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A SYSTEMATIC REVIEW OF ACCIDENTS AND INCIDENTS AT FLIGHT TRAINING ORGANISATIONS WITH SPECIAL REFERENCE TO SOUTH INDIA

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ABSTRACT

Aviation safety is paramount in flight training organizations (FTOs) worldwide, and India is no exception. This systematic review aims to analyze and synthesize existing literature on accidents and incidents within FTOs in India over a specified period. The review utilizes a systematic search strategy to identify relevant studies, focusing on incident types, causal factors, and mitigation strategies reported in peer-reviewed journals, government reports, and industry publications. Findings suggest a recurring pattern of contributing factors such as human error, operational challenges, and regulatory issues. The synthesis highlights the need for enhanced safety protocols, improved training methodologies, and regulatory reforms to mitigate risks and enhance aviation safety within South Indian FTOs. The consistent focus on corrective training, thorough audits, and increased oversight provides a valuable roadmap for Flight Training Organizations (FTOs) to proactively address challenges and cultivate a strong safety culture within the aviation industry. Future research directions are proposed to further understand and address the complex dynamics of aviation safety in training environments. This review paper contributes to the literature on the role of human factors in implementing aviation safety norms to trainee pilots by providing a comprehensive synthesis of existing literature on the topic. The review paper will also provide practical implications for organizations, policymakers, and other stakeholders to promote and ensure safety to pilots and other employees at flight training organizations in South India.

Keywords: Aviation Safety, Flight Training Organizations, Accidents, Incidents, Systematic Review.

I. INTRODUCTION

Flight Training Organisations (FTOs) play a crucial role in shaping the future of aviation professionals in India. These organizations provide aspiring pilots with the necessary training and experience to navigate the skies safely. With a strong focus on theory, practical flight training, and simulator sessions, FTOs ensure their students are well-equipped to handle various flying conditions.

In India, FTOs operate under strict regulations set by the Directorate General of Civil Aviation (DGCA), which ensures adherence to safety standards and guidelines. These organisations offer courses ranging from student pilot licenses to commercial pilot licenses, catering to individuals who dream of soaring through the clouds professionally. The demand for trained pilots has steadily risen over the years due to increased air travel and expansion in the aviation industry. As a result, FTOs have become instrumental in meeting this demand by producing competent aviators who can confidently operate different types of aircraft.

Moreover, FTOs also contribute significantly to enhancing aviation safety standards across India. By instilling disciplined practices and promoting situational awareness during flight operations, these organizations help reduce accidents and incidents within the aviation industry. To maintain their reputation as reliable training providers, FTOs regularly update their curriculum based on industry advancements and technological innovations. Organisations invest in state-of-the-art simulators and equipment to create realistic training environments for aspiring pilots.

With their dedication towards maintaining high safety standards, and commitment towards providing comprehensive training programs. FTO's continue playing a pivotal role in fostering excellence within India's aviation sector.

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Definition of Accidents and Incidents in Aviation

Accidents and incidents in aviation are events that occur during flying operations, which may result in damage to aircraft, injury or loss of life. These occurrences can happen for various reasons and can have serious consequences. Understanding the difference between accidents and incidents is crucial in analysing their causes and implementing safety measures.

An accident refers to a serious event that involves substantial damage to the aircraft, severe injuries, or even fatalities. It usually occurs due to factors such as pilot error, mechanical failure, or external influences like weather conditions. Accidents require thorough investigation by aviation authorities to determine the root cause and prevent similar incidents from happening again.

On the other hand, an incident is a less severe occurrence that does not lead to significant damage or harm but still poses a potential risk. Incidents can involve situations like near-misses with other aircraft, technical malfunctions that are successfully resolved, or minor injuries without extensive impact. Although these events may not result in immediate danger, they serve as warning signs for possible hazards within flight operations.

Both accidents and incidents play a vital role in improving aviation safety by identifying areas of improvement and implementing corrective actions. By thoroughly examining each case through investigative processes conducted by organizations like the Directorate General of Civil Aviation (DGCA), valuable insights are gained into potential risks and effective preventive measures.

II. REVIEW OF LITERATURE

S. No	Area	Contribution of Author	References
1	Ultralight Aviation Accident Factors and Latent Failures	Understanding the causes can help prevent future incidents. The study analysed 66 accident reports from the National Transportation Safety Board between 1985 and 2004. The researchers used Reason's Swiss cheese model, where errors are compared to slices of cheese. The study found that pilots with less than 40 hours of flying a specific type of ultralight were more likely to have fatal crashes due to a loss of control. Conversely, pilots with 40 or more hours of flying experience were more prone to crashes caused by engine failure. Loss of control was often related to factors like strong winds and poor mission planning, while engine failure was usually due to inadequate maintenance. To reduce accidents, the study recommends organizations focus on training pilots in mission planning, aircraft familiarity, and proper maintenance. Further research is also suggested to better understand these errors and evaluate the impact of new FAA regulations for light sport aircraft.	Pagán, B. J., De Voogt, A. J., & Van Doorn, R. R. (2006).
2	Weather-related Aircraft accidents	The researchers examined two aeroplane accidents in 1975, one in New York and another in Denver, and are currently investigating a third accident in Philadelphia in 1976. What's intriguing is that before each accident, unusual radar patterns known as "spearhead echoes" were detected just north of the accident sites. These echoes appeared on weather service	Fujita, T. T., & Caracena, F. (1977).

		radars between 5 to 50 minutes before the accidents, moving faster than other radar signals. Even from a distance of 130 to 205 kilometres, these echoes were observed. When examined up close, both airborne and ground radars showed circular echoes with small diameters (3–5 km). These radar patterns were associated with intense downdrafts called downbursts. All accidents occurred during aircraft descent or ascent, experiencing abrupt and powerful changes in wind within these downburst areas.	
3	Aircraft Loss-of-Control Accident	Loss of control (LOC) remains a major cause of fatal aircraft accidents, especially in commercial jet aeroplanes. This study analysed data from 1999 to 2008, focusing on 74 LOC accidents between 1993 and 2007. It identified various factors contributing to LOC events, such as aerodynamic stalls, flight control system issues, crew disorientation, aerofoil contamination, and atmospheric disturbances. Notably, LOC accidents occurred across different operational categories, impacting aviation safety significantly. The study emphasizes the complex nature of LOC accidents and the need for a comprehensive intervention strategy based on NASA's 2009 study. By analysing precursor combinations and sequences, the study aims to enhance aviation safety through a holistic approach to prevent LOC accidents.	Belcastro, C., & Foster, J. (2010, August).
4	Review of aircraft crash reports	Despite significant advancements in the aerospace industry, accidents still occur due to human errors, equipment malfunctions, and unforeseen events. This study examined aircraft crashes from 2000 to 2020 and found that structural failures, particularly engine-related issues, were a major contributing factor. This research by analysing 111 crash investigation reports and using airport handling manuals from Airbus and Boeing, the research highlighted the impact of engine pod locations, specifically beneath the wing. The study identified a prevalent position between 20% and 40% of the wingspan from the front reference line. Still, outliers like the Antonov An-225 Mriya emphasized the need for a comprehensive understanding of diverse aircraft configurations to enhance safety protocols.	Kane, A. N., Jadhav, A. S., Sahamate, S., Kokare, V., & Jadhav, K. B. (2021, December).
5	Analysis of pilot-related errors.	This study takes a multidisciplinary team approach to investigate pilot error-related	Kowalsky, N. B., Masters, R. L., Stone, R. B.,

