USING THE PEAR FRAMEWORK TO STUDY THE RELATIONSHIP BETWEEN AVIATION SAFETY, MAINTENANCE DOCUMENTATION, AND HUMAN FACTORS

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RESEARCH CONTEXT AND BACKGROUND

Aviation Maintenance Instructions and Safety

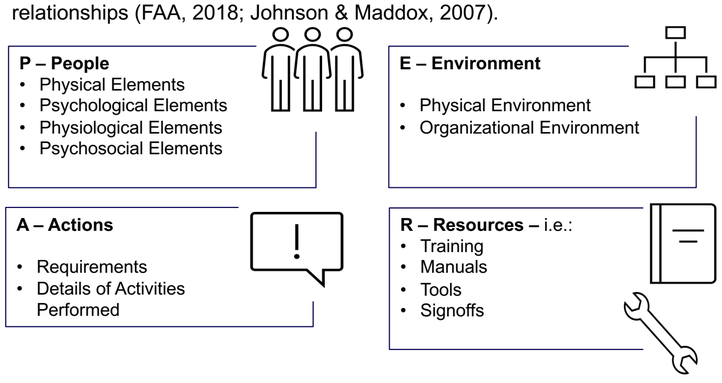
- Instructions are required while performing maintenance on aircraft (Title 14 C.F.R. § 43.13, 2011).
- Room for mistakes still exists, even with the use of written instructions: Result in procedural errors and/or violations.
- Maintenance instructions are frequently quoted to be causal factors in maintenance errors (Hobbs, 2008; Hobbs & Kanki, 2008; ICAO, 2002; Rashid et al., 2013).
- Maintenance errors can be detrimental and pose a threat to aviation safety.

Human Factors and Errors in Aviation Maintenance

- Human factors (HF) are extensively studied in the field of aviation.
- 12% of accidents citing human errors as causal factors are linked to aviation maintenance activities (Federal Aviation Administration [FAA], 2018).
- Maintenance errors may remain unidentified for extended period of times (FAA, 2018).
- There is a need to understand the root causes of the maintenance errors (Hobbs, 2008).

People, Environment, Actions, Resources (PEAR) Model

- PEAR is a framework that categorizes human factor elements and their relationships (FAA, 2018; Johnson & Maddox, 2007).



RESEARCH QUESTIONS

1. What are the characteristics of the maintenance activities that could be improperly performed due to issues presented and caused by written maintenance instructions?
2. What are the underlying human factor-related causes of the maintenance errors induced by written maintenance instructions issues?

METHODOLOGY

Data Collection: National Transportation Safety Board (NTSB) Database Query

- Part 121 and Part 135 airplane accidents
- Ocurred between 2003 and 2017 (15 years)
- Keyword search: “Maintenance”
- Manual filtering for accidents related to the use of maintenance instructions

Demographic Analysis:

Coding into Categories

1. Number and type of injuries
2. Level of damage
3. Aircraft system(s) affected
4. Physical description of errors
5. Maintenance activity involved

PEAR Analysis:

Identify HF Elements

1. Identify HF from accident reports
2. Sort accident HF into PEAR model categories
3. Determine frequency of each category

Data Use: Answer Research Questions

- Research Question 1: Used demographic analysis to identify reocurring themes in accident characteristics.
- Research Question 2: Using the PEAR model, determined human factor related elements that impacted and influenced the erroneoulsy completed maintenance activities.

RESULTS – DEMOGRAPHIC INFORMAITON

- 85 accidents from NTSB database met search criteria
- Manual selection/sorting: Reduced to 12 accidents (5 Part 121 & 7 Part 135)

Demographic Accident Analysis:

	Injuries	Level of Damage	Aircraft System Affected	Physical Description of Errors	Maintenance Activities
Part 121	21 fatalities 1 serious 1 minor	4 substantial 1 destroyed	2 powerplant 2 landing gear 1 flight controls	3 omission 1 comission 1 timing/precision	1 replacement 2 service 1 overhaul 1 adjustment
Part 135	1 fatality 3 serious 5 minor	6 substantial 1 destroyed	2 powerplant 4 landing gear 1 flight controls	6 omission 2 timing/precision	2 replacement 3 inspection 1 airworthiness directive 2 adjustment 1 service bulletin 1 service

RESULTS – PEAR ANALYSIS

PEOPLE		
	Part 121	**Part 135**
Workload (Psychological)	1	-
Experience (Psychological)	1	-
Knowledge (Psychological)	1	-
Training (Psychological)	1	-
ENVIRONMENT		
	Part 121	**Part 135**
Supervision (Organizational)	1	-
ACTION		
	Part 121	**Part 135**
Maintenance Action Not Completed	1	-
Sequence of Activities	4	4
Steps Required	2	-
Knowledge (Requirement)	2	2
Maintenance Action Improperly Completed	1	-
RESOURCES		
	Part 121	**Part 135**
Other People	1	-
Procedures/Work Cards	4	4
Quality System	2	-
Manuals	2	2
Training	1	-

INTERPRETATION OF RESULTS

- Human element is a crucial consideration in properly using instructions
- Factors influencing human factors and aircraft maintenance activities:
  - FAA certification
  - Organizational structure
  - Quality systems
- Important elements to consider related to maintenance instructions:
  - Tailoring instructions to specific aircraft/airline use
  - Discrepancies between original instructions and job cards
  - Adequate level of detail included in instructions

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