THE INFLUENCE OF HUMAN ASPECTS AND CONSERVATION DOCUMENTATION ON AVIATION SAFETY: USING PEAR STRUCTURE FOR ANALYSIS OF 10 YEAR DATA

Authors

MALIK ASAD

MUHAMMAD REHAN

MUHAMMAD ZAHID WASEEM

SHABBIR HUSSAIN

DEPARTMENT OF AVIATION MANAGEMENT

November 02, 2021

Abstract

Conservation is the important thing for the aircraft. In aviation using instruction or manual provide the aviation technicians to conservation the aircraft and complete their job with guidance. Anyhow, it's not guaranteed that the instructions are correct and finalization of the conservation activity may be incorrect as instructions or may be the workers cannot understand the procedures. Errors of CONSERVATION have clearly result of aircraft accidents, an example of Pakistan flightPK-661. Objective is that how human factor linked with the CONSERVATION instructions has involved aircraft accidents. The researchers using the PEAR structure, people (P), Environment (E), Action (A) and Resource (R) to analyzed the data qualitatively. 11 plane injuries that exist from January 1, 2011 through December 31, 2020 Operations in PAKISTAN that had human factors and CONSERVATION involved. Accidents of aircraft given from the Aircraft Accident investigation Board of Pakistan (AAIB [PCAA]). Proper CONSERVATION of aircraft with guidance and proper implement on instructions are great impact on human errors, organizational environments and accessible assets.

THE INFLUENCE OF HUMAN ASPECTS AND CONSERVATION DOCUMENTATION ON AVIATION SAFETY

Background Of Study

In Pakistan PCAA registered or others aircraft operate and takes occasional CONSERVATION services of aircraft. Anyhow the CONSERVATIONs services depend upon the type of operations and aircraft, operate in Pakistan. Ensure about safety circular of Pakistani airline to give training and reduce aircraft accidents caused of human error and CONSERVATION.Anyhow one thing is common that they need proper documentation and CONSERVATION instructions, checklist to do the good work in all types of aircraft inspection and CONSERVATION. Aircraft accidents occurred when the CONSERVATION instructions could not fulfill in proper way. Despite all these protocols there are still various mistakes occurs and because of that mistakes accident occurred in Pakistan. However, these CONSERVATION commands have the capability to negatively affect on aviation safety. For instance, while poorly prepared, CONSERVATION commands may be a contributing component to aircraft accidents (Hobbs, 2008, Jain, Morris, Beck, Johnson, Short, Shakour, & Chalil Madathil2021, Zimmermann, & Mendonca, 2021). The CONSERVATION commands and documentation, among others, can present technical errors, be difficult to follow, describe techniques in an doubtful manner, or provide awkward commands, that can bring about procedural errors – while techniques aren't executed as intended – and/or violations – while techniques are intentionally and deliberately now no longer followed (International Civil Aviation Organization [ICAO], 2002). Thus, the risk is present of improperly CONSERVATION actions with gaudiness of technical documentation. In conditions in which CONSERVATIONactions are done erroneously, a so-called CONSERVATIONmistakes is stated to have occurred (Dillon& Liu, 2006, Zimmermann, &Mendonca, 2021).A listing of the CONSERVATION and human errors an associated aircraft accidents given from the AIRCRAFT ACCIDENT INVESTIGATION BOARD (AAIB) clarify that CONSERVATION errors, how slightly CONSERVATION errors seem,

can have critical effects and outcomes, with the possibly of creating major safety issues and result in fatal accidents, as was observed during the accident of PIA FLIGHT PK-661 (PCAA, AIRCRAFT ACCIDENT INVESTIGATION BOARD [AAIB], 2020).

