REVIEW OF THE MAJOR CAUSES OF AVIATION FATAL ACCIDENTS UNDER AIB FROM 2008 – 2018

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Abstract— Aviation Industry is in a boom from the last decade and this weighs mostly upon cutting-edge technologies and fast-growing commerce which has made air travel both convenient and affordable for people. As a result, the world airline traffic is the highest currently with air traffic for passenger airlines having increased by 8.1% in 2017 than the year before, according to Statista. While the number of passengers has been on the rise, the number of air accidents both fatal and non-fatal has remained consistent and even increasing in some years as described by the NTSB. The human and systems error are the primary reasons for crashes and the continual improvement in these areas are necessary, to bring down the number even further. According to the investigative reports released by the AIB (Aircraft Investigation Board), the years 2005 – 2014 saw 13 fatal accidents relating to air carriers which comprise commercial passenger and cargo aircraft. Each fatal accident on a Type 121 aircraft sees at least 150 on board die; also since, passenger and cargo air transport is on the rise, it is essential to continuously improve it to ensure lesser life–threatening accidents. To gather more recent data and base conclusions on that, the paper has considered all fatal accidents of Type 121 air carriers caused as a result of system errors and as reported under AIB from 2008 until April 2018. Upon the review and detailed study of the investigative reports published by AIB, the summaries and recommendations have been noted for each accident. These are then statistically analyzed and general conclusions have been provided. Every cause has been studied and analyzed individually and is traced to a commonality to provide the means to arrive at a solution. The statistics obtained from the accidents help identify the vital nerve that has to be addressed and a clear indication of improvement in technology is shown.

I. INTRODUCTION

The paper provides an insight into the different fatal accidents with commercial passenger aircraft in the 10-year span of 2008 – 2018 (included) as shown in **Figure 1**. It is commonly known about crashes that they occur fundamentally due to four causes, human, systems, environment and miscellaneous and/or a combination of any of these. Historical crash report/accident cause report have been instrumental in developing better technologies or optimizing existing ones to ensure passenger, crew and aircraft safety since they have provided clues for further research and development. The motive of this paper is to look for the common thread in the accident and root it to certain basic causes which still need to be looked into and solved, in the aviation field today. Results have been promising and a new perspective of the accidents has been provided which can help students, professors, scientists, pilots and interested people alike. The paper starts with listing the accidents and their description acquired from published technical reports under common categories and identifies the common thread in them. Following that, the commonality is presented through text and illustrations, with suggestions of the direction that needs to be looked into to mitigate the issue. Lastly, the conclusion along with references and citations have been provided.

II. METHODOLOGY

The accident analysis, performed by the team in this paper is based on adopting an integrated, data-driven methodology aimed to reduce the fatality risk in Part-121 Commercial Aviation sector.
The analysis is aimed at identifying all factors whether primary or secondary, that played a role in causing the accident. All the accidents are those where final investigation reports are issued.

The first step in the analysis is the collection of information available regarding the accidents like date, place, aircraft model, aircraft damage, fatalities, and phase of flight.

Next, the factors have been identified that played a major role in accidents. This focuses on identifying all the factors not only the primary factors. It includes all factors whether human, systems, environmental or any other miscellaneous factor. Human factors here refer to the organizational influences, unsafe supervision, unsafe preconditions, unsafe acts of operators (e.g. flight crew, maintainers, air traffic controllers etc.), whereas Environmental factors refer to conditions during the flight which affects the flying of aircraft. This data is then statistically analyzed and segregated into the factor branches and the conclusion has been inferred.

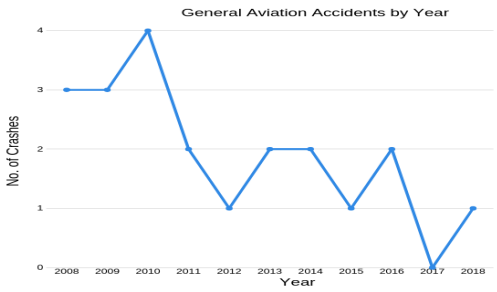


Figure 1:- No. of General Aviation Accidents by year

III. ANALYSIS

Scope

The dataset in focus by the paper consists of 21 reports incorporating fatal accidents with commercial passenger aircraft from 1st January 2008 until 1st August 2018.

