Maintenance Human Factors to Support Risk-Based Decision Making and Maintenance Safety Culture, A11G.HF.10

Research Project Description

- This research takes a programmatic approach to investigating useful tools to support Risk-Based Decision Making and actionable recommendations that can be used to help mitigate some of the maintenance domain's most persistent human factors hazards

Sponsor Anticipated Outcome

- Assure a direct mapping from known risks to R&D tasking
- Recommend effective countermeasures for common maintenance risk areas
- Evaluate approaches/tools to aid quality assurance of technical documentation

Critical Milestones

- Milestone 1: Conduct literature review (3/2022)
- Milestone 2: Evaluate potential countermeasures (12/2022)
- Milestone 3: Translate the science into operational guidance (Ongoing)

Research Accomplishments in FY22

- Published literature review (3/2022)
  - Procedural Noncompliance in Aviation Maintenance: A Multi-Level Review of Contributing Factors and Corresponding Mitigations
- Conducted and published Phase 1 evaluation of countermeasures (6/2022)
  - Preliminary Findings: Application of Maintenance Instructions Displayed in Augmented Reality

By focusing on the hazards that pose the highest risk, we are supporting data-informed and risk-based decision making

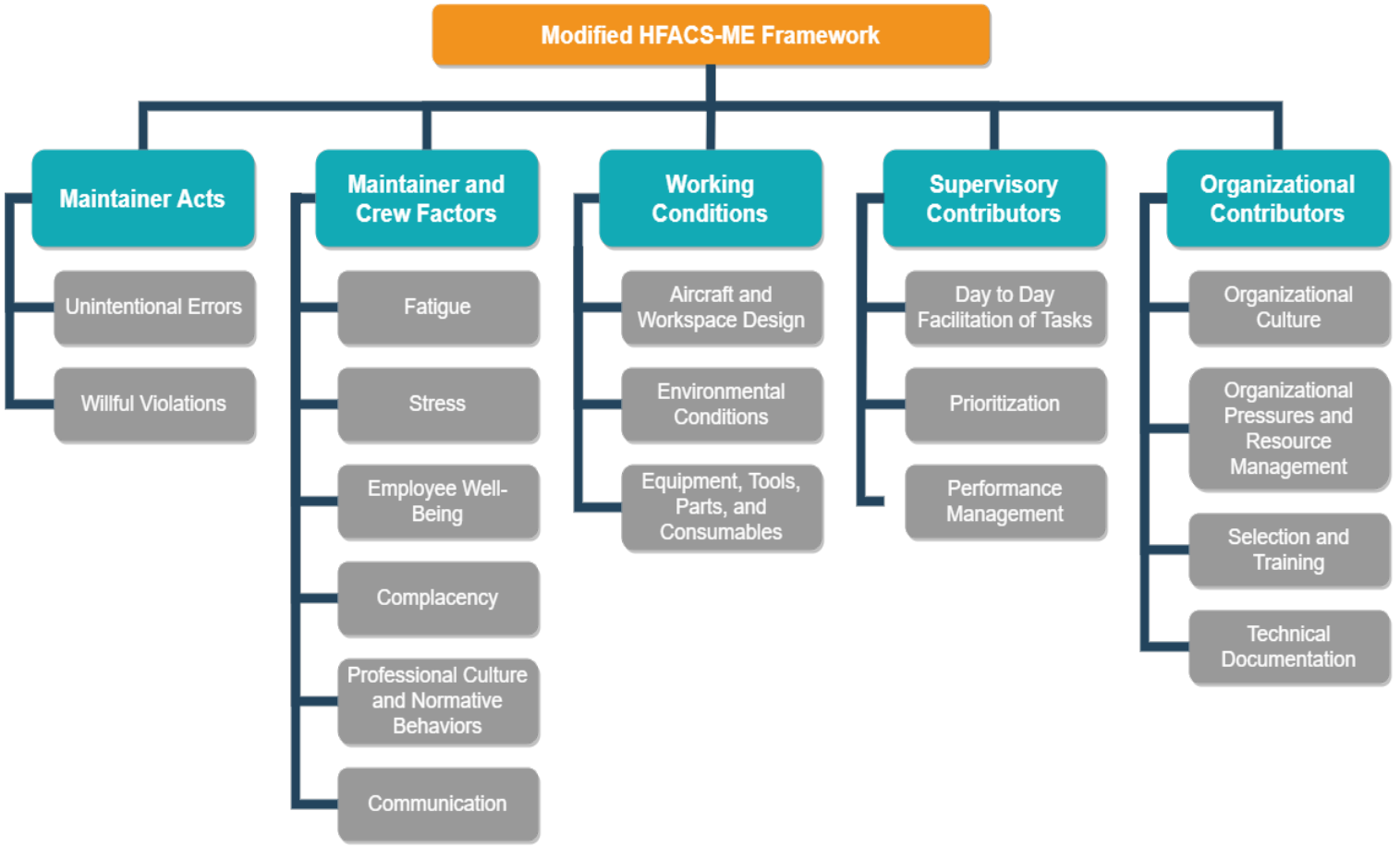
- **Failure to follow procedures (FFP) is a <u>leading</u> human factors challenge in aviation maintenance**
  - FFP contributes to between 40-80% of all maintenance-related events (depending on the source)
  - FFP has been ineffectively mitigated

