<table>
<thead>
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<th>Organization</th>
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Human Factors in Civil Aircraft Accident Investigations

What is the State of the Art... and Where Do We Go from Here?
Human Factors in Aircraft Accident Investigation at the NTSB

*Disclaimer: Opinions expressed during this presentation are mine and do not necessarily reflect the official views of the National Transportation Safety Board*
Working-level investigators: 90

Human Factors in the NTSB Office of Aviation Safety

Office of Aviation Safety

- Regional Investigations
  - Alaska Regional Office
  - Western Regional Office
  - Central Regional Office
  - Eastern Regional Office
- Major Investigations
- Operational Factors
- Aviation Engineering
- Human Performance & Survival Factors
- Writing & Editing

4 Human Performance Investigators
NTSB Aviation Human Performance Investigators

- Front-line, working investigators
- Ph.D.’s in psychology or engineering with a concentration in human factors and some aviation training and experience
- Responsible for investigating operator fitness for duty and applying HF models and paradigms
- Operate within the NTSB party system and discipline-based working group model
NTSB Party System

Major Accident Investigation

- NTSB
- FAA
- Airline
- Union
- Manufacturer
- Airport

Investigative Team
NTSB Working Group Model
NTSB Working Group Model

- Operations Group
- Maintenance Group
- Aircraft Structures Group
- Aircraft Systems Group
- Vehicle Performance Group
- Powerplants Group
- Air Traffic Control Group
- Survival Factors Group

Investigator in Charge

HP
Professional Successes

- Accepted as a core investigative specialty
- Considered key to fact-finding and analysis
- Have incorporated HF and system safety concepts in some landmark accident reports
- Have initiated a disproportionate number of safety recommendations
Professional Challenges

- Some colleagues have a limited understanding of human factors
- Working group model can lead to confusing overlap of responsibilities
- Working group model can create artificial barriers to HP involvement
- Lack of structure in the analysis process can lead to concatenation of ideas and haphazard integration of human factors
What’s Missing?

Organizational policy defining HF and system safety and their relationship to other investigative specialties

Organizational policy defining how HF and systems safety should inform models of accident causation

Investigative protocols and organizational processes that support systematic integration of HF in accident analysis

Organizational policy describing how HF and system safety inform safety improvement strategies
Organizational policy defining HF and system safety and their relationship to other investigative specialties

Organizational policy defining how HF and systems safety should inform models of accident causation

Investigative protocols and organizational processes that support systematic integration of HF in accident analysis

Organizational policy describing how HF and system safety inform safety improvement strategies
• Human performance attention can be addressed toward any individual involved in the accident.

• Human performance attention may be directed at larger system issues, such as those concerning company policy, training, and design.

• The work of the human performance specialist may parallel operations or air traffic control, except the human performance specialist examines certain evidence in greater depth.

• In other cases, such as medical and equipment design issues, the human performance specialist may be the lead collector of evidence for an investigation.
An Improved Mission Statement

• Improving safety depends on our ability to understand how human and other system characteristics interact to produce accidents.

• The human factors and system safety disciplines study such interactions and try to optimize them through the application of scientific theory and data.

• Human factors investigation is an inductive reasoning process that requires deep knowledge of human, organizational, operational, and engineering system characteristics and knowledge about how these system elements can be degraded or interact unfavorably, therefore...

• Close collaboration between human factors and other investigative specialties is required.
What’s Missing?

- Organizational policy defining HF and system safety and their relationship to other investigative specialties.
- Organizational policy defining how HF and systems safety should inform models of accident causation.
- Investigative protocols and organizational processes that support systematic integration of HF in accident analysis.
- Organizational policy describing how HF and system safety inform safety improvement strategies.
Investigative Protocols

NTSB Human Performance Model (1983)

HUMAN PERFORMANCE FACTORS

BEHAVIORAL
- Behavior during the event
- 24 to 72-hour history
- General habit patterns
- Recent life events

MEDICAL
- General Health
- Sensory Acuity
- Drug / alcohol ingestion
- Fatigue

OPERATIONAL
- Training
- Experience / familiarity / habits
- Operating procedures
- Company policy

