THE HUMAN FACTORS ANALYSIS AND CLASSIFICATION SYSTEM (HFACS)

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MISTAKES

It could be that the purpose of your life is only to serve as a warning to others.
Scheduled Air Carrier

U.S. General Aviation

U.S. Navy/Marine Corps

U.S. Air Force

Source: Boeing

Source: NTSB

Source: U.S. Naval Safety Center

Source: U.S. Air Force Safety Center
REASONS FOR CONCERN

- The rate of improvement has slowed significantly and substantially during the last 25 years.
  - This has led some to conclude that further reductions in accident rates are improbable, if not impossible.
REASONS FOR CONCERN

- The rate of improvement has slowed significantly and substantially during the last 10 years.
  - This has led some to conclude that further reductions in accident rates are improbable, if not impossible.

- Still, aircraft are becoming increasingly expensive raising the cost of aviation accidents.
TOTAL: $3.9 Billion

COST OF ACCIDENTS
U.S. Navy and Marine Corps
FY96-00

Aviation
$3.3B

Shore/Ground
$150M

Shipboard
$277M

PMV
$129M

Recreation
$67M

Source: U.S. Naval Safety Center

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U.S. Navy/Marine Corps (1950-2000)

Source: U.S. Naval Safety Center
Mechanical Failure
- Catastrophic failures are infrequent events
- When failures do occur, they are often less severe or hazardous due to effective intervention programs.

Data-Driven Research
- Highly sophisticated techniques and procedures
- Information is objective and quantifiable
- Effective at determining why the failure occurred

Accident Investigation
- Designed around traditional categories
- Variables are well-defined and causally related
- Organization and structure facilitate access and use

Accident Database
- Traditional analyses are clearly outlined and readily performed.
- Frequent analyses help identify common mechanical and engineering safety issues.

Database Analysis

Effective Intervention and Prevention Programs
- FAA, DoD, NASA, & airplane manufacturers provide research funding.
- Research programs are needs-based and data-driven. Interventions are therefore very effective.

Research Sponsors

Feedback


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Feedback

Human Error
- Errors occur frequently and are the major cause of accidents.
- Few safety programs are effective at preventing the occurrence or consequences of these errors.

Ineffective Intervention and Prevention Programs

Fad-Driven Research

Research Sponsors
- FAA, DoD, NASA, & Airlines provide funding for safety research programs.
- Lack of good data leads to research programs based primarily on interests and intuitions. Interventions are therefore less effective.

Prevention

Mitigation

Accident Investigation
- Less sophisticated techniques and procedures
- Information is qualitative and illusive
- Focus on “what” happened but not “why” it happened

Accident Database
- Not designed around any particular human error framework
- Variables often ill-defined
- Organization and structure difficult to understand

Database Analysis
- Traditional human factors analyses are onerous due to ill-defined variables and database structures.
- Few analyses have been performed to identify underlying human factors safety issues.

Feedback


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ADDRESSING THE PROBLEM

- What was required, therefore, was a general human error framework around which accident investigation and prevention programs can be developed.

- We explored several approaches and “off-the-shelf” frameworks
  - Cognitive
  - Ergonomics
  - Aeromedical
  - Psychosocial
  - Organizational


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The Human Factors Analysis and Classification System (HFACS)


