Human Factors in Aviation
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Outline

- Scope of aviation operations
- How human factors affects outcomes
- Contributions of Human Factors to aviation
  › Cockpit technologies
  › Air Traffic Control technologies
- Closing comments

Scope of Aviation Operations

- At any given moment, on a typical day, over 5,000 aircraft are flying in US airspace
- Over 70,000 total flights each day (NATCA, 2012)

5664 flights
Fri Jul 22 14:00:11 CDT 2005
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Scope of Aviation Operations

- Human operators flying the aircraft and directing their progress through the National Airspace System
  › Promptly
  › Efficiently
  › SAFELY
- Maintain fatal accident rate (better than) 10^{-9} per flight hour

U.S. and Canadian Operators Accident Rates by Year
Fatal Accidents – Worldwide Commercial Jet Fleet – 1959 Through 2011
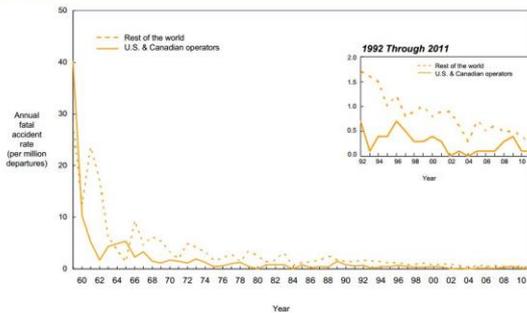
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2011 STATISTICAL SUMMARY, JULY 2012

Scope of Aviation Operations

- While the National Airspace System is extremely safe, 70% of incidents that do occur are thought to result from human factors issues
  › Mechanical issues have experienced great declines
    • O'Hare, Wiggins, Batt, & Morrison (1994)
- Human Factors bridges the gap between the users and the systems (aircraft and air traffic control) to tailor interfaces such that errors are minimized

Specific examples

- In aviation, as in many fields, there is a trend toward increasingly tailored displays and controls with a user-centered design focus

- A vivid example is the "glass cockpit", moving away from numerous data-centric analog dials and indicators to a user-centric, fluid display of information

Cockpit Changes

- DC3 cockpit

Cockpit Changes

- Airbus 380 cockpit

Navigation Displays

- Several non-intuitive displays (and any of dozens of paper maps) were needed for navigation

Navigation Displays

- Contemporary layout overlays information, provides dynamic, egocentric perspective

Images from Garmin.com

Flight Progress Strips

- Current operations utilize paper flight progress strips to coordinate certain operations
  › Some information handwritten
  › Physical transfer from position to position

Electronic Flight Progress Strips

- Information can be manipulated electronically (and/or handwritten)

- Transfer (and sharing) between positions electronically

Images from NavCanada.ca and Frequentis.com

Challenges with Flight Strips

- Paper flight progress strips have been designed to efficiently display information

- Modernization may not be simply "intuitive"
  › Expert workforce proficient in their use
  › Manual manipulation provides memory aids
    • e.g., "cocking a strip" in the strip bay

- Need to develop new technology that adds new functionality without eliminating tacit capabilities of the old system

Automation in Air Traffic Control

- Application of Levels of Automation research
  › e.g., Parasuraman, Sheridan, & Wickens (2000)

- Automation relieves the operator of some cognitive processing, along a continuum of contribution

- Examples
  › Automated handoffs – reduces landline communications by visually communicating a transfer of control
  › Conflict alerts – identifies a potential airspace conflict for the controller to resolve
  › Proposed decision support tools for scheduling that may suggest a rescheduled release time for a flight (and facilitate that coordination)

Automation Issues

- As in many fields, the challenge is to find the optimal level of automation
  - › Relieve tedious, time consuming, or error-prone processing
  - › Make task challenging enough for operators to maintain vigilance
    - i.e., operator must not be "lulled to sleep" passively monitoring an automated process

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Closing Thoughts

- Human performance plays a much larger role in outcomes of aviation operations (i.e., safety) than any other factor
- By employing Human Factors standards and conducting Human Factors research, we can improve safety and efficiency
- "Intuitive" solutions are often the result of an extensive research and development endeavor

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Human Solutions, Inc.

- Human Factors Program Planning
  - › Procedures Development
  - › Post-Implementation Studies
- System Reviews
  - › Mission Analysis
  - › System Requirements Review
- Design Development
  - › GUI Design
  - › Mockups and Storyboards

Human Solutions, Inc.

- Test and Evaluation Support
  - › Early User Involvement Events
  - › Computer-Human Interface Evaluation
- Human Factors Analysis
  - › Job/Task Analysis
  - › Training Analysis and Support
  - › Risk Management