hitting piece of metal
- Fragments from tire hit wing, punctured fuel tank
- Leaking fuel caught fire



GOL 1907

– Chain of Events

- Aircraft eastbound, FL 370, per international convention
- Assigned route turned westbound at navigation waypoint
- Go to even thousand (FL 380 or 360)?
- Pilots tried unsuccessfully to contact controllers, so remained at FL 370
- Transponder on “Standby” (for long time), hence
 - Airplane invisible to ATC
 - Airplane also invisible to TCAS in other airplanes
- Both airplanes navigating with GPS



– Theory

- Pilot’s foot on footrest hit transponder “Standby” button



Increasing Automation: Good News, Bad News

- *Good:* When working as designed, automation has demonstrated that it can and does significantly improve safety, reliability, and productivity
- *Bad:* Problems may occur if the automation
 - Has design flaws,
 - Is not appropriate for the situation,
 - Malfunctions
 - Is relied upon too much
 - Undermines professionalism



Statement of the Problem

“In their efforts to compensate for the unreliability of human performance, the designers of automated control systems have unwittingly created opportunities for new error types that can be even more serious than those they were seeking to avoid.”

*Reason, James,
Managing the Risks of Organizational
Accidents (Ashgate Publishing, 1997), p. 46*



Metro, Washington, DC

– The Conditions

- Electronic collision prevention
- Parasitic electronic oscillation
- Stopped (struck) train became electronically invisible
- “Invisibility alarm” at dispatch center – ignored
- No invisibility alarm in following (striking) train
- Sensing empty track ahead, following train was accelerating
- Sight distance limited due to curve



Lessons Learned

- Need to address parasitic oscillation
- Need invisibility alarm in following trains
- Over-warning can lead to warning system complacency, which can be worse than no warning



Strasbourg, France

– Risk Factors

- Night, mountainous terrain
- No ground radar
- No ground-based glideslope guidance
- No airborne terrain alerting equipment



– Very Sophisticated Autopilot

– Autopilot Mode Ambiguity



Human Factors Challenge

- “3.2” in the window, *with a decimal*, means:
 - Descend at a 3.2 degree angle (about 700 fpm at 140 knots)
- “32” in the window, *without a decimal*, means:
 - Descend at 3200 fpm

Flight data recorder readout program could have helped safety experts identify this problem

Clue: Quick changes in autopilot mode frequently signal a problem



Cali, Colombia

– Risk Factors

- Night
- Airport in deep valley
- No ground radar
- Airborne terrain alerting limited to “look-down”
- Last minute change in approach
 - More rapid descent (throttles idle, spoilers)
 - Hurried reprogramming



– Navigation Radio Ambiguity

– Spoilers Do Not Retract With Power



Recommended Remedies:

- Operational
 - *Caution re last minute changes during the approach!!*
- Aircraft/Avionics
 - Enhanced ground proximity warning system
 - Spoilers that retract with max power
 - Require confirmation of non-obvious changes
 - Unused or passed waypoints remain in view
- Infrastructure
 - Eliminate single-letter navigational radio identifiers
 - Ground-based radar
 - Improved reporting of, and acting upon, safety issues



Landing on the Hudson

- Bird ingestion, dual engine failure
- Dead-stick landing into river
- Unknown to pilot, phugoid damping software restricted nose-up movement during “landing” flare
- Result: Higher vertical impact speed, damage to fuselage



Queries

- Need for phugoid damping in this situation?
- Different result if pilot had known about phugoid damping?



Amsterdam, Holland

– The Conditions

- Malfunctioning left radar altimeter
- Pilots selected right side autopilot
- Aircraft vectored above glideslope
- Autothrottles commanded throttles to idle
- Unknown to pilots, throttles idle because right autopilot was using left radar altimeter
- Attempted go-around unsuccessful



Queries

- Should autopilot default to same side altimeter?
- More clarity re source of altitude information?
- Enable pilots to select altitude information source?



Rio to Paris

– The Conditions

- Cruise, autopilot engaged
- Night, in clouds, turbulence, coffin corner
- Ice blocked pitot tubes
- Autopilot, autothrust inoperative without airspeed information
- Alpha protections disabled
- Pilots' responses inappropriate



Queries

- Adequate redundancy?
- More effective error message displays?
- Reduction of startle effect, e.g., interim “virtual” airspeed?
- Improved pilot training?
- Improved CRM training: Importance of pilot knowing other pilot’s actions?
- Train manual flight at cruise altitude?



Effect on Professionalism?

- Subways: The automation
 - Takes the train out of the station
 - Observes speed limits
 - Avoids collisions
 - Enters the station
 - Opens the doors
- The operator
 - Closes the doors
- Job Satisfaction? Professionalism?
- At work to do great job, or to earn paycheck?



Challenging Issue

- Problem goes beyond skills, knowledge
- Issue is *attitude*, i.e., do I have pride in my work?
- Skill/knowledge problem most often arises when the automation *fails*
- Attitude problem arises even when the automation *functions as designed*



Conclusions

- Automation has significantly improved safety, reliability, and productivity
- More effective training re automation will always be essential, but
- We must also more effectively address the human/machine interface challenges of increasingly complex and increasingly reliable automation



Thank You

Questions?



National Transportation Safety Board