ICAO Workshop
Human Factors Checklist

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Paul Cox
NTSB Eastern Regional Office
Ashburn, Virginia
Based on a U.S. Naval Postgraduate School paper:

• “Human Factors Checklist; An Aircraft Accident Investigation Tool”

• The complete checklist is in your toolbox; however, the Eight Factors and conditions for those factors will be discussed here.
Eight Factors

1. Sensory – Perceptual Factors
2. Medical and Physiological Factors
3. Knowledge or Skill Factors
4. Personality and Safety Attitude Factors
5. Judgment-Risk Decision Factors
6. Communications/Crew Coordination Factors
7. Design/System Factors
8. Supervisory Factors
Case Study

- Hazy, night lighting conditions
- Over water to an island
- Accident occurred at 2141, moon 11 degrees above horizon, bearing 270 degrees, 19% illumination

- Private pilot (recovering from ankle injury) plus two passengers
- No instrument rating; wx brief indicated VFR.
- TT 310 hours, 55 at night
- 36 hours in the airplane, 48 minutes at night, 1 night landing
- Had flown at least 35 flights to the island, 5+ at night (most recent logbook not found)
• Purpose of flight to drop off one pax at island, then proceed to another destination (press: for a wedding).

• Pilot’s CFI said pilot was not ready for an instrument rating, but had capability to fly to island as long as visible horizon existed.

• Pilot’s CFI offered to fly with him that night.

• Originally scheduled to take off at 1800, departed at 2039, about ½ hour after sunset. (Waiting for a passenger.)
• Stress in pilot’s life – with wife; spent last 3 nights in hotel; business failing. (But press said he was in good spirits that day.)

• Accident proceeded over land at 5,500 feet, then crossed a 30-mile stretch of water and eventually began a descent.

• About 7 miles from the island, airplane stopped its descent at 2,200 feet, climbed to 2,600 feet and entered a left turn.

• It then descended at 900 fpm, began a right turn, and impacted water at a rate that exceeded 4,700 fpm.
Flight Path of N9253N Based on New York Center ARSR Data

Selected Final Radar Returns for N9253N

Aircraft Performance 13 - Attachment 1 - Chart 2 - Radar Data from Several sources

Aircraft Performance 13 - Attachment 1 - Chart 4 - Radar Data from Several Sources
• Probable Cause: The pilot’s failure to maintain control of the airplane, which was the result of spatial disorientation.
1. Sensory-Perceptual Factors

- Misjudged distance, clearance, altitude, speed, etc.

- False perception due to visual illusion
Sensory-Perceptual Factors

Conditions that contribute to impaired Visual Performance:

- 1) Featureless terrain (desert, dry lake bed, water)
- 2) Dark/low visibility
- 3) Black hole approach (VFR, dark landmass, lights against rising terrain)
- 4) No/false horizon (unreliable visual attitude reference)
- 5) Mountain terrain or sloping runway
- 6) Helicopter rotor downwash effects (cascading water on windscreen, ripples on water, grass or sand, white/brown out)
- 7) Anomalous light effects (e.g. pulsating or oscillating lights; flicker vertigo)
- 8) Low contrast target/object to background or poor illumination
- 9) Looking into bright sun/moon light, or shadowed area
Sensory-Perceptual Factors

• False perception due to vestibular illusion:
  – Coriolis-cross coupling (spinning sensation due to vestibular overstimulation)
  – Somatogravic (gravity induced false pitch up or down sensation)
  – Somatogyral (false sensation of angular rotation)
  – G-excess (error in perceiving actual angle of bank)

• Spatial Disorientation/Vertigo:
  – Type I: Unrecognized or "misoriented" (loss of attitudinal orientation without awareness)
  – Type II: Recognized (Vertigo or the “Leans”)
  – Type III: Incapacitating (e.g. G-induced vestibular-ocular decoupling)
Sensory-Perceptual Factors

Conditions that affect sense of Body Position or Aircraft Attitude:

• 1) Loss of visual cues/attitude reference (especially with no natural horizon)
• 2) Acceleration-related illusions (G-force and centrifugal force illusions)
• 3) Adverse medical or physiological condition (alcohol/drug effects, hangover/dehydration, fatigue, other)
Sensory-Perceptual Factors