		accidents in U.S. air carrier jet aircraft. By using innovative analytic techniques like Critical Element Analysis, Cluster Analysis, and Pattern Recognition, the research uncovers nuanced human error information that statistical analyses may overlook. These methodologies facilitate the discovery of novel insights within extensive datasets and enhance the understanding of pilot-related factors contributing to jet aircraft accidents. The study contributes to the existing literature by offering innovative methodologies for extracting hidden human error aspects from air carrier accident records.	Babcock, G. L., & Rypka, E. W. (1974).
6	Health-Related Factors Among Pilots in Aviation Accidents	This study examines the impact of health-related factors on aviation safety by analysing historical aviation accidents investigated by the U.S. National Transportation Safety Board (NTSB). Using a two-part methodology that includes a review of medical literature and an analysis of NTSB accident reports, the research reveals that medications for psychiatric, cardiovascular, and neurological conditions were prevalent in fatal aircraft accidents. The study emphasizes the need for further investigation into the association between health-related factors, particularly cardiovascular diseases and their treatment, and aviation accidents.	Zhu, Y., Wolf, M. E., Alsibai, R. A., Abbas, A. S., Alsawaf, Y., Saadi, S., ... & Murad, M. H. (2024).
7	Flight Training	Flight training is a systematic process aiming to modify behaviour and enhance skills through instruction, practice, and feedback. It utilizes various resources, including personnel, aircraft, simulators, and media, while emphasizing effective resource management. In-flight training typically involves individualized instruction due to cockpit constraints, with crew training becoming feasible in advanced stages.	Caro, P. W. (1988).
8	Flight Instructors	Flight instructors in Canada express dissatisfaction with traditional training methods and lack of standardized syllabus. They advocate for competency in teaching methods and oppose evaluation methods like role playing and flight test records.	Lazure, C., Dumont, L., El Mouderrib, S., Delisle, J. F., Sénécal, S., & Léger, P. M. (2020).
9	PCATDs in General Aviation Training	This article reviews the history and effectiveness of personal computer aviation training devices (PCATDs) in general aviation pilot training. Emphasizes their role in novice instruction and instrument flight training, addressing fidelity and advocating for standardized certification standards.	Koonce, J. M., & Bramble Jr, W. J. (1998).

10	Simulation-based training.	University of Illinois flight students, pre-trained with a computer-animated landing display in a simulator, required fewer presolo landings, suggesting potential time savings of about 1.5 flight hours per student. Adaptive visual augmentation showed incremental transfer benefits.	Lintern, G., Roscoe, S. N., Koonce, J. M., & Segal, L. D. (1990).
11	Simulator Effectiveness	Meta-analysis on flight simulation research reveals effectiveness of simulators combined with aircraft training, particularly for jets. Motion cuing showed minimal impact, while performance-paced training proved more effective than lock-step training.	Hays, R. T., Jacobs, J. W., Prince, C., & Salas, E. (1992).
12	Ab-initio Flight Training	Evolution in flight simulation, using powerful yet affordable computers, facilitates high-fidelity training for ab-initio pilots. A study applying an experimental curriculum found significant effective transfer for flight tasks, combining FTD and airplane training.	Macchiarella, N. D., Arban, P. K., & Doherty, S. M. (2006).
13	Abnormal Event Training	The study evaluates airline pilot training for abnormal in-flight events, revealing that routine training environments lead to rote-memorized responses. The findings emphasize the need for broader and more realistic training approaches.	Casner, S. M., Geven, R. W., & Williams, K. T. (2013).
14	Pilot Judgment Training	Pilot judgment is traditionally seen as an intrinsic quality, but recent efforts in Canada and the United States explore it as a vital flight-training requirement. A study with Canadian air cadets shows improved judgment through training, emphasizing its teachability.	Buch, G., & Diehl, A. (1984).
15	Simulator Validity	This study examines factors influencing performance in basic flight simulators for ab initio pilot candidates. Results show the simulator's incremental validity in predicting success in flight training, justifying its use in candidate selection.	Mittelstädt, J. M., Hörmann, H. J., Oubaid, V., & Soll, H. (2024).
16	Novice Pilot Training	Experienced pilots demonstrate more adaptive visual scanning patterns and better decision-making in low-visibility approaches compared to less experienced counterparts. Training for novice pilots should focus on enhancing visual scanning for safer decision-making.	Gao, S., & Wang, L. (2024).
17	Novice Pilot Attention	Examining visual attention and flight performance, novices and experts' eye movements were analysed during simulator flights. Experts showed better performance, focusing more on critical instruments. Developing effective visual attention models can	Jin, H., Hu, Z., Li, K., Chu, M., Zou, G., Yu, G., & Zhang, J. (2021).