Breakdown of a Productive System

Failed or Absent Defenses

Unsafe Acts

Active Conditions
- Failed to scan instruments
- Penetrated IMC when VFR only

Adapted from Reason (1990)
Breakdown of a Productive System

Active and Latent Conditions
- Poor CRM
- Loss of situational awareness

Active Conditions
- Failed to scan instruments
- Penetrated IMC when VFR only

Preconditions for Unsafe Acts

Unsafe Acts

Failed or Absent Defenses

Adapted from Reason (1990)
Breakdown of a Productive System

Latent Conditions
- Deficient training program
- Improper crew pairing

Active and Latent Conditions
- Poor CRM
- Loss of situational awareness

Unsafe Acts
- Failed to scan instruments
- Penetrated IMC when VFR only

Adapted from Reason (1990)
Breakdown of a Productive System

**Inputs**
- Economic inflation
- Few qualified pilots

**Organizational Factors**
- Excessive cost cutting
- Inadequate promotion policies

**Unsafe Supervision**
- Deficient training program
- Improper crew pairing

**Preconditions for Unsafe Acts**
- Poor CRM
- Loss of situational awareness

**Unsafe Acts**
- Failed to scan instruments
- Penetrated IMC when VFR only

**Failed or Absent Defenses**

**Active and Latent Conditions**

**Active Conditions**
- Crashed into side of mountain

**Adapted from Reason (1990)**
Unsafe Acts

Errors
- Decision Errors
- Skill-Based Errors
- Perceptual Errors

Violations
- Routine
- Exceptional
UNSAFE ACTS

Errors
- Decision Errors
- Skill-Based Errors
- Perceptual Errors

Violations
- Routine
- Exceptional

DECISION ERRORS
- Rule-based Decisions
  - If X, then do Y
  - Highly Procedural
- Choice Decisions
  - Knowledge-based
- Ill-Structured Decisions
  - Problem solving
UNSAFE ACTS

Errors

Decision Errors

Skill-Based Errors

Perceptual Errors

Violations

Routine

Exceptional

SKILL-BASED ERRORS

- Attention Failures
  - Breakdown in visual scan
  - Inadvertent operation of control
- Memory Failure
  - Omitted item in checklist
  - Omitted step in procedure
- Stick-and-Rudder Skills
UNSAFE ACTS

Errors
- Decision Errors
- Skill-Based Errors
- Perceptual Errors
- Errors
- Violations
  - Routine
  - Exceptional

PERCEPTUAL ERRORS (due to)
- Misjudge Distance, Altitude, Airspeed
- Spatial Disorientation
- Visual Illusions
UNSAFE ACTS

Errors

- Decision Errors
- Skill-Based Errors
- Perceptual Errors

Violations

- Routine
- Exceptional

Routine (Infractions)
(Habitual departures from rules condoned by management)

- VFR Flight into IMC
- Elected to File VFR in Marginal Weather Conditions
- Failed to Use Radar Advisories from ATC
- Inadequate Brief and Limits on Mission
- IFR Procedure Not Followed
- Weight and Balance Exceeded
- Procedure/Directives Not Followed
- Operating With Known Deficiencies
- Min. Descent Altitude not Complied with
**UNSAFE ACTS**

- **Errors**
  - Decision Errors
  - Skill-Based Errors
  - Perceptual Errors

- **Violations**
  - Routine
  - Exceptional

**EXCEPTIONAL**
(Isolated departures from the rules not condoned by management)

- Violated NATOPS/Regulations/SOP
  - Performed Unauthorized Acrobatic Maneuver
  - Canyon Running
  - Failed to Complete Performance Computations for Flight
  - Failed to Obtain Valid Weather Brief
- Accepted Unnecessary Hazard
- Not Current/Qualified for Mission
- Exceeded Limits of Aircraft
PRECONDITIONS FOR UNSAFE ACTS

Environmental Factors
- Physical Environment
- Technological Environment

Condition of Operators
- Adverse Mental States
- Adverse Physiological States
- Physical/Mental Limitations

Personnel Factors
- Crew Resource Management
- Personal Readiness

Unpreconditions for Unsafe Acts
PRECONDITIONS FOR UNSAFE ACTS

Condition of Operators

Environmental Factors
- Physical Environment
- Technological Environment

Personnel Factors
- Crew Resource Management
- Personal Readiness

Adverse Mental States
- Loss of Situational Awareness
- Circadian dysrhythmia
- Alertness (Drowsiness)
- Overconfidence
- Complacency
- Task Fixation

Adverse Physiological States

Physical/Mental Limitations

ADVERSE MENTAL STATE
PRECONDITIONS FOR UNSAFE ACTS

Condition of Operators

Environmental Factors
- Physical Environment
- Technological Environment

Technological Environment

Personnel Factors
- Crew Resource Management
- Personal Readiness

Adverse Physiological States
- Spatial Disorientation
- Visual Illusions
- G-induced Loss of Consciousness
- Hypoxia
- Medical Illness

Adverse Mental States

Physical/ Mental Limitations

Personal Readiness

Preconditions for Unsafe Acts

Unsafe Acts

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PRECONDITIONS FOR UNSAFE ACTS

Condition of Operators

Environmental Factors
- Physical Environment
- Technological Environment

Personnel Factors
- Crew Resource Management
- Personal Readiness

Condition of Operators
- Physical/Mental Limitations
  - Lack of Sensory Input
  - Limited Reaction Time
  - Incompatible Physical Capabilities
  - Incompatible Intelligence/Aptitude