The data of these accidents have been collected from the official investigation reports released by the authority in charge of the case.

A. Human Errors

Human errors are major contributors to airline accidents; they are a result of the mistakes committed by pilots, co– pilots, air – traffic controllers and/or ground controllers and they lose control of the situation.

• On 14 September 2008, A Boeing-737-505, Aeroflot–Nord Airlines Flight AFL 821 experienced a fatal crash on its way during the approach to the runway 21 at the Bolshoye Savino Airport, 23:10 hours UTC from Moscow (Sheremetyevo). The primary cause of the accident according to investigation and findings state that the crew was spatially disoriented which led to lack of control of the flight resulting in slipovers and an extreme descent.

• At 12:24 UTC on 20 August 2008; A McDonnell Douglas DC-9-82, Spannair Flight 5022 suffered an unrecoverable crash involving its McDonnell Douglas flight MD-82 resulting in 154 deaths and 18 seriously injured immediately after the crash. It departed from the El- Part Airport in Barcelona heading towards Gran Canaria Airport. The accident is attributed according to the official investigation report to the loss of control of the aircraft due to it entering stall resulting from the non – utilization of flaps and/or slats. It was the crew which failed to identify the errors in the configuration of the flight because they did not utilize the checklist according to the protocols prior to the flight.

• 2009, 12 February saw the crash of the Bombardier DHC-8-400 Colgan Air Flight 3407 which was operating between Newark, New Jersey to Buffalo, New York. At 22:17 Eastern time (UTC time, 2:17 am next day), the flight got destroyed; crew and passengers killed due to impact forces and fire resulting from the crash. The mishap is purely a flaw on the end of the captain who could not respond appropriately to the stick shaker which resulted in the aircraft going into a stall. Alongside this, the crew also could not follow the established cockpit procedures and failed to properly deal with the airspeed with respect to the increasing low-speed cue. A part of the secondary reasoning is attributed to the failure of Colgan Air to properly establish procedures for airspeeds during icing.

• On 1st June 2009, an Airbus A330-203, Air France Flight 447 crashed over the Atlantic Ocean during its journey towards Charles De Gaulle Airport, Paris from Rio de Janeiro, Brazil. All 216 on board the aircraft were killed as it crashed into the waters. Although the primary cause as stated by the official report indicates a failure of the pitot probes, a part of the cause is a result of the crew not being able to co-relate the airspeed losses with the correct procedures and lack of any action that could evade the stall, the aircraft experienced.

• On 4th November 2010, an ATR-72-212, Aero - Caribbean flight 883 crashed leaving zero survivors while on its way to the Jose Marti International Airport at Havana from the Santiago Di Cuba Airport. The crash time according to the official report was 17:51 local time, (21:51 UTC). The primary cause for the accident was meteorological conditions that hampered its flight but this was also with the inability of the pilots to manage the situation effectively and bail out the aircraft from the weather.

• 28th July 2010 saw the crash of Airbus A321-231, Airblue flight 202 which departed from the Jinnah International Airport in Karachi, Pakistan to arrive at the Benazir Bhutto International Airport in Islamabad, Pakistan. It crashed into the hills of Margalla at Islamabad while attempting to land in inclement weather. This case was a typical case of pure crew failure as they failed to heed to all established procedures with respect to visual landing, and lacked the skills to complete the landing in a volatile environment. Apart from this, the official report also stated that the behavior of the Captain towards the First Officer was harsh which resulted in the latter not establishing his initiative.

• On 12th May 2010, an Airbus 330-200 Afriqiyah Airways Flight 771 crashed during the final approach towards the Tripoli International Airport having departed from Tambo International Airport in Johannesburg, South Africa. The crew undertook a

miss – approach procedure and a go – around having informed the concerned tower. However, they failed to execute a common plan of action during such a procedure, and could not initiate proper applications of the flight controls. They could not properly analyze the flight data and neither did they heed to the instructions in the flight manual. This was linked to the lack of training of the pilots and the misinformation of the weather, according to the official investigation report.