		enhance safety for novice pilots.	
18	Pilot Expertise Acquisition	The study investigates information acquisition in novice, intermediate, and expert pilots during simulated pre-flight decision-making. Significant differences highlight the need for initiatives to enhance expertise acquisition among less experienced pilots.	Wiggins*, M., Stevens, C., Howard, A., Henley, I., & O'Hare, D. (2002).
19	Cognitive Workload	The study investigates cognitive workload in novice and expert military pilots using neurometric measures during simulated flights. Novices demonstrated higher workload and differences in brain and autonomic activities, suggesting potential applications in enhancing novice pilot training.	Borghini, G., Roberto, I., Giovanni, V., Jlenia, T., Laura, A., Carlo, C., & Fabio, B. (2012).
20	Go-Around Training	The study investigates aircrew performance and visual scanning during final approach and unexpected go-around maneuvers. Results show frequent errors during go-arounds, emphasizing the challenge of the manoeuvre. Eye tracking proves valuable for explicit attention training, enhancing flight safety. The study investigates aircrew performance and visual scanning during final approach and unexpected go-around maneuvers. Results show frequent errors during go-arounds, emphasizing the challenge of the maneuver. Eye tracking proves valuable for explicit attention training, enhancing flight safety.	Frédéric Dehais, Julia Behrend, Vsevolod Peysakhovich, Mickaël Causse, Christopher D. Wickens.
21	Personality Impact on Flight Training	The study applies the MBTI test to flight instructors and student pilots in introductory flight training. Results highlight the influence of personality types on academic achievement and success rates for novice pilots.	Yoon, Y., Lee, S., & Park, S. (2015).
22	Flight Training Stress Analysis	Research explores stress in flying training, linking it to instructor pilot behaviour. Twelve students' stress levels, measured through catecholamine excretion, show correlation with negative instructor styles impacting student performance.	Krahenbuhl, G. S., Darst, P. W., Marett, J. R., Reuther, L. C., Constable, S. H., Reid, G. B., & ARIZONA STATE UNIV TEMPE DEPT OF HEALTH AND PHYSICAL EDUCATION. (1980).
23	Automated Flight Performance Assessment	Flight Performance Assessment, Physiological Measures, Student Pilots, Simulated Flight Training, Novel Model, Automated Flight Instruction, Performance Errors, National Research Council.	Jenings, S., Law, A., Bourgon, A., & Grenier, H. (2024).
24	Collegiate Aviation Training Analysis	This study analyzes 83,942 flight training records in a collegiate aviation program,	Polstra Sr, P. A. (2012).

		examining the relationship between instructor experience characteristics and student completion times for various pilot ratings.	
25	Training Equipment Evaluation	This research evaluates flight instructors' ability to predict success based on initial performances in ground trainers versus aircraft. Ground trainer groups show time savings, with transfer effectiveness ratios of 0.8 and 1.0.	Povenmire, H. K., & Roscoe, S. N. (1971).
26	Aviation Regulatory Framework	This chapter explores the impact of supranational and international regulations on aviation, covering the Chicago Convention, freedoms of air, ICAO, EASA, airspace classifications, and consumer protection laws for passengers.	Müller, R. (2021).
27	Flight Safety Factors	The article discusses human factors, cultural influences, and cockpit automation's impact on flight crew performance, focusing on the Asiana Airlines Flight 214 accident. It calls for systematic efforts to address these issues for safer flights.	Chow, S., Yortsos, S., & Meshkati, N. (2014).
28	Fatigue Management Practices in New Zealand Aviation	Flexibility in flight and duty time regulations in New Zealand hasn't significantly impacted fatigue management practices. Strategies vary between operators, highlighting a need for improved industry knowledge and safety culture.	Leigh Signal, T., Ratieta, D., & Gander, P. H. (2008).
29	Regulatory Interaction	"The globalized nature of industries prompts private self-regulation in aviation. Examining IATA's internal audit, reporting, and data analysis, this paper finds private programs complement government regulation but face threats from competing public initiatives."	Mills, R. W. (2016).
30	International aviation safety standards	This study finds ICAO plays a crucial role in international flight safety, using PT Lion Airlines in Indonesia as a case study to assess its safety standards and goals	Agustini, E., Kareng, Y., & Victoria, O. A. (2021).
31	Examining aviation accidents, and incidents related to maintenance for safety improvements.	We can identify contributing factors and improve maintenance procedures to enhance safety in commercial aviation.	Majumdar, N., Bhargava, D., El Khoury, T., Marais, K., & Duffy, V. G.
32	Combatting aviation maintenance fatigue, researchers advocate a dual strategy: HF FRM to reduce fatigue	This study advocates for a two-pronged safety approach in aviation maintenance, addressing fatigue through a Fatigue Risk Management System and mitigating procedural errors via a Safety Reporting System, enhancing Safety	Miller, M., Mrusek, B., & Herbic, J.

	impact and a safety reporting system.	Management Systems for improved aviation safety.	
33	Understanding Human factors in aviation maintenance personnel such as physical demands, communication challenges, time pressures and emotional burden.	It explains the unique human factors challenges faced by aviation maintenance personnel, emphasizing the hazardous work environment, stressors, and the parallel with medical professionals. It underscores the importance of understanding and addressing these factors for enhanced aviation safety.	Hobbs, A.
34	Enhancing civil aviation safety through AI-based risk analysis advancements.	The vital contribution of integrating deep learning and AI technologies in civil aviation risk analysis provides more accurate predictions and emphasises the need for rigorous risk management.	Xirui, L., Romli, F. I., Ali, S. A. M., & Zhahir, M. A. M.

Research Objectives

1. To explore various causes of the accidents/incidents at Flight Training Organisations.
2. To suggest suitable safety recommendations based on the study and analysis of collected data.
3. To identify the research gap based on the literature.
4. To provide guidelines to the various stakeholders in the aviation sector to protect the employees and to ensure sustainable growth in aviation industry.

III. METHODOLOGY

The study mainly focused on secondary data collected from sources such as DGCA reports and other flying clubs and academic institutions in aviation industry. The source of the data is from the Director General of Civil Aviation, India website. The information was collected on 31/12/2023 using the keywords Flying Clubs and Aviation Academy. This study involves 26 accidents/incidents that happened in various Flight Training Organisations in India from the period of 2008 – 2022 and from scholarly articles.