Literature Review

Impact of Aviation Maintenance on Aviation Safety

A big example of the significance and effect of protection documentation on aviation safety, specifically of misunderstanding instructions, is given by the PIA FLIGHT PK-661

PIA FLIGHT PK-661 on 07 December 2016 morning, inspection at Benazir Bhutto International Airport (BBIAP) Islamabad, Pakistan International Airlines (PIA) aircraft ATR42-500 Reg. No AP-BHO operated 05 flights (i.e. Islamabad to Gilgit and back, Islamabad to Chitral, Chitral to Peshawar and back). The 6th and the last flight off the day, it took off from Chitral at time 10:38:50 UTC (15:38:50 PST) with 40 passengers (include of 01 engineer) and 05 members of firm (03 pilots and 02 cabin firm) aboard for Islamabad. In the report of AAIB(PCAA) identified the flight crashed at 11:20:38 UTC (16:20:38 PST) about 3.5 Nautical Miles (NM) SSE of Havelian and 24 NM North of BBIAP Islamabad after 40 minutes of flight. All 47 souls aboard were fatally injured.

The AIRCRAFT ACCIDENT INVESTIGATION BOARD (AAIB) of Pakistan identify that the PT-1 blade of engine no 1 dislodging and the broken pin indoors OSG that effect the performance of the aircraft and the outcome in the accident.

Also identify that the PT-1 blade completes their requirements for replacement but not replaced.

Aviation Maintenance and Safety

The human element, inclusive of flight employees in addition to employees at the ground, such as plane technicians, has a first rate effect on protection with inside the aviation

enterprise (Hobbs, 2004; Oster, Strong, & Zorn, 2013, Zimmermann, & Mendonca, 2021). Human blunders has been referred to as a causal thing for among 75% to 80% of all aviation injuries, and round 12% of this share of plane injuries are connected to plane protection activities. As the plane protection machine and surroundings are very complicated and intricate, human mistakes have to be expected. Even if improper maintenance activities are not identified as the primary cause of an accident, they may still have played an important role therein.

Table 1

RELATED CONSERVATION AND HUMAN ERROR ACCIDENTS

FLIGHT	YEAR	MISHAP TYPE	CAUSES
BHO 213	2012	Accident	Incorrect decision Lack of experience of the crew to the airplane's automated flight deck.
Cessna 172	2014	Accident	Lack of knowledge
NL-142	2015	Accident	Unstabilized approach
PK-661	2016	Accident	Engine no 1 PT-1 blade complete their using time and but were not replaced
PK-390 ATR72-500	2017	Incident	Improper replacement of filter element without checking maintenance manual

DA-42	2018	Incident	Crew missed out to check thoroughly the door lock position
ATR 72-212A	2018	Accident	Lack of professionalism of maintenance crew of PIA
SVA 734	2018	Incident	Lack of situation awareness on the part of APC
THY 714E & RBA 003	2018	Incident	Lack of situational awareness on part of duty ATC
PK 8303	2020	Accident	Crew did not follow standard callouts
PIA301 & UAE516	2020	Incident	Lack of situational awareness on part of duty ATC

The PEAR Model

The PEAR model provides a framework to characterize human factors – the relationship between people, their capabilities, and their environment and activities (ICAO, 2002,Zimmermann, & Mendonca, 2021). Specifically, the PEAR model considers four elements that impact human factors in the area of aviation maintenance, namely people (P), environment (E), actions (A), and resources (R).

Table 2

PEAR structure classification

<table>
<tr><td colspan="4">P - People</td></tr>
<tr><td>Physical Elements</td><td>Psychological Elements</td><td>Physiological Elements</td><td>Psychosocial Elements</td></tr>
<tr><td>Physical size
Gender
Age
Strength
Sensory limitations</td><td>Workload
Experience
Knowledge
Training
Attitude
Mental/emotional state</td><td>Nutritional factors
Health
Lifestyle
Fatigue
Chemical dependency</td><td>Interpersonal conflicts Financial hardships Personal loss</td></tr>
<tr><td colspan="4">E – Environment</td></tr>
<tr><td colspan="2">Physical Environment</td><td colspan="2">Organizational Environment</td></tr>
<tr><td colspan="2">Weather
Location of activities
Shift
Workspace
Safety
Sound level Lightning characteristics</td><td colspan="2">Personnel
Corporate culture
Morale
Supervision
Company size
Profitability
Crew structure
Labor-management relations
Pressures</td></tr>
<tr><td colspan="4">A - Actions</td></tr>
<tr><td colspan="4">Steps required to perform and complete a task
The number of people involved to complete a task</td></tr>
</table>