• On 9th January 2011, A Boeing 727-286, Iran Air IR 277 crashed at 16:15 UTC while it was arriving at its destination to the Urmeya Airport from Tehran. According to the official reports, 27 people ultimately survived still resulting in 78 deaths. The official investigation report says that, the flight experienced bad weather and the pilot could not control the aircraft then. This was further traced to the instruments being obsolete and there were no simulators for pilots to train under adverse conditions. Further, the cockpit management failed to meet the required standards.

• On 8th July 2011, Boeing 727-022, The Hewa Bora Flight 952, undergoing a domestic service from the N'Djili Airport to Kisangani Bangoka International Airport experienced thunderstorms along with high speed winds. After the crash at the arrival airport, the official report and investigations revealed that the pilot was not qualified to fly the type of airplane and neither was the tower controllers licensed. This led to the transmission of incorrect information about the weather.

• Following this, on 20th April 2012, Bhoja Air Boeing 737-236A, BHO–213 crashed at Rawalpindi in Pakistan while on its journey towards the Benazir Bhutto International Airport in Islamabad from the Jinnah International Airport in Karachi. According to the official report released, both the pilots were not trained to drive the flight out of danger in wind shear and downdraft, microburst situations. Neither were they familiar with the Boeing procedures for such situations nor did they carry out the same.

• Tatarstan Airlines A Boeing 737-53A, Flight 363 underwent a crash on 17th November 2013, while it was trying to land after a go – around procedure as the pilot was unable to recover the flight from the high altitude in the nose – up configuration. The flight was servicing domestically from Moscow to Kazan in Russia and killed all the souls on board, as reported by the official investigation analysis.

• Lao Airlines ATR-72-600 crashed on October 16, 2013 on its journey from Vientiane to Pakse in Laos crashed during a go – around procedures undertaken during bad weather conditions at the arrival airport. In-spite of the rain, the pilot continued with the procedure without following the required guidelines and protocols.

• On 23rd July 2014, Transasia Airways ATR-72-212A GE222, a domestically operating flight from Kaosiyung Airport in Taiwan to Magong Airport crashed into residential buildings while it attempted to land in inclement weather. The official report revealed that the crew did not follow the runway non – precision approach instrument procedures and guidelines in conjunction with the MDA. Without utilizing any visual references, the pilot descended the flight below 330 feet.

• The LAMIA Corporation Chartered flight AVRO RJ85 on 28th November, 2016 carrying the Brazilian Football team, Chapecoense crashed into the slope of a mountain during the landing on the runway at Jose Maria Cordova International Airport and the report stated that the cause was the negligence on the part of the flight crew who knew the low levels of fuel on the flight and yet did not take any corrective measures to land for re-fueling and continuing with the flight.

B. System Errors

Systems error or flaw arising in an aircraft refers to the issue with both the navigational, aerodynamic or structural systems and sensors that can result in in-correct information to the pilot or wrong behavior of the aircraft.

• The crash of McDonnell Douglas DC-9-82(MD-82) Spannair Flight 5022 on 20th August 2008 after taking off from the run-way at the airport in Madrid was also attributed to the in-correct configuration of the slats and flaps during the procedure which system was not able to detect that led the flight into an aerodynamic stall. This resulted in the pilots not gaining control of the aircraft thereafter.

• On 1st June 2009, the AirFrance flight Airbus A330-203, AF 447, crashed during its journey from Rio de Janeiro to Paris over the waters of the Atlantic Ocean. Although the crew failed to identify the flaw correctly in the situation, the primary causes for the crash was the failure of pitot tubes to correctly measure and consistently maintain the airspeed which was followed by the pitot tubes being obstructed by ice. The official report also states that this led to the disconnection of the autopilot ultimately destabilizing the path of the flight.

• 15th July 2009 saw Caspian Airlines operating a Tupolev 154M crashed at around 16 minutes after takeoff, as reported by official agencies due to the plane going out of control because of a sudden fire in the engine. The Armenian commission set up to investigate the same reported that it was the damage of

the compressor in the first engine that initiated the destruction of all other components of that engine, thereby spreading the fire.