Adverse Mental States

Adverse Physiological States

Personal Readiness

PHYSICAL/MENTAL LIMITATIONS

Preconditions for Unsafe Acts

Unsafe Acts

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PRECONDITIONS FOR UNSAFE ACTS

Environmental Factors
- Physical Environment
- Technological Environment

Condition of Operators
- Adverse Mental States
- Adverse Physiological States
- Physical/Mental Limitations

Personnel Factors

Crew Resource Management
- Not Working as a Team
- Poor Aircrew Coordination
- Improper Briefing Before a Mission
- Inadequate Coordination of Flight

Personal Readiness

CREW RESOURCE MANAGEMENT

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PRECONDITIONS FOR UNSAFE ACTS

Environmental Factors
- Physical Environment
- Technological Environment

Condition of Operators
- Adverse Mental States
- Adverse Physiological States
- Physical/Mental Limitations

Personnel Factors
- Crew Resource Management
- Personal Readiness

Personal Readiness

PERSONAL READINESS

Readiness Violations
- Crew Rest Requirements
- Bottle-to-Brief Rules
- Self-Medicating

Poor Judgement
- Poor Dietary Practices
- Overexertion While Off Duty
PRECONDITIONS FOR UNSAFE ACTS

Environmental Factors
- Physical Environment
- Technological Environment

Condition of Operators
- Adverse Mental States
- Adverse Physiological States
- Physical/Mental Limitations

Personnel Factors
- Crew Resource Management
- Personal Readiness

PHYSICAL ENVIRONMENT
- Weather
- Lighting
- Noise
- Heat
- Acceleration
- Vibration
- Pollutants

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PRECONDITIONS FOR UNSAFE ACTS

Environmental Factors
- Physical Environment
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Condition of Operators
- Adverse Mental States
- Adverse Physiological States
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Personnel Factors
- Crew Resource Management
- Personal Readiness

Technological Environment
- Equipment and controls
- Automation reliability/complexity
- Task and Procedure Design
- Manuals and Checklist Design
- Interfaces and Displays

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UNSAFE SUPERVISION

Inadequate Supervision
Planned Inappropriate Operations
Failed to Correct Problem
Supervisory Violations

Unsafe Supervision
Preconditions for Unsafe Acts
Unsafe Acts
Unsafe Supervision

Preconditions for Unsafe Acts

Unsafe Acts

Inadequate Supervision

Planned Inappropriate Operations

Failed to Correct Problem

Supervisory Violations

Unsafe Supervision

Inadequate Supervision

Planning Inappropriate Operations

Failed to Correct Problem

Supervisory Violations

Unsafe Acts

Preconditions for Unsafe Acts

Unsafe Supervision

UNSAFE SUPERVISION

INADEQUATE SUPERVISION

- Failure to Administer Proper Training
- Lack of Professional Guidance

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UNSAFE SUPERVISION

- Inadequate Supervision
- Planned Inappropriate Operations
- Failed to Correct Problem
- Supervisory Violations

PLANNED INAPPROPRIATE OPERATIONS
- Mission Risk without Benefit
- Improper Work Tempo
- Poor Crew Pairing
**Unsafe Supervision**

- Inadequate Supervision
- Planned Inappropriate Operations
- Failed to Correct Problem
- Supervisory Violations

**Failed to Correct a Known Problem**

- Failure to Correct Inappropriate Behavior
- Failure to Correct a Safety Hazard

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UNSAFE SUPERVISION

Inadequate Supervision

Planned Inappropriate Operations

Failed to Correct Problem

Supervisory Violations

SUPERVISORY VIOLATIONS

- Not Adhering to Rules and Regulations
- Willful Disregard for Authority by Supervisors
ORGANIZATIONAL INFLUENCES