TASK
- Task information
- Task components
- Task-time relation
- Workload

EQUIPMENT DESIGN
- Workspace interface
- Display / instrument panel design
- Control design
- Seat design / configuration

ENVIRONMENTAL
- External conditions
- Internal conditions
- Illumination / visibility
- Noise / vibration / motion
HUMAN / TEAM
- 24 to 72-hour history
- General habit patterns
- Recent life events (stress)
- General Health
- Sensory Acuity
- Drug / alcohol ingestion
- Fatigue
- Training
- Experience
- Aptitude / Motivation
- Cognitive vulnerabilities
- Cultural influences
- Goal conflicts
- Flawed mental models
- Team structure / hierarchy
- Team communication

TASK / AIRCRAFT / SYSTEM
- Task complexity
- Contextual factors
- Task information
- Task components
- Task-time relation
- Workload
- Workspace interface
- Display design
- Control design
- Control dynamics
- Seat design
- Automation design / logic
- Warning / safeguard design
- External conditions
- Internal conditions
- Illumination / visibility
- Noise / vibration / motion

OPERATING ORGANIZATION
- Leadership / Culture
- Organizational structure
- Management & Supervision
- Company policy
- Organizational goal conflicts
- Organizational change
- Risk controls
- Operating procedures
- Safety Management
- Assumptions about human performance and other factors

REGULATOR
- Guidance
- Certification
- Oversight
- Assumptions about human performance and other factors

MANUFACTURER
- Design philosophy
- Assumptions about human performance and other factors
- Risk controls
- Guidance to operators

OUTCOMES
- (Individual) Human behavior
- Team behavior
- Aircraft behavior
- Human error / noncompliance
- Human-human interaction
- Human-aircraft interaction

ACCIDENT EVENT SEQUENCE
Investigative Analysis

• Each group chairman shall submit an analysis report based on the information contained in his or her factual report. Group chairmen should begin writing their analysis reports as soon as appropriate and should not wait until the entire factual portion of the investigation is complete.

• The analysis report should review and evaluate all facts documented by the group regarding their relevance to the accident and should state the principal findings and their relevance to a probable cause of the accident.
What’s Missing?

- Organizational policy defining HF and system safety and their relationship to other investigative specialties
- Investigative protocols and organizational processes that support systematic integration of HF in accident analysis
- Organizational policy defining how HF and systems safety should inform models of accident causation
- Organizational policy describing how HF and system safety inform safety improvement strategies
§ 845.30 Board products.

(a) Reports of investigations.

(1) The Board will adopt a report on the investigation. The report will set forth the relevant facts, conditions, and circumstances relating to the accident or incident and the probable cause thereof, along with any appropriate safety recommendations and/or safety alerts formulated on the basis of the investigation. The scope and format of the report will be determined in accordance with Board procedures.
Accounting for Complexity

- Rasmussen (1997)
What’s Missing?

Organizational policy defining HF and system safety and their relationship to other investigative specialties

Investigative protocols and organizational processes that support systematic integration of HF in accident analysis

Organizational policy defining how HF and systems safety should inform models of accident causation

Organizational policy describing how HF and system safety inform safety improvement strategies
Sociotechnical Systems

The socio-technical system involved in risk management includes several levels ranging from legislators, over managers and work planners, to system operators. This system is presently stressed by a fast pace of technological change, by an increasingly aggressive, competitive environment, and by changing regulatory practices and public pressure.

Traditionally, each level of this is studied separately by a particular academic discipline, and modelling is done by generalising across systems and their particular hazard sources. It is argued that risk management must be modelled by cross-disciplinary studies, considering risk management to be a control problem and serving to represent the control structure involving all levels of society for each particular hazard category.

– Rasmussen (1997)
System Safety Order of Precedence

- Eliminate the hazard
- Reduce risk through design alteration
- Incorporate engineered features or devices
- Provide warning devices
- Incorporate signage, procedures, training, and PPE
How HF Investigation Could Evolve

- Policy, culture, and training role
- Investigative facilitation role
- Investigative analysis role
- Safety improvements role