Sequence of activities		
Requirements		
Communication Attitude Certification	Information control Knowledge	Skill Inspection
R – Resources		
Manuals Tools Work stands and lifts Other people Materials Quality systems Procedures and work cards	Computer software systems Test equipment Fixtures Task lightning Ground handling equipment Training Paperwork and associated signoffs	

Significance

Often times, protection risks which could cause destiny plane injuries may be removed or mitigated after a disaster whilst they may be nicely understood and proactive motion is taken (ICAO, 2016, Zimmermann, & Mendonca, 2021). As provided withinside the literature review, aviation CONSERVATION and its effect on protection is a recognized and often studied discipline, concurrently highlighting CONSERVATION documentation as a threat factor. However, the studies provided do now no longer awareness on particular injuries and incidents wherein CONSERVATION documentation, as a sub-detail of CONSERVATION actions, has impacted and threatened aviation protection. Consequently, learning plane injuries that had been prompted by, or associated with CONSERVATION

instructions, and expertise habitual issues among the traits of the CONSERVATION actions achieved is predicted to permit the firms to understand and extra correctly address the dangers and elements related to plane CONSERVATION instructions. Along the predicted improved expertise acquired via this study, proactive movement may be taken to improve the vicinity of CONSERVATION instructions, with the goal of enhancing the general protection of the aviation enterprise.

Methodology

Records of plane injuries that came about between January 1, 2011 to December 31, 2020 operations, and that had been brought on by, or associated with, problems with written plane CONSERVATION commands and documentation had been received from theAIRCRAFT ACCIDENT INVESTIGATION BOARD(AAIB). The accrued records had been used to observe thehuman elements factors that had been associate with the CONSERVATION documentation problems via the PEAR model.

DATA Collection

The information of the aircraft accident information from 10 years has been obtained from the web of aviation injuries database (AAIB [PCAA]). To question most effective the injuries of interests, the hunt filters at the AAIB internet site have been adjusted to consist of injuries labeled by the AAIB as “airplane” injuries going on with inside the Pakistan operations from January 1, 2011 to December 31, 2020. A key words seeks for “protection” became performed to achieve most effective the reviews from injuries wherein the protection activities have been investigated. Information used include: legal regulations, technical publications, written reviews via way of means of occasion participants, and different causes of information.

In the studies of assessing human elements variables in aviation CONSERVATION, the information could be used to offer quantitative information for the reason of analysis. The information could be used because the studies on assessing human elements is extra of cognitive technological know-how where via way of means of the notion of the humans worried with inside the CONSERVATION surroundings closer to the informal elements of human mistakes should be examined.

DATA analysis

The list came about the AAIB search involved the accidents that took place withinside the precise time range, operations, and whose reviews have the keyword "CONSERVATION" involved. This blanketed any point out of CONSERVATION withinside the coincidence reviews, and therefore did now no longer in particular kind out accidents associated with troubles with CONSERVATION commands and documentation. To kind out the accidents that have been associated with, or as a result of, CONSERVATION commands troubles, the very last or initial coincidence reviews, depending on availability, have been examine and analyzed. After manually filtering out the accidents that have been as a result of CONSERVATION documentation-associated troubles, the method utilized by (Goldman, Fiedler, & King 2002, Zimmermann, & Mendonca, 2021) become followed. The decided on accidents have been coded in exceptional classes so one can obtain coincidence demographic information. In this study, the accidents have been coded within side the classes defined below.

The accidents had been coded with admire to the quantity and styles of accidents, as supplied via way of means of the AAIB report. The styles of accidents are fatal, serious, minor, and none AAIB. The accidents had been in addition coded in phrases of the extent of harm to the aircraft, as supplied via way of means of the AAIB coincidence report. Aircraft harm may be

coded into four categories, as supplied and described via way of means of the AAIB: destroyed, substantial, minor, and none.

The Aircraft System Affected class identifies and classifies the plane device that the wrong CONSERVATION hobby and human blunders become taking area on. The plane device classes are adopted from (Goldman, Fiedler, & King 2002, Zimmermann, & Mendonca, 2021), and are: flight controls, engine failure, touchdown gear (landing gear), flight/navigation instruments, electric device, fuselage, rotor device, wing (vertical and horizontal), Fire warning device, air conditioning/heat/pressurization/oxygen, and anti-/de-ice systems.