Resource Management

Organizational Climate

Operational Process

Organizational Influences

Unsafe Supervision

Preconditions for Unsafe Acts

Unsafe Acts

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ORGANIZATIONAL INFLUENCES

Resource Management

Organizational Climate

Operational Process

RESOURCE MANAGEMENT
- Human
- Monetary
- Equipment/Facility

Unsafe Supervision

Preconditions for Unsafe Acts

Unsafe Acts

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ORGANIZATIONAL INFLUENCES

Resource Management

Organizational Climate

Operational Process

ORGANIZATIONAL CLIMATE
- Structure
- Policies
- Culture

Unsafe Acts

Unsafe Supervision

Preconditions for Unsafe Acts

Organizational Influences

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ORGANIZATIONAL INFLUENCES

- Resource Management
- Organizational Climate
- Operational Process

OPERATIONAL PROCESS
- Operations
- Procedures
- Oversight

Unsafe Acts
- Preconditions for Unsafe Acts
- Unsafe Supervision

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ORGANIZATIONAL INFLUENCES

Resource Management
Organizational Climate
Organizational Process

UNSAFE SUPERVISION

Inadequate Supervision
Planned Inappropriate Operations
Failed to Correct Problem
Supervisory Violations

PRECONDITIONS FOR UNSAFE ACTS

Environmental Factors
Physical Environment
Technological Environment
Adverse Mental States
Adverse Physiological States
Physical/Mental Limitations

Condition of Operators

Personnel Factors
Crew Resource Management
Personal Readiness

UNSAFE ACTS

Errors
Decision Errors
Skill-Based Errors
Perceptual Errors
Violations
Routine
Exceptional

ORGANIZATIONAL INFLUENCES
Resource Management
Organizational Climate
Organizational Process

UNSAFE SUPERVISION
Inadequate Supervision
Planned Inappropriate Operations
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Intervention: Filling the Holes in the Cheese

- Safe Decisions
- Safe Supervision
- Preconditions for Safe Acts
- Safe Acts


### Sample of the Types of Human Error Typically Found

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft Control Not Maintained</td>
<td>Clearance Missed</td>
</tr>
<tr>
<td>Procedures/Directives Not Followed</td>
<td>IFR Procedure Not Followed</td>
</tr>
<tr>
<td>Aborted Takeoff</td>
<td>Inattentive</td>
</tr>
<tr>
<td>Airspeed (VREF) Not Maintained</td>
<td>Remedial Action Attempted</td>
</tr>
<tr>
<td>APU Selected</td>
<td>Someone Goofed</td>
</tr>
<tr>
<td>Proper Touchdown Point Misjudged</td>
<td>Improper Use of Preflight Briefing Service</td>
</tr>
<tr>
<td>Aborted Above V1 Impr</td>
<td>Descent Premature</td>
</tr>
<tr>
<td>Airspeed (VMC) Not Maintained</td>
<td>Proper Descent Rate Not Attained</td>
</tr>
<tr>
<td>Autopilot Improper Use Of Complacency</td>
<td>Airspeed Not Maintained (generic)</td>
</tr>
<tr>
<td>Control Interference Inadvertent</td>
<td>Inadverted Stall</td>
</tr>
<tr>
<td>Crew/Group Coordination Not Maintained</td>
<td>Visual Lookout Inadequate</td>
</tr>
<tr>
<td>Proper Touchdown Point Not Attained</td>
<td>Inadequate Substantiation Process</td>
</tr>
<tr>
<td>Airspeed Not Maintained</td>
<td>Identification of Aircraft Visually Delayed</td>
</tr>
<tr>
<td>Airspeed (VR) Impr</td>
<td>Inadequate Substantiation Process</td>
</tr>
<tr>
<td>Autopilot Inadvertent Deactivation</td>
<td>Crew/Group Coordination Not Maintained</td>
</tr>
<tr>
<td>Circuit Breaker Selected</td>
<td>Flaps Improper Use Of</td>
</tr>
<tr>
<td>Compensation for Wind Conditions Not Possible</td>
<td>Flare Excessive</td>
</tr>
<tr>
<td>Unsafe/Hazardous Condition Not Identified</td>
<td>Flight into Known Adverse Weather Initiated</td>
</tr>
<tr>
<td>VFR Flight Into IMC Attempted</td>
<td>Go-Around Not Performed</td>
</tr>
<tr>
<td>Flight Into Adverse Weather Continued</td>
<td>Identification of Aircraft Visually Delayed</td>
</tr>
<tr>
<td>Hydraulic System Not Selected</td>
<td>Inadequate Substantiation Process</td>
</tr>
<tr>
<td>Inadequate Surveillance of Operation</td>
<td>Crew/Group Coordination Not Maintained</td>
</tr>
<tr>
<td>Proper Touchdown Point Not Possible</td>
<td>Flaps Improper Use Of</td>
</tr>
<tr>
<td>Aborted Takeoff Delay</td>
<td>Flare Excessive</td>
</tr>
<tr>
<td>Airspeed (VLOF) Not Attained</td>
<td>Flight into Known Adverse Weather Initiated</td>
</tr>
<tr>
<td>Airspeed Excessive</td>
<td>Go-Around Not Performed</td>
</tr>
<tr>
<td>Altimeter Setting Not Obtained</td>
<td>Identification of Aircraft Visually Delayed</td>
</tr>
<tr>
<td>Altitude Not Maintained</td>
<td>Inadequate Substantiation Process</td>
</tr>
<tr>
<td>Became Lost/Disoriented</td>
<td>Checklist Not Complied With</td>
</tr>
<tr>
<td>Checklist Not Complied With</td>
<td>Crew/Group Coordination Not Maintained</td>
</tr>
<tr>
<td>Flaps Improper Use Of</td>
<td>Flaps Improper Use Of</td>
</tr>
<tr>
<td>Flare Excessive</td>
<td>Flare Excessive</td>
</tr>
<tr>
<td>Flight into Known Adverse Weather Initiated</td>
<td>Flight into Known Adverse Weather Initiated</td>
</tr>
<tr>
<td>Identification of Aircraft Visually Delayed</td>
<td>Inadequate Substantiation Process</td>
</tr>
<tr>
<td>Inadequate Substantiation Process</td>
<td>Crew/Group Coordination Not Maintained</td>
</tr>
<tr>
<td>Visual Separation Not Maintained</td>
<td>Flaps Improper Use Of</td>
</tr>
<tr>
<td>Minimum Descent Altitude Not Maintained</td>
<td>Flare Excessive</td>
</tr>
<tr>
<td>Wheels Up Landing Inadvertent</td>
<td>Flight into Known Adverse Weather Initiated</td>
</tr>
<tr>
<td>Aircraft Preflight Not Performed</td>
<td>Inadequate Substantiation Process</td>
</tr>
<tr>
<td>Aircraft Weight and Balance Misjudged</td>
<td>Identification of Aircraft Visually Delayed</td>
</tr>
<tr>
<td>Altimeter Not Used</td>
<td>Inadequate Substantiation Process</td>
</tr>
<tr>
<td>Checklist Inaccurate</td>
<td>Crew/Group Coordination Not Maintained</td>
</tr>
</tbody>
</table>