Discussion

The survey of literature undertaken and the discussion has been summarized as follows:

Descriptive Analysis of 26 Accidents and Incidents in Indian FTOs

1. This research work focuses on the incident involving M/s Blue Ray Aviation Pvt. Ltd CESSNA 172S aircraft VT-JSN during landing at Mehsana, Gujarat. The study examines the area of pilot error and its contribution to the incident. The type of error identified in this case is insufficient flare and subsequent incorrect bounce recovery technique during landing, which led to the aircraft entering into Pilot Induced Oscillations. This resulted in damage to the propeller and various parts of the aircraft structure, including the nose landing gear, engine mount strut, lower firewall, shock mount rubber unit, fuselage lower skin, rudder pedal bar, nose gear support bracket, and Cabin lower front floor. The investigation conducted by the Director General of Civil Aviation highlights the importance of proper landing techniques and the potential consequences of pilot-induced oscillations.
2. This investigation focuses on the incident involving M/s National Flying Training Institute's DA-40 aircraft VT-NFF during a cross-country solo navigational sortie. The study investigates the cause of the rear right side passenger window transparency separating from the airframe during flight. The most probable cause identified is the deterioration of the terostat adhesive sealant. The investigation, conducted by DGCA-India, highlights the importance of proper maintenance and inspection procedures to ensure the integrity of aircraft components. This research review emphasizes the need for regular checks and maintenance of adhesive sealants to prevent similar incidents in the future.
3. This investigation focuses on aviation safety and specifically examines an incident involving a Diamond DA 40 CS aircraft on 23.11.2021. It highlights the importance of correct approach procedures and flare

techniques during solo landings to avoid nose wheel touchdowns and propeller strikes. The study emphasizes the significance of proper training protocols for pilots to ensure safe landings. By analysing the consequences of procedural deviations, this research contributes valuable insights to enhance aviation safety protocols. The identified error type in this incident is a procedural deviation that impacts landing safety.

4. This incident brings to light the importance of following checklists in aviation safety. The study specifically focuses on pilot training and highlights the consequences of not adhering to checklists during take-off. It's crucial to understand how overlooked procedures can have a domino effect, ultimately leading to a runway excursion. This case serves as a prime example of a procedural error where insufficient speed for take-off and subsequent abort resulted in a runway overrun. The findings stress the necessity for ongoing training and reinforcement of checklist protocols to prevent such errors and prioritise flight safety.
5. This report investigates the serious runway excursion incident involving Ambition Flying Club's Cessna 172R aircraft VT-AFR. The probable cause was a fatigue crack initiating at the top bolt hole, leading to structural discontinuity and disintegration of the RH-MLG tubular strut. The incident resulted from a material failure due to a technical error. Recommendations include one-time removal and inspection of LH-MLG tubular strut for cracks/corrosion and a dimensional check of IB-LCG bore of left MLG to prevent reoccurrence.
6. The investigation centres on Pioneer Flying Academy's Cessna 152 aircraft VT-NNN on 27-05-2021 at Yamuna Express Highway. No fatalities occurred. The incident stemmed from an engine malfunction, specifically the slipping out of the mixture control cable from the carburettor linkage. The probable cause was attributed to insufficient pressure due to a missing washer, resulting in the loss of engine power during flight. A contributory factor identified was perfunctory maintenance actions. This incident underscores the critical role of meticulous maintenance procedures in ensuring flight safety.
7. This study investigates the Gujarat Flying Club Cessna FA 152 aircraft VT-EMM incident on 19-03-2020 in Vadodara, involving a solo flight by a 19-year-old female pilot with 28:50 hours of experience. The incident entailed abnormal runway contact during landing. The probable cause was identified as improper flare and bounce recovery techniques leading to multiple bounces, resulting in damage to the nose landing gear and engine propeller. Inadequate training on Go-Around Procedure, Recovery from Bounce, Balloon & PIO/Runway change before solo release flight contributed to the incident, classifying it as a pilot error.
8. This investigation centres on Falcon Aviation Academy's Cessna 152 aircraft VT-PTD incident on 26-04-2018 in Faizabad, involving a forced landing due to material failure. The accident was likely caused by inadvertent "Leaning of Mixture" or "Slam opening of the Throttle" during emergency procedures for Rough Engine Operations or Loss of power due to Spark Plug Fouling. Contributory factors include poor maintenance practices, a broken starter motor gear, and an improperly installed fuel jet nozzle. DGCA's safety recommendations emphasize caution, meticulous maintenance, communication on fuel jet observations, wildlife control, audit of maintenance practices, and inclusion of relevant regulations in Training and Procedure Manuals for Special VFR operations.
9. This investigation centres on the National Flying Training Institute DA-42 aircraft VT-NFM incident on 26-04-2017 near Gondia, involving a dual flight resulting in the unfortunate demise of both pilots. The crash occurred due to deviating from the assigned route and flying low over a river bed, leading to a collision with a ropeway cable. Potentially, lower visibility than VFR minima may have contributed. DGCA's recommendations include procedural enhancements, clarification on CFI presence during Special VFR operations, fostering a culture of reporting hazards, monitoring flight paths, and continuous ATC surveillance. The incident is attributed to a pilot error.
10. This research centres on the Rajiv Gandhi Academy for Aviation Technology Cessna 172R aircraft VT-RGV incident on 03-04-2017 at Trivandrum airport, involving a non-fatal runway excursion. The probable cause was attributed to the Flight Cadet's incorrect handling of flight controls during crosswind landing, particularly excessive left rudder travel amplifying the yaw moment. Safety recommendations include corrective flying training for the Flight Cadet, a one-time inspection of rudder travel for the entire Cessna 172R fleet by RGAAT, and the use of a digital inclinometer for more accurate measurements. The incident is classified as a pilot error.

