

## Analysis of factors leading to pilot error accidents in civil aviation

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### ABSTRACT

An aircraft accident may occur from one or any combination of vast number of factors. With increasing proportion of mechanical reliability, most accidents are attributable to 'Human Failure' or 'Pilot Error'. If human failure has occurred, the whole sequence leading up to the error should be explored. The office of the 'Directorate General of Civil Aviation' (DGCA) was approached and Court/Committee reports maintained by this office were studied. The epidemiological data collected from these accidents were analysed. Three (03) accidents where extraneous factors played an important role in bringing about human errors are described in this paper. In these accidents, pilot error was assigned as the primary cause, but other agents either induced or influenced this pilot error. From these accident analyses, it is demonstrated that so many interlinked factors lead to pilot error. Direct and indirect relationships between pilot and other risk parameters are analysed and projected as accident causative factors. Accident investigators should explain circumstances of individual accidents and incidents in order to extract general principles to enhance air safety. This paper emphasises the importance of minor / major risk factors and maintains proper vigilance over those possible contributors which lead to human error and crash.

IJASM 2000; 44(1) 34 - 38

KEY WORDS: Epidemiology, Pilot errors, Risk parameters

The Air Coordinating Committee (Washington DC) on accident prevention, investigation, analysis and report defines the an aircraft accident as "an occurrence during the starting, warming up or operation of the a/c which results in injury to one or more persons or in damage to the aircraft. It further goes on to define major and minor accidents differentiating them in terms of the seriousness of the injury and the amount of damage.

An accident may result from one or any combination of a vast number of factors. It is suggested that 90% of all fatal accidents in US civil aviation involve factors other than the aircraft. As

mechanical reliability improves, an increasing proportion of accidents are attributable to human failure or 'Pilot Error'. Pilot error is the commonest causative factor in civil aviation accidents. [1] However