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### Number and Percentage of Mishaps Associated with Each HFACS Causal Category (FY 91-99)

<table>
<thead>
<tr>
<th>Category</th>
<th>USMC n=73</th>
<th>USN n=105</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organizational Influences</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource Management</td>
<td>17 (23)</td>
<td>32 (30)</td>
</tr>
<tr>
<td>Organizational Climate</td>
<td>0 (0)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Organizational Process</td>
<td>19 (26)</td>
<td>39 (37)</td>
</tr>
<tr>
<td><strong>Unsafe Supervision</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate Supervision</td>
<td>18 (25)</td>
<td>27 (26)</td>
</tr>
<tr>
<td>Planned Inappropriate Operations</td>
<td>9 (12)</td>
<td>11 (10)</td>
</tr>
<tr>
<td>Failed to Correct a Known Problem</td>
<td>4 (5)</td>
<td>10 (10)</td>
</tr>
<tr>
<td>Supervisory Violations</td>
<td>8 (11)</td>
<td>11 (10)</td>
</tr>
<tr>
<td><strong>Preconditions for Unsafe Acts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse Mental States</td>
<td>57 (78)</td>
<td>79 (75)</td>
</tr>
<tr>
<td>Adverse Physiological States</td>
<td>18 (25)</td>
<td>27 (26)</td>
</tr>
<tr>
<td>Physical/Mental Limitations</td>
<td>7 (10)</td>
<td>11 (10)</td>
</tr>
<tr>
<td>Crew Resource Mismanagement</td>
<td>40 (55)</td>
<td>69 (66)</td>
</tr>
<tr>
<td>Personal Readiness</td>
<td>2 (3)</td>
<td>5 (5)</td>
</tr>
<tr>
<td><strong>Unsafe Acts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision Errors</td>
<td>36 (49)</td>
<td>64 (61)</td>
</tr>
<tr>
<td>Skill-based Errors</td>
<td>38 (52)</td>
<td>57 (54)</td>
</tr>
<tr>
<td>Perceptual Errors</td>
<td>23 (32)</td>
<td>28 (27)</td>
</tr>
<tr>
<td>Violations</td>
<td>22 (30)</td>
<td>33 (31)</td>
</tr>
</tbody>
</table>
Violations