• On 12th May, 2010, an Airbus A330-200 Afriqiyah Airways flight 771 crashed while approaching the designated runway at the Tripoli International Airport. The pilot during the approach undertook the miss – approach procedure with complete information to the traffic control tower. But alongside, the pilot not following the correct regulations, the CRM available to the crew were insufficient mainly due to the high number of communications during the approach and the occupancy of the frequency of the towers in both the air and the ground.

• On 9th January 2011, Boeing 727-286 an Iran Air flight IR 277 crashed in the city of Urmia. Although the primary cause was the pilot losing control of the aircraft in severe icing conditions, the official investigation did reveal that the technology onboard the aircraft was outdated resulting in incorrect results.

• The Indonesia AirAsia Airbus A320-216 flight 8501 crashed at the Karimata Strait on the 28th December 2014, during its journey to Singapore from Surabaya in Indonesia. According to the official investigation report, the pilot was unable to control the aircraft after it entered an aerodynamic stall. The report also stated that the issue started with a fault in the RTLU of the aircraft or the Rudder Travel Limiter Units. A crack in the electrical connection inside the RTLU made it send caution messages four times to the ECAM. Three out of four times, the pilot addressed the issue successfully with the procedures. But the fourth warning was ignored by the pilot who instead reset the circuit breakers which were not complying with the required procedures.

• The Egypt Air Airbus A320-232 flight 804 crashed on its journey to the Cairo International Airport from Charles De Gaulle International Airport in Paris killing all the 66 souls on board, as reported in the official investigation report. The crash initiated due to the high temperature combustion at the engine which caused the fire that spread to the cockpit.

C. Environmental Issues

These issues arise from the changes in weather conditions that may prove unfavorable to the flight. The risks posed by environmental issues are high and thus, the accidents resulted from them are plenty.

• On the 4th November 2014, the Aero Carribean ATR-72-212 Flight 883 experienced severe weather conditions and had to change its altitude to FL160 because of severe icing. The weather conditions at 20,000 feet caused the plane to experience severe icing which led the sequence of the events thereafter.

• On 28th July 2010, the Airbus A321-231 Airblue Flight 202 tried to land in inclement weather, with thick fog and heavy rain which resulted in the loss of control of the aircraft resulting it the collision with the terrains.

• The crash of A Boeing 727-286 Iran Air flight IR 277 crashed while approaching to land at the Urmia Airport as the pilot decided to conduct a go – around procedure in a weather that was characterized by poor visibility due to heavy snow.

• The crash of Boeing 727-022 Hewa Bora Flight 952 at the Bangoka International Airport at Kisangani occurred during its landing attempt at weather conditions that was severely characterized by heavy rain and thus resulting in limited visibility. According to the official investigation report, the aircraft impacted the ground due to the poor visibility during the visual approach to the runway number 31.

• On 20th April 2012, Boeing 737-236A ,the Bhoja Air flight 213 crashed at Rawalpindi in Pakistan; its crash owing to the bad weather during the approach to the Islamabad Airport, its destination. Since the aircraft attempted to land in inclement weather involving heavy rains, the aircraft also experienced two down – drafts which caused wind – shear on the flight. This further resulted in the air – craft going into a stall which was not recovered by the crew.

• On 16th October 2013, the Lao Airlines ATR 72-600 crashed during approach to the Pakse International Airport in Laos when the pilot tried to land the aircraft after the second go – around procedure in heavy rains. The aircraft crashed into the ground before falling into the Mekong River.

D. Miscellaneous

All other causes of accidents apart from Human, Systems and Environmental have been grouped under miscellaneous. General conclusions cannot be drawn from such accidents as each one has a distinct cause but nevertheless solutions can be inferred to avoid such mishaps.

• The Hewa Bora Flight 952 Boeing 727-022 crash on the 8th July 2011 was also attributed according to the official investigation reports to the tower controllers not licensed according to the regulations and thus, gave wrong information of the weather.

• An Airbus A320-211 Germanwings flight 9525 crashed on 24 March 2015 around 70 miles on the northwest of Nice in France while on its way to Dusseldorf Airport in Germany from Barcelona. The

official report stated that the co-pilot has been subjected to an 'unfit for work' due to his tendency to suicide and as a result, he deliberately crashed. He was suffering from a psychological dis – order and hid this information from the employing team.