The human Errors class permits the type of the aircraft disasters in phrases of the physical CONSERVATION motion that become accomplished incorrectly. The classes are; Less Knowledge, Bad Decision, Less Experience, Less Actions, Exclusion, Commission and Time & Precision.

Accidents that fit into multiple sub-class in the 5 classes supplied above had been counted in each sub-classes. For example, if plane structures had been affected in an accident, each of the structures had been counted as structures affected. The frequency of the form of operation, form of accidents, aircraft damage, system affected, bodily description of errors, and CONSERVATION pastime changed into then computed. Following the instance supplied with the aid of using (Goldman, Fiedler, & King 2002, Zimmermann, & Mendonca, 2021), the frequencies of every class had been used to attain average information of the demographic of the accidents that had been triggered with the aid of using, or associated to, CONSERVATION instruction, human error and documentation issues.

PEAR MODEL

The human factors that resulted in, or affected, the CONSERVATION instructions-related troubles had been analyzed via the utility of the PEAR model. Researchers applied the PEAR model to become aware of the person elements that affected the CONSERVATIONactivities that specialize in the CONSERVATION documentation troubles that had been improperly completed. More precisely, the AAIB (PCAA) reviews of the chosen injuries had been cautiously reviewed with the aid of using the researchers to become aware of the frequency of the subject matters and classes of the PEAR model. The subject matters diagnosed below the Results phase mirror the human factors classes from the PEAR model. The researchers aimed to become aware of stated classes and subject matters withinside the decided on AAIB (PCAA) reviews to acquire a remember of the human elements present withinside the accidents reviews analyzed. To lessen the ability effect of bias, the technique carried out changed into primarily based totally on the techniques supplied in preceding research that specialize in aviation human elements and CONSERVATION errors, as brought withinside the Literature Review. Furthermore, the category changed into guided with the aid of using the researchers' preceding revel in withinside the discipline of aviation protection and human factors.

Applying the PEAR framework for analysis of the Accident

PEAR factors diagnosed in table4 primarily based totally on records given from the AAIB injuries reports.The PEAR factors that had been recognized for every accident primarily based totally at the data gave withinside the AAIB (PCAA). Some of the reviews did now no longer offer extra info at the accidents causal elements other than outlining that the CONSERVATION items gave withinside the CONSERVATION documentation had been now no longer finished or finished improperly. Thus, those classes account for the

shortage of element in the AAIB (PCAA) at the same time as nonetheless supplying a demonstration of the accident elements associated with CONSERVATION instructions.

Table 3

Information of accidents

Accident	Injuries	Fatalities	Damages	System Affected Of Aircraft	Human Error	CONSERVATION Activity
BHO 213	-	127	Destroyed	Flight controls	Bad decision Less experience	-
Cessna 172	2-minor	-	Substantial	-	Less knowledge	-
NL-142	Few minor	-	Substantial	Landing gear	Less experience	-
PK-661	-	47	destroyed	Engine failure	Exclusion Time &Precision	Replacement
PK-390 ATR72-500	-	-	No damage	-	Exclusion	Replacement

DA-42	-	-	Substantial	-	Exclusion	-
ATR 72-212A	1-minor	-	Substantial	Parking brakes	Less knowledge Commission	Services
SVA 734	-	-	No damage	-	Less experience	-
THY 714E & RBA 003	-	-	No damage	-	Exclusion	-
PK 8303	5	98	Destroyed	Landing gear	Less actions Time & Precision	-
PIA301 & UAE516	-	-	No damage	-	Less knowledge	-

Analysis of the accidents applying PEAR structure to clarify the people, who done the job, Environment, in which done the job, Actions, who apply to done the job and Resource. The tow types of resource in category; procedures and manuals.