- Violation of Orders/Regulations/SOP
  - Failed to Inspect ACFT after In-Flight Caution Light
  - Violated Squadron SOP Restricting Flight Below 500’
  - Failed to Comply with NATOPS During Streaming
  - Conducted Night Training and Ops Mission with PAX
  - Elected to File VFR in Marginal Weather Conditions
  - Failed to Use Radar Advisories from ATC
  - Inadequate Brief and Limits on Mission
  - HAC Knowingly Accepted Non-Current Crew
- Failed to Adhere to Brief
- Not Current/Qualified for Mission
- Improper Procedure
Percentage of Human Error Mishaps Associated with Violations (FY 91-97)

\( \rho = -0.487, \text{ ns} \)
Intervention Strategy

- Professionalism
- Accountability
- Enforcing the Rules
Percentage of Human Error Mishaps Associated with Violations (FY 91-99)
Unsafe Acts

- Errors
  - Decision Errors
  - Skill-Based Errors
  - Perceptual Errors
- Violations
  - Routine
  - Exceptional

Skill-Based Errors

- Breakdown in Visual Scan
- Failed to See and Avoid
- Poor Technique
- Omitted Checklist Item
- Inadvertent Operation of Control
- Improper Use of Flight Controls

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Percentage of Human Error Mishaps Associated with Skill-based Errors (FY 91-99)

\[ \rho = 0.832, \ p < 0.01 \]
Preliminary Intervention Strategy

- Improve instrument scan
- Prioritizing attention
- Recognizing extremis situations
- Refine basic flight skills (Stick-and-Rudder)
- Practice procedures
- Review the mishap database!
PRECONDITIONS FOR UNSAFE ACTS

Environmental Factors
- Physical Environment
- Technological Environment

Condition of Operators
- Adverse Mental States
- Adverse Physiological States
- Physical/Mental Limitations

Personnel Factors
- Crew Resource Management
- Personal Readiness

CREW RESOURCE MANAGEMENT
- Not Working as a Team
- Poor Aircrew Coordination
- Improper Briefing Before a Mission
- Inadequate Coordination of Flight
Percentage of Human Error Mishaps Associated with Crew Resource Management Failures (FY 91-98)

ρ = .551, ns

Percentages do not add up to 100%
Preliminary Intervention Strategy

- Platform specific training
- Use of video feedback
- Restructure tasks (i.e., EP’s)

- Change group composition
- Attempt to change attitudes
- Additional research...
Percentage of Human Error Mishaps Associated with Crew Resource Management Failures (FY 91-99)

Percentages do not add up to 100%
Human Error
- Errors occur less frequently.
- Safety programs are effective at preventing the occurrence or consequences of these errors.

Data-Driven Research
- Sophisticated techniques and procedures
- Information is qualitative and quantitative
- Focus on both “what” happened and “why”

Accident Database
- Designed around a well-known human error framework
- Well-defined variables
- Organization and structure easy to understand

Database Analysis
- Traditional human factors analyses are much less onerous due to well-defined variables and error database
- Analyses can now be performed to identify human factors safety issues

Research Sponsors
- FAA, DoD, NASA, & Airlines provide funding for safety research programs.
- Research programs are needs-based and data-driven. Interventions are therefore very effective.

Effective Intervention and Prevention Programs
- Ineffective Intervention and Prevention Programs
- Accident Investigation
- Accident Database
- Database Analysis
- Feedback

HFACS
- Exceptional Routine
- Inadequate Supervision
- Failed to Correct Problem
- Supervisory Violations
- Resource Management
- Organizational Influences
  - Preconditions for Unsafe Acts
  - Condition of Operators
  - Adverse Physical/Mental States
  - Technological Environment
  - Physical Environment
  - Personal Readiness
  - Crew Resource Management
  - Crew Resource Management Personnel Factors
  - Adverse Physiological States
  - Environmental Factors
HFACS can be applied anywhere!

Flightdeck (HFACS)

Maintenance (HFACS-ME)

? (HFACS-ATC)

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