11. This investigation centres on the IGRUA DA-40 aircraft VT-FGA incident on 03-07-2015 in U.P State, involving a non-fatal solo flight. The occurrence was attributed to pilot-induced oscillations after touchdown, arising from the flight cadet's non-adherence to prescribed procedures. Safety recommendations emphasize corrective training for the involved flight cadet to ensure adherence to established procedures for safe aircraft operation. The incident is categorized as a pilot error.
12. This investigation centres on Falcon Aviation Academy's Cessna 152 aircraft VT-PTB incident on 04-03-2015 in Faizabad, involving a non-fatal solo flight with abnormal runway contact. The probable cause is attributed to the student pilot's improper flare during landing, leading to a bounce, and her subsequent incorrect bounce recovery technique, resulting in the incident. The breaking of the nose gear was caused by a loose tube axle inside the bearing. Safety recommendations include issuing instructions for immediate evacuation post-incident for trainee pilots and conducting a one-time inspection of the axle tube and bearing dimensions for the entire fleet. The incident is categorized as a pilot error.
13. This investigation focuses on Madhya Pradesh Flying Club's Cessna 152 aircraft VT-EUE incident on 19-11-2014 in Indore, involving a crash landing during a dual flight with an unauthorized person. The accident occurred as the aircraft stalled, impacting the ground and nose rolling over due to an erroneously steep left turn by the pilot practising simulated engine failure with the throttle in idle position. Safety recommendations include a DGCA safety audit of MPFC activities, issuing instructions to flying clubs to avoid carrying unauthorized persons during solo flights, MPFC ensuring adherence to training procedures, and AAI, Indore ensuring proper maintenance of green areas outside airstrips. The incident is categorized as a pilot error.
14. This investigation focuses on Garg Aviation's Cessna 152 aircraft VT-SGN incident on 03-09-2014 in Kanpur, involving a solo flight where the student sustained serious injuries. The accident occurred as the aircraft stalled while attempting to avoid birds on the runway during landing, ultimately crashing onto the roof of an abandoned building. The probable cause was identified as the trainee pilot's improper handling of controls during the final approach, leading to a crash landing. Contributory factors included deviation from the flight path due to bird activities and inappropriate corrective action for stall warning by the trainee pilot. Safety recommendations advocate for a DGCA audit of Garg Aviation's training procedures. The incident is categorized as a pilot error.
15. This investigation centres on Saraswathi Aviation Academy's Alarus CH 2000 incident on 23-08-2014 at Amhat airfield, Sultanpur, involving a non-fatal dual flight where the nose wheel sheared off during landing. The probable cause was identified as a fully corroded pre-developed crack, unnoticed during visual inspection of the welded part, compromising the structure's ability to withstand repeated impact loads. Repetition of similar cracks in the welded portion across different operators and countries indicated a structural weakness or improper welding technique. Safety recommendations include the manufacturer developing a more robust structure or effective welding technique to prevent crack recurrence and considering NDT inspections at regular intervals to detect internal cracks in the welded area. The incident is classified as a technical error.
16. This investigation focuses on Madhya Pradesh Flying Club's Cessna FA 152 aircraft VT-EMU incident on 12-06-2013 at Devi Ahilyapur Holkar Airport, Indore, involving a non-fatal forced landing during a dual flight. The most probable cause was identified as the failure to perform total oil replenishment as per the approved 50-hour schedule, leading to significant changes in engine oil properties and heavy carbon deposits on spark plugs. This resulted in insufficient burning of charges and inadequate lubrication, leading to the seizure of the No. 3 piston and engine power loss. Safety recommendations include suitable action by DGCA based on the probable cause and corrective training for API to ensure proper engine securing before forced landings. The incident is classified as a maintenance error.
17. This investigation centres on Carver Aviation Academy's Cessna 172R incident on 26-08-2013 at Baramati airfield, involving a non-fatal solo flight with a runway excursion. The probable cause was identified as the trainee pilot's over-correction of the rudder during landing in crosswind conditions, with winds serving as a contributing factor. Safety recommendations include installing a windsock near Runway 29 end for improved wind estimation by pilots and considering DGCA licensing of airports with regular flying activities for enhanced safety. The incident is categorized as a pilot error.

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18. This investigation focuses on the Haryana Institute of Civil Aviation's Cessna 152 aircraft VT-EMT incident on 03-11-2012 at Pinjore, involving a bounced landing. The probable cause was attributed to the student pilot's improper flare during landing, resulting in a bounce, and his subsequent incorrect bounce recovery technique. Safety recommendations include providing suitable corrective training to the student pilot before resuming flying and cautioning the Chief Flying Instructor (CFI) for not conducting a recency check on the student pilot who had a one-year break in flying. The incident is classified as a pilot error.
19. This investigation centres on Chimes Aviation's Cessna 172R aircraft with registration VT-CAJ incident on 03-02-2012 at Dhana Airstrip, Madhya Pradesh, involving a non-fatal solo flight with a runway incursion. The probable cause was identified as the high nose attitude during landing, and the trainee pilot adopting the wrong go-around procedure as directed by the AFI, leading to a stall and the subsequent accident. Safety recommendations include providing necessary corrective training to the trainee pilot and taking corrective action against the AFI for instructing the wrong procedure without a proper assessment. Additionally, the training institute is advised to conduct necessary runway surface maintenance/repair work and ensure the availability of serviceable instruments/equipment at ATC. Any further actions are to be taken as deemed fit by the competent authority. The incident is categorized as a pilot error.
20. This investigation focuses on Pioneer Flying Academy's Cessna 152 aircraft with registration VT-PSJ incident on 29-07-2011 at Aligarh, involving a dual flight where both pilots succumbed to their injuries during take-off. The probable cause was identified as the accident occurring due to an impact on the ground following a sudden loss of height, attributed to encountering an abnormal situation possibly caused by the loosening of the propeller mounting. Safety recommendations include introducing a procedure for the integrity check of the propeller mounting bushing in the maintenance program, a one-time check on all Cessna 152 aircraft to verify compliance with Service Instruction No. 1098H, thorough inspection of maintenance documents before the initial issue of Certificate of Airworthiness, taking appropriate action against the organization for not ensuring the security of the wreckage, and emphasizing the importance of proper planning and briefing for training sorties. The incident is categorized as a technical failure.
21. This investigation centres on HAL Wing Academy's Chetak helicopter with registration VT-EIV incident on 27-08-2010 at HAL Airport, Bangalore, involving a dual flight with serious injuries to the occupants during hovering. The probable cause was attributed to a sudden pitch-up during hover due to the instructor's improper handling of controls, leading to the tail rotor hitting the ground and damaging the helicopter. The instructor was granted an exception under Rule 160 for his license. Safety recommendations include subjecting the involved instructor to a skill test on the Chetak helicopter, taking appropriate action against the Flight Instructor (FI) for not timely responding and following proper emergency procedures, action against the organization for lacking an approved Training and Procedures Manual and required forms for skill tests/proficiency tests, ensuring DGCA examiners are familiar with the latest regulatory requirements, providing skill test forms in regulatory documents, and establishing a system for monitoring pilots/instructors holding authorizations under Rule 160 for medicals, renewals, and periodic checks. The incident is classified as a pilot error.
22. This investigation focuses on Chimes Aviation's Cessna 172 aircraft with registration VT-CAI incident on 06-04-2009 at Jabalpur, involving a solo cross-country flight that resulted in a fatal accident. The probable cause was identified as the pilot carrying out very low flying over water in cruise configuration at high speed, touching the water and causing the aircraft to crash into the dam. Safety recommendations include checking the X61-0027 relay on all Cessna 172R aircraft using the Starter with 149NL/ec manufactured by M/s Skytech, conducting a one-time inspection and submitting a report to DGCA, discussing the matter with the manufacturer for contactor X61-0027 modification or restricting its life, issuing advisories for exercising abundant precaution during starter installation, taking appropriate action against the AME responsible for perfunctory work on starter removal/installation, and increasing safety oversight on general aviation and flying club aircraft, especially those located in remote places. The incident is categorized as a pilot error.
23. This investigation focuses on IGRUA's TB20 aircraft with registration VT-IGC incident on 29-12-2008 near Gondia, Maharashtra, involving a non-fatal solo flight that was a pilot error. The probable cause was identified as not adhering to the Standard Operating Procedure, with the contributory factors being the use of autopilot without functional knowledge and flying at a low altitude, almost touching the water. Safety

recommendations include flying clubs conducting feasibility studies for GPS upgrading to record and download the flight path flown by trainee pilots on computers for verification with exercises authorized by Flight Instructors. Additionally, the competent authority is advised to take appropriate action against the trainee pilot. The incident is categorized as a pilot error.