- **Imperative to properly identify contributing factors to events, so that countermeasures can be targeted appropriately**
  - E.g., napping is a viable countermeasure for fatigue-related events; napping would not be effective for other contributing factors, such as quality of technical documentation

- **This research is collecting information on <u>why FFP occurs</u> and <u>how to mitigate:</u>**
  - Milestone 1: Conducting literature review of contributing factors and potential countermeasures (3/2022)
  - Milestone 2: Evaluating potential countermeasures (12/2022)
  - Milestone 3: Translating the science into operational guidance (Ongoing)

Milestone 1: Conduct Literature Review

Identified contributing factors and potential countermeasures acting at each level of the organization



Milestone 2: Evaluate Potential Countermeasures

Quality of technical documentation is a frequently-cited contributor to FFP

- **Traditional instructions may be:**
  - Extensive, written documentation of procedures
  - Significant number of manual steps with different components
  - Not easily understood

Augmented Reality (AR) is increasingly being applied

- **Potential benefits of AR instructions:**
  - Real-time access to information
  - Instant visualization of key data
  - Reduced quantity of text content
  - Status tracking

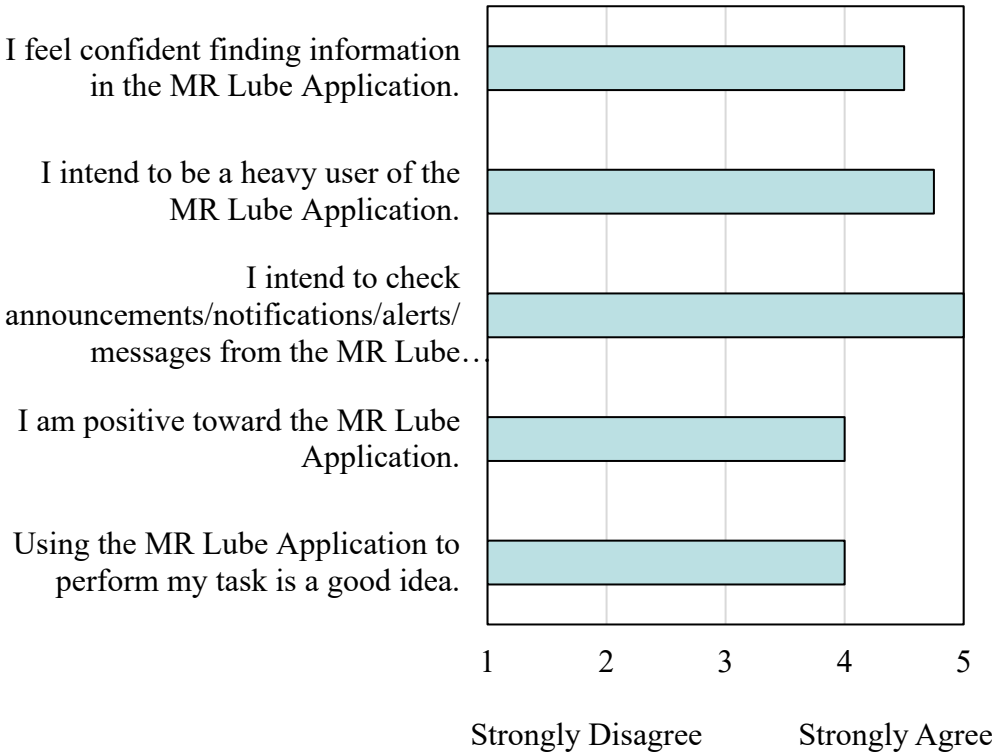
Research Purpose: inform the overall applicability and human factors considerations for AR applications in aviation maintenance

Closer Look: AR Instructions Phase 1

Collaborative study with colleagues at The Boeing Company and United Airlines

- **The Participants**
  - Aviation Maintenance Technicians (AMTs) with task experience
- **The Task**
  - B777 Main Landing Gear & Actuating Mechanism Lubrication
  - 160+ fittings per side (~ 4 hours)
  - Multiple lubricant types
- **The Technology**
  - 3D Holographic Model
  - All 200 fittings shown via fly around or fly through technology
  - Colors depict status
- **The Measures**
  - Usability & User Experience
  - Ergonomics / Comfort
  - Workplace Safety

Results at a Glance



Usability / User Experience

"I would consider it an enhancement to paper."

"Good for people who are visual learners."

Ergonomics / Comfort

"Tight around the head. Feels heavier after a while."

Safety Concerns

"Trip/slip hazards may be harder to see."

Key Insights

AR applications may support maintenance tasks in a variety of ways, but more research is needed

Ongoing Activities

The complex nature of FFPs, along with the advances of new technology, tools, and procedures, requires continued human factors research and oversight

- **Milestone 2: Evaluate potential countermeasures**
  - Collaborate with The Boeing Company to conduct Phase 2 study: compare traditional to AR instructions (12/2022)
- **Milestone 3: Translate the science into operational guidance**
  - Publish FFP Operator Manual (9/2022)
  - Collaborate with Airlines for America to develop ATA Spec 127: Best Practice Guidelines for Procedure Writing (TBD)

THANK YOU!

Kylie Key, Ph.D.
Kylie.N.Key@faa.gov

Katrina Avers, Ph.D.
Katrina.Avers@faa.gov

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