• The Sarotov Airlines Antonov An-148-100B which crashed on 11 February 2018 was primarily attributed according to the black box data obtained to the heat detection systems not being switched on by the pilot that lead to severe icing of the plane, finally bringing it to an uncontrollable state.

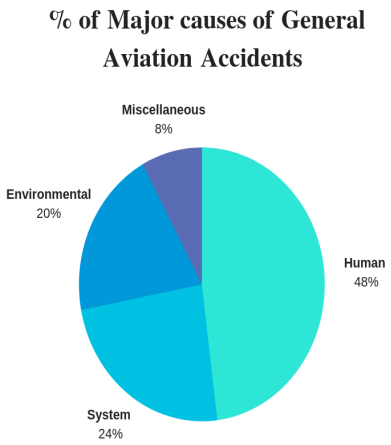


Figure 2. Representation of Accidents by causes.

IV. ACTION PLANS

E. Human Errors

It is evident from the observations above that situational loss of control for pilots is a major cause for accidents. To better equip them to handle tough situations and enable them to take correct decisions, pilots and co – pilot can be trained to fly in tough situations via simulators that create realistically challenging environments.

F. System Errors

Although a rigorous maintenance procedure is already in operation in almost all aircrafts and airports, a more specific check with certain systems which have the tendency to fail in certain recurring conditions must be checked. This could also be done by connecting all the systems and sub – systems of the aircraft to a common server which will update with the status of them. This becomes easy to analyze.

Further, pilots could be exposed to handling critical systems during the early stages of their learning, and they could be taught to mitigate the danger of critical systems being damaged during accidents and also to almost nullify the damage caused by damage to the non – critical systems.

G. Environmental Issues

Instrumental landing systems in all aircrafts must be advanced to ensure landing in conditions that do not provide appropriate visual information.

Specifically, the pilots must follow the correct procedures to land in inclement conditions.

Weather prediction systems must be enhanced at all airports so that the journey to an area of rough weather can be either delayed or avoided for the good.

H. Miscellaneous

More comprehensive background checks must be conducted with each new pilot. The check must also include psychological and emotional analysis of the crew and must be held at regular intervals throughout the tenure.

Pilots must follow a comprehensive checklist and must not always rely on their intuition while executing operations before and after a flight; this is to avoid them forgetting a task.

The license of tower controllers must be thoroughly checked so that wrong and unqualified information do not pass to the pilot. The pilots must have more knowledge about aircraft they fly regularly such that they know all the flight manuals, procedures and protocols.

II. CONCLUSION

The paper has analyzed 21 reports of fatal accidents between, 2008–2018 and by referring to the stats described by the above graphs and pie charts, the recommendations include:

- Human factors contribute to the majority of accidents. Adequate training must be provided extensively to take more number of correct decisions in tough situations.
- Human + Systems errors are the second most common occurrence. The solution for this is two – fold. One, the maintenance history of the aircraft must be considered and more emphasis must be laid on the systems which are bound to fail with more probability. Two, experienced pilots can help alleviate the issues caused by systems and bring the situation down to non – critical from critical.
- Human + Environmental errors are also a fairly common occurrence. Flights can be scheduled in a way to avoid being exposed to rough conditions and pilots who have experience flying in those can be appointed for such routes.
- Systems + Environmental causes are fairly rare and apart from doing a more thorough check on systems and environmental factors, a pilot must know proper deployment of all emergency procedures at such situations such as landing at the sea or in the nearby airport.

The significance of the report described above helps to visualize the major causes of fatal accidents involving passenger air – crafts and measures can be taken to

alleviate the same. The faults are highly evident from the reports and the report suggests that it all comes down to more extensive training of pilot, handling of systems and prediction of the environment.

The work is limited to the data collected over a 10 year period. There have been plenty of accidents before and after this bracket which could be for diverse systems. More insights on systems error could be provided by considering a larger set of accidents.

The insight this report provides makes it easy for students, researchers and, investigation agencies to find ready data for further work. As a recommendation for future work a simulator can be built using Machine Learning and Artificial Intelligence that makes the pilot adapt to situations, and for systems, the line maintenance can be more comprehensive for systems that are sensitive to pilot and environmental factors. Additionally, a central server system can provide immediate data as soon as an aircraft lands or take – off.

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