• Loss of Situation Awareness (SA):
  • A. Geographic disorientation (off navigation route or lost)
  • B. Did not perceive hazardous condition
  • C. Erroneous assessment (misinterpreted situation)
  • D. Failed to predict/anticipate changing conditions
  • E. False hypothesis/confirmation bias
Sensory-Perceptual Factors

- Attention failure (did not monitor or respond when correct information was available)
  - Missed flight checklist items, callout, or crew challenge.
  - Failed to monitor flight progress or maintain instrument scan.
  - Failed to respond to communication or warning input.
  - Control action errors (motor response SLIP or memory LAPSE)
  - Forgot to set/move/reset switch (Lapse)
  - Unintentional activation (Slip)
  - Control substitution error (Slip)
  - Control reversal error (Slip)
  - Control adjustment/precision error (Slip)
Sensory-Perceptual Factors

- *Conditions that influence Attention and Situation Awareness:*
  - Inattention (focused on information unrelated to cockpit tasks/flying)
  - Fixation or Distraction
  - Task overload
  - Cognitive workload (problem-solving concentration)
  - Habituation (old/previous learned habit interference)
  - Excess aircrew stress or fatigue level.
  - Inadequate briefing or poor flight preparation/training
  - Negative learning transfer (e.g. transitioning to new aircraft).
  - Adverse weather/meteorological conditions.
  - Adverse cockpit environmental conditions (temperature, vibrations, etc.)
  - Tactical situation or display information overload.
  - Low aircrew motivation and poor flight vigilance.
  - Poor cockpit design (control/display location or data format)
2. Medical and Physiological Factors

- Self-medicated (without or against medical advice) or taking nutritional supplements
- Flew under influence of drugs/alcohol
- Flew with cold or flu (or other known illness)
- Flew while under excessive personal stress or fatigue
- Flew without adequate nutrition (skipped meals)
- Experienced G-induced loss of consciousness (G-loc) or excessive G-load
- Experienced hypoxia or hyperventilation during flight
- Other medical or physiological condition
Conditions that may lead to an adverse Medical/Physiological State:

- Mission fatigue (on job/duty over 12 hours; late night or early morning operations between 0200-0600)
- Cumulative fatigue (excess physical or mental workload, circadian disruption, or sleep loss)
- Cumulative effects of personal or occupational stress
- Emergency flight condition/workload transition (normal to emergency situation)
- Medical or physiological pre-conditions (preceding state of health, fitness level, hangover/dehydration, etc.)
3. Knowledge or Skill Factors

- Showed inadequate knowledge of systems, procedures, etc. (*Knowledge-based error*)

- Poor flight control/airmanship or poor accuracy/precision of flight maneuvering (*Skill-based error*)

- Misuse of procedures or incorrect performance of cockpit tasks (*Rule-based error*)
  - Failed to perform required procedure(s)
  - Used wrong procedure or rule(s)
  - Missed step(s) in a prescribed sequence
  - Performed steps out of sequence
Knowledge or Skill Factors

- Below required proficiency or currency standards
- Showed poor performance trend and/or documented flight aptitude deficiencies
- Low flight hours (total flight hours, or hours in-type aircraft)
- Lacked essential training for specific task(s)
- Lacked recent mission or flight conditions (instrument, night, weather, etc.) experience
- Transition pilot (learning new aircraft system)
- Considered a marginal pilot (documented history of poor performance or flight violations)
4. Personality and Safety Attitude Factors

- Showed pattern of overconfidence about flying ability
- Showed pattern of excess motivation to achieve mission
- Exhibited anger/frustration on the job
- "Hot Dogging" on mishap flight and/or exhibited stress-related "acting out" behavior
- Was too assertive or non-assertive for the situation
- Lacked confidence to perform tasks/mission(s)
- Yielded to social pressure to perform in hazardous situation (from command or peers)
Personality and Safety Attitude Factors