Table 4

PEAR Analysis

Accidents	**PEAR ELEMENTS**			
	PEOPLE	ENVIRONMENT	ACTION	RESOURCE

BHO 213	Psychological attribute; Experience Knowledge	-	Steps required to perform	Other people
Cessna 172	Psychological attributes; Knowledge Training	-	Knowledge	Training Manuals
NL 142	Psychological attributes; Experience	-	Steps required to perform	Manuals
PK 661	-	-	Maintenance actions not completed	Procedures Manuals
PK 390 ATR 72-500	-	-	Maintenance actions not completed	Manuals
DA 42	Psychological attributes; Knowledge Training	-	Improper action	-
ATR 72-212A	Psychological attributes; Knowledge	-	Services not completed	Manuals Procedures

SVA 734	Psychological attributes; Knowledge Experience	-	-	-
THY 714E & RBA 003	Psychological attributes; Workload Experience	-	-	-
PK 8303	Psychological attributes Experience	-	-	Procedures Manuals
PIA 301 & UAE 516	Psychological attributes; Workload Knowledge Experience	-	-	-

CONCLUSION

The analysis performed to understand the human errors and CONSERVATION instructions of aircraft and studied further, the importance of manuals and impact is

highlighted. Exclusion, less knowledge, less experience were identified the most error in type while the most instructions errors in aircraft system were landing gear, engine failure, flight controls and parking brakes. Applying the PEAR Structure to identify the human errors combined with PCAA training requirement for aircraft technicians while simultaneously and furthering the results of previous human errors study to perform in aviation. Especiallythe important factor is CONSERVATION of aircraft efforts used the instructions therein. Such as available resources were found to be crucial.

The findings support the idea that flight safety is a combination of many things working together. As mentioned in a previous study, the results of the study were highlighted a completed study, the presence of written maintenance instructions does not warrant appropriate elimination of related care items. Instead, supporting things like a professional adequate training and supervision and the overall work environment are important affecting adequate flight maintenance. As the above, human-related factors such as training, experience, and knowledge, are such particularly the PCAA-regulated training of aircraft repair specialists. On the other hand, the elements under the resource and environmental categories identified under The PEAR framework in this study, is usually tied into management and planning features of care organizations. As a result, increasing the security of flying, when designing and applying repair instructions, impact elements the real understanding and implementation of the stated instructions - i.e. the consideration of “performance its environment ”- they are important and need to be considered.

REFERENCE

- PCAA. (n.d.). AAIB Final Investigation Report.
- AAIB. (18-11-2020). Final Investigation Report of PIA Flight PK-661. 207.
- Hobbs, A. (2004). Human factors: the last frontier of aviation safety? The International Journal of Aviation Psychology, 14(4), 331-345.
- Hobbs, A. (2008). An overview of human factors in aviation maintenance. ATSB Safty Report, Aviation Research and Analysis Report AR, 55, 2008.
- Oster Jr, C. V., Strong, J. S., & Zorn, C. K. (2013). Analyzing aviation safety: Problems, challenges, opportunities. Research in transportation economics, 43(1), 148-164.
- Jain, M., Morris, T., Beck, J., Johnson, K., Short, R., Shakour, K., & Chalil Madathil, K. (2021). Educational Challenges Presented by COVID-19 at Technical Colleges Offering Aviation Maintenance Technology Program. Computers in Education Journal, 12(1), 2.
- Zimmermann, N., & Mendonca, F. A. C. (2021). The Impact of Human Factors and Maintenance Documentation on Aviation Safety: An Analysis of 15 Years of Accident Data Through the PEAR Framework. The Collegiate Aviation Review International, 39(2).
- Goldman, S. M., Fiedler, E. R., & King, R. E. (2002). General aviation maintenance-related accidents: A review of ten years of NTSB Data.
- Dhillon, B. S., & Liu, Y. (2006). Human error in maintenance: a review. Journal of quality in maintenance engineering.
- ABCD.XXX. (2019, 08 04). The Pear Model.

- International Civil Aviation Organization [ICAO]. (2002). Human factors guidelines for safety audits manual (Doc. 9806, 1st ed.). Retrieved from https://www.ukfsc.co.uk/files/SMS%20Material/SARPS%20Guidance%20Material%20 Oct%202008/Doc9806_%20HF%20in%20SOA%20Manual.pdf
- International Civil Aviation Organization [ICAO]. (2016). Annex 13 aircraft accident and incident investigation (11th ed.). Retrieved from https://www.kenyoninternational.com/clients/pdf/usefulinfo/ICAO%20Annex%2013%20 Jul%202016%2011%20ed.pdf