24. This investigation centres on APAA's Cessna 152 aircraft with registration VT-EMR incident on 08-09-2009 at Hyderabad, involving a dual flight where both pilots succumbed to their injuries. The probable cause was identified as a sharp turn at a low height leading to stalling and subsequent crash landing of the aircraft. Non-adherence to recommended operating procedures was noted as a contributory factor. Safety recommendations include bringing the accident to the attention of all Flying Training Academies/Institutes and small aircraft operators, as well as conducting a comprehensive safety audit of the operator. The incident is categorized as a pilot error.
25. This investigation focuses on IGRUA's TB-20 aircraft with registration VT-EMG incident on 08-04-2008 at Raebareli, Uttar Pradesh, involving a non-fatal solo flight during landing. The probable cause was identified as the aircraft bouncing during landing, and the pilot's improper bounce recovery technique causing the aircraft to go into the kutcha, resulting in consequential damage. The existence of crosswinds and the selection of the wrong setting of flaps were noted as contributory factors to the incident. A safety recommendation includes providing necessary corrective training to the Student Pilot as deemed fit. The incident is categorized as a pilot error.
26. This investigation focuses on Carver Aviation Academy's Cessna 152 aircraft with registration VT-ACC incident on 14-03-2008 in Maharashtra, involving a dual flight with minor injuries. It is categorized as a pilot error, with the probable cause being the pilot's failure to notice high-tension cables while engaging in low flying. Consequently, the main landing gear got entangled in the high-tension electric cables, leading to the aircraft falling into the river. Safety recommendations include taking appropriate action against the Pilot-in-Command for intentional low flying and carrying an unauthorized passenger on board the aircraft. Additionally, surveillance activities by Flying Training Institutes should be enhanced to discourage low-flying activities by training students and to monitor flying activities both on the ground and in the air.

Research Gap

Although aviation safety and training methods have improved, there are still important gaps in understanding accidents and incidents at flight training organizations (FTOs) in India. It's crucial to identify and address these gaps to make pilot training programs safer and more effective.

1. **Limited Regional Data:** When it comes to aviation safety and training incidents, there's a lack of region-specific data for India compared to global studies. It's crucial to collect and analyse comprehensive data specifically for Indian flight training organizations (FTOs) to better understand the unique challenges and risk factors in this context.
2. **Root Cause Analysis:** To focus on the immediate causes of accidents and incidents without delving deeper into the underlying factors. However, it's crucial to conduct a thorough root cause analysis that investigates systemic issues like regulatory compliance, organizational culture, and training quality. By addressing these factors, we can prevent future occurrences and ensure safer aviation practices.
3. **Incident Reporting and Analysis:** One of the challenges we face is the lack of detailed and transparent reporting of incidents and near-misses. It's important to address this issue by enhancing incident reporting systems and analyzing near-misses. By doing so, we can gather valuable data that will help us prevent accidents and improve aviation safety.
4. **Instructor Training and Quality:** The impact of instructor training and quality on safety incidents at flight training organizations (FTOs) in India. There hasn't been sufficient exploration of this area. It's important for research to focus on the qualifications, training, and performance of instructors, and how these factors relate to the safety records of FTOs. This will help us understand the role of instructors in ensuring safe and effective pilot training programs.
5. **Human Factors:** The role of human factors in accidents and incidents at Indian flight training organizations (FTOs) hasn't been thoroughly researched. It's important for studies to explore how factors like pilot fatigue, stress, decision-making, and instructor-student dynamics contribute to incidents, and how we can mitigate

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these factors. Understanding and addressing these human factors will greatly contribute to improving safety in FTOs.

Research Agenda

1. Gather and Evaluate India Specific Data

Objective: Enhance aviation safety by developing and sharing regionally relevant information on training incidents and safety concerns.

Action Steps:

a. Execute a comprehensive data gathering strategy targeting Flight Training Organizations (FTOs) in India, aiming to capture valuable insights and trends
b. Create a unified data hub to consolidate and manage the gathered information, ensuring easy access and strategic utilization.
c. Perform a cross regional analysis, juxtaposing Indian data with international benchmarks, to identify distinct pain points and areas for improvement
d. Share findings to inform policymakers and stakeholders within India's aviation sector.

2. Perform Root Cause Analysis

Objective: Identify underlying factors and root causes contributing to adverse events, enabling proactive measures to mitigate risks and enhance safety.

Action Steps:

a. Employ a multifaceted approach to identify root causes, examining adherence to regulations, organizational dynamics, and training efficacy, to drive targeted improvements and robust safety outcomes
b. Collaborate with industry experts and regulatory authorities.
c. Develop and disseminate actionable guidance to address underlying vulnerabilities, empowering stakeholders to implement targeted solutions and enhance overall safety performance.

3. Improve Incident Reporting and Analysis

Objective: To Strengthen the reporting framework at Indian FTOs, capturing more comprehensive and nuanced information on safety events and close calls, to facilitate data driven insights and informed decision-making

Action Steps:

a. Create and integrate unified reporting protocols for incidents, establishing a consistent and harmonized framework for capturing and analysing safety data
b. Create a culture of transparency and openness in reporting.
c. Provide FTO staff with comprehensive training on the principles and methodologies of effective incident reporting, fostering a deeper understanding of the critical role that detailed reporting plays in enhancing safety outcomes.
d. Conduct in-depth examinations of reported incidents to identify trends and correlations, leveraging data driven insights to inform proactive strategies and mitigate future risk.

4. Examine Instructor Training and Quality

Objective: Investigate the correlation between instructor training standards and safety performance at FTOs, seeking to understand how instructor expertise and effectiveness influence the likelihood and severity of safety incidents.

Action Steps:

a. Examine the flight instruction landscape, analysing instructors' certifications, training protocols, and inflight assessment methods to identify best practices and areas for improvement
b. Design and facilitate professional development sessions to elevate instructor expertise and teaching effectiveness.
c. Systematically review and analyse the safety outcomes of training programs to ensure they meet the highest standards of quality and effectiveness.