*Conditions leading to Poor Safety Attitude:*

- Habitual high risk taker (personality-driven with previous history)
- Pattern of overconfidence (very high self-image)
- Considered Marginal or High Risk Aviator (documented history of poor performance or flight violations)
- Excessive self-motivation (did not know limits)
- Poor command climate/safety culture
5. Judgment-Risk Decision Factors

- Knowingly accepted a high-risk situation
- Misjudged actual risks of mission (complacency)
- Did not monitor flight progress/conditions (complacency)
- Used incorrect task priorities
- Knowingly deviated from safe procedure (imprudence)
- Intentionally violated safety standard or regulation
- Willfully ignored warning input (from human or display system)
- Knowingly exceeded personal or aircraft limits
- Knowingly exceeded prescribed mission profile/parameters
- Yielded to social pressure (command or peers)
Judgment-Risk Decision Factors

- Conditions that could contribute to improper risk decisions:
  - Considered a "hotdog" pilot (reputation) or High Risk Aviator (documented)
  - Excessive self-motivation (did not know limits)
  - Not handling "life stress" (anger/frustration; not coping)
  - Too assertive or non-assertive (interpersonal Style)
  - Influenced by poor command climate/safety culture (lack of adequate supervision)
6. Communications/Crew Coordination Factors

- Inadequate mission plan/brief or preflight
- Failed to communicate plan/intentions
- Failed to use standard/accepted language
- Misunderstood or unacknowledged communication
- Inadequate crew challenges or crosscheck
- Crewmember intentionally withheld vital safety data
- Pilot in command failed to lead and/or delegate
- Pilot in command failed to use all available resources
- Interpersonal conflict/crew argument during flight
Communications/Crew Coordination Factors

- **Conditions that can lead to Poor Communication/Coordination:**
  - Inadequate training in communications/crew coordination.
  - Inadequate standard operating procedures for use of crew resources.
  - Weak support from command for aircrew coordination doctrine.
  - Aircrew/cockpit rank/experience gradient present.
  - Command safety culture does not support a "crew concept".
Your thoughts on CRM?
7. Design/System Factors

• Used wrong switch/lever or control
• Misread or misinterpreted instrument reading
• Could not reach or see control
• Could not see or read instrument or indicator
• Failed to respond to warning signal
• Selected/used wrong avionics system operating mode (mode confusion)
• Over-reliance on automated system (automation complacency)
Conditions that contribute to Design-Induced Crew Errors:
- Poor primary aircraft controls or display arrangement
- Inadequate primary display data or data format
- Hard to read instrument data (legibility, glare, lighting)
- Incompatible cockpit control-display activation, or aircraft response mapping
- Inadequate hazard advisory or warning display
- Poor cockpit design layout (controls/displays outside vision/reach envelope)
- Poor human-computer-display interface/usability (error prone design)
- Poor system instructions/documentation
- Inadequate aviation system support or facilities (navigation aids, airport, traffic control)
- Nonstandard cockpit layouts (invitation to negative habit transfer)
- Inappropriate type or level of automation, or excess operational mode complexity
8. Supervisory Factors

- Inappropriate schedule/crew assignment
- Failed to monitor crew rest/duty allowance
- Failed to establish/monitor compliance with quality standards
- Failed to provide/monitor crew training/qualifications
- Failed to screen/remove known high-risk aviators
- Intentionally violated or directed other(s) to violate a standard, rule or regulation
- Failed to correctly assess or perceive actual mission risks, with respect to:
  - Environmental hazards/operating conditions
  - Mission tasking and aircrew skill level
  - Aircraft and equipment limitations
Supervisory Factors

• *Conditions leading to Supervisory Failures:*

• Excess operations tempo/organizational workload
• Poor command climate/safety culture, lax safety supervision.
• Inadequate standards and/or low performance expectations.
• Inadequate resources to support safe mission accomplishment.
• Inadequate training of the mishap pilot or crew.
• Commanders did not set a good example, or did set a bad example.
• Supervisors did not provide adequate commitment or emphasis on safe operations.
• Poor communications up/down command chain.
• No system or weak system for management of high-risk aviators.
• Weak processes or procedures for operational risk management.
• Inadequate Aeromedical or Human Factors Training.
In Closing, Any Human Factors Issues Here?