5. Investigate Human Factors in Flight Training

Objective: Investigate the influence of human performance and behaviour on safety events at Indian Flight Training Organizations (FTOs).

Action Steps:

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a. Investigate the impact of pilot exhaustion, psychological stress, and cognitive decision-making processes on flight safety and performance.
b. Create evidence-based interventions to counteract the effects of human factors on flight safety and performance
c. Evolve the pilot training curriculum by incorporating human factors education, transitioning from traditional to modern approaches.

Research Proposal

After a through examination and evaluation of the research literature, the paper recommends that a study to be conducted to better understand human factors in pilot progression.

a. Proposed title: Study of Human Factors in Novice Pilot Progression
b. Target respondents: Trainee Pilots.
c. Geography: South India

Objectives

a. To identify key human factors influencing novice pilot performance.
b. To assess the impact of training environment on pilot development.
c. To develop strategies to mitigate negative human factors.

IV. FINDINGS

1. From the study it is found out that out of the 26 case reports, there are 19- pilot errors, 03- Mechanical Failures, 02- Maintenance Errors and 02- Technical errors

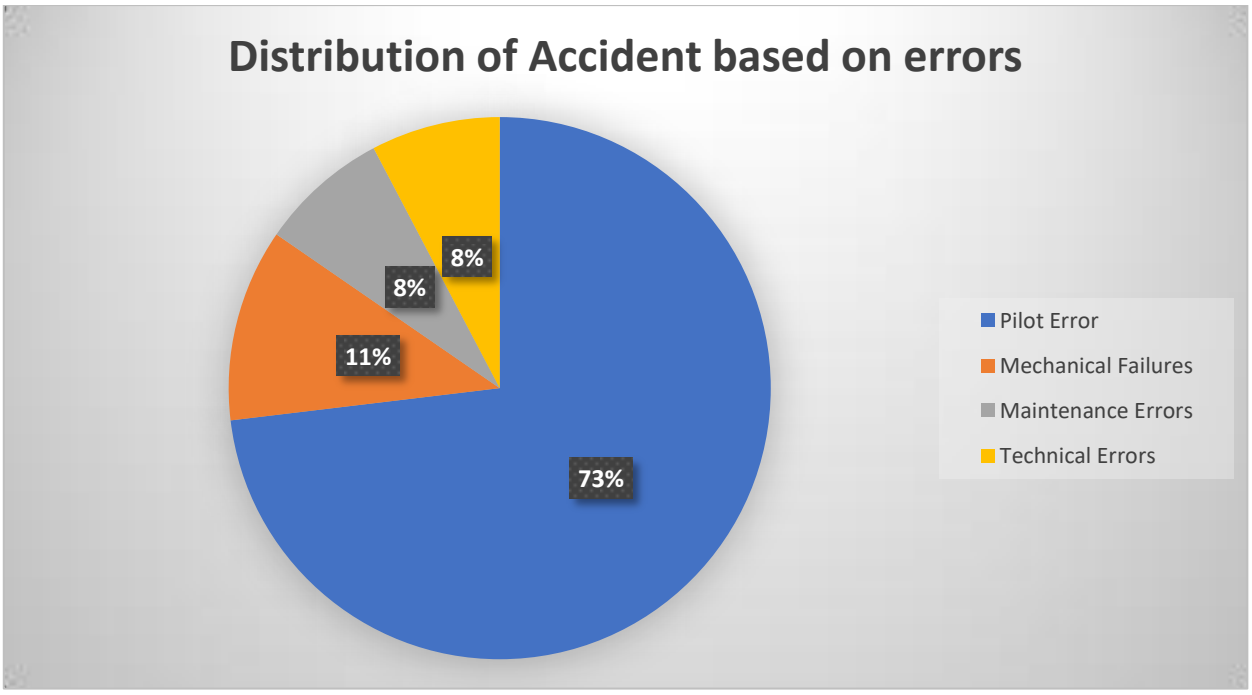

Chart 1 – Distribution of accidents based on errors

Source: Author

Based on the analysis of 26 case reports, the research identifies several factors that contribute to aviation incidents. One recurring theme is pilot error, which includes issues like improper landing techniques, procedural deviations, and inadequate go-around training. Maintenance-related errors, such as deteriorating sealants and insufficient maintenance actions, also contribute to these incidents.

2. There was a total of 11 different types of aircraft involved in these case studies and the majority of them were Cessna 152. There are 16 FTOs involved in the accidents.

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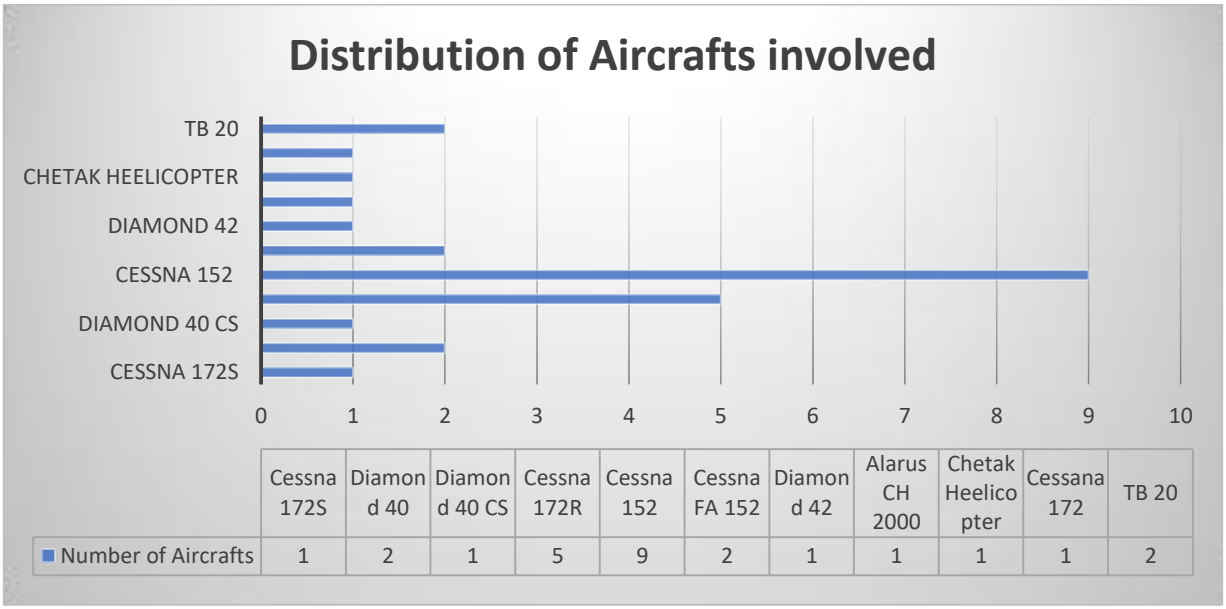

Chart 2 – Distribution of aircrafts involved

Source: Author

3. The research findings shed light on the importance of meticulous maintenance procedures in addressing technical failures. These failures, such as material deterioration, slipping control cables, and propeller mounting issues, highlight the need for thorough checks and adherence to prescribed procedures. Additionally, the research emphasizes the role of ongoing training in ensuring proper checklist adherence and handling emergencies effectively.
4. The case reports highlight a wide range of incidents in aviation, including forced landings, runway excursions, and crashes caused by low flying and stalls. To prevent future occurrences and enhance aviation safety, the recommendations focus on corrective training, audits of maintenance practices, and improved safety oversight. These measures aim to address the diversity of incidents and ensure a safer environment for aviation.
5. Improper flare techniques during landing, which result in multiple bounces and subsequent damage to landing gear and propellers, underscore the critical importance of pilot proficiency in landing procedures. Additionally, pilot-induced oscillations after touchdown, caused by non-adherence to prescribed procedures, highlight the significance of comprehensive pilot training and strict adherence to established protocols for safe aircraft operation. Pilots must possess the necessary skills and knowledge to ensure smooth and safe landings, minimizing the risk of damage and ensuring the overall safety of the aircraft.
6. Instances, where forced landings occur as a result of engine malfunctions, highlight the crucial role of meticulous maintenance procedures in preventing power losses during flight. Furthermore, the investigation into a tragic collision with a ropeway cable emphasizes the significance of adhering to assigned flight routes and maintaining proper altitude. By prioritizing thorough maintenance practices and following designated flight paths, pilots can mitigate risks and ensure the safety of both the aircraft and its occupants.
7. Fatigue cracks and corrosion-induced cracks, highlight the need for thorough and ongoing inspection and maintenance practices. It's crucial to have robust procedures in place to identify and address these issues promptly. Additionally, incidents involving overlooked procedures during take-off and insufficient speed, resulting in runway excursions, emphasize the importance of adhering to regulatory guidelines and utilizing checklists. By following these guidelines and implementing proper procedures, FTOs can ensure safer operations and prevent accidents.
8. The wide range of incidents, including pilot errors, technical failures, and maintenance lapses, highlights the complex nature of ensuring aviation safety. The recommendations consistently stress the importance of corrective training, audits, and increased oversight as essential measures to prevent future accidents and foster a strong safety culture within the aviation industry. By implementing these measures, FTOs can

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address the multifaceted challenges and take a proactive approach to aviation safety. The in-depth analysis of these cases provides valuable insights that contribute to enhancing safety practices and protocols. It's crucial to continuously learn from past incidents and strive for continuous improvement to ensure the highest level of safety in aviation.

V. SUGGESTIONS

1. Implement comprehensive corrective training programs for pilots, these programs should specifically focus on teaching proper landing techniques, making sure pilots follow checklists, and enhancing their emergency response skills.
2. Enhance aircraft safety is by conducting regular audits of maintenance practices. These audits help ensure precision in procedures, reducing the risk of technical failures and strengthening overall aircraft safety. By closely monitoring and maintaining the aircraft, we can minimize potential issues and ensure a safer flying experience.
3. Proposed to emphasize the importance of following designated flight routes and maintaining optimal altitude during training. By doing so, we can significantly reduce the risk of potential collisions. Adhering to these guidelines ensures a safer training environment.
4. By strengthening the ongoing inspection and maintenance protocols to proactively address structural concerns. This includes being vigilant about fatigue cracks and issues caused by corrosion. By implementing robust protocols, we can identify and resolve these issues.
5. Ensure to put more effort into ensuring regulatory compliance and strict adherence to checklists. This will help reduce incidents caused by overlooked procedures during take-off and minimize the occurrence of runway excursions.
6. It's essential to foster a strong safety culture within Flying Training Organizations (FTOs) by consistently learning from past incidents and embracing a mindset of continuous improvement. By studying historical incidents, we can identify areas for enhancement and implement proactive measures to prevent similar incidents in the future.
7. Instruct to work hand in hand with regulatory bodies like the Directorate General of Civil Aviation (DGCA) to ensure that our training curricula align with the ever-evolving safety standards and guidelines.
8. Encourage open and transparent reporting of hazards and incidents. By fostering a culture of continuous improvement and proactive risk management, we can create an environment where everyone feels comfortable sharing their experiences and lessons learned.
9. Regularly update our training curriculam based on the valuable insights we gather from incident investigations and emerging industry trends. By staying proactive and anticipating evolving challenges, it can be ensured that our training programs will effectively address the changing needs of the aviation industry.

VI. CONCLUSION

This research provides a thorough analysis of 26 aviation incidents and accidents in India FTOs, giving us valuable insights into the various factors that contribute to accidents and incidents. It becomes clear from the examination that pilot proficiency, strict adherence to established protocols, and rigorous maintenance practices play a crucial role in ensuring aviation safety. The recurring themes of pilot errors, procedural deviations, and maintenance-related issues highlight the urgent need for continuous training, systematic audits, and enhanced safety oversight. By prioritizing these measures, we can work towards a safer aviation environment.

The research also highlights the importance of corrective training, meticulous maintenance procedures, and the implementation of robust safety measures to prevent similar incidents from happening again. It specifically identifies areas for improvement, such as addressing improper landing techniques, mitigating pilot-induced oscillations, managing forced landings, and preventing material failures. This paper emphasizes the significance of following assigned flight routes, maintaining optimal altitude, and adhering to regulatory guidelines. By focusing on these areas, we can enhance aviation safety and minimize the occurrence of such incidents.

The different types of incidents, including pilot errors, technical failures, and maintenance lapses, highlight the complex task of ensuring aviation safety. The consistent focus on corrective training, thorough audits, and

increased oversight provides a valuable roadmap for Flight Training Organizations (FTOs) to proactively address challenges and cultivate a strong safety culture within the aviation industry. By learning from past incidents and continuously striving for improvement, FTOs can play a crucial role in upholding the highest standards of safety in aviation operations. FTOs need to embrace these strategies and prioritize safety every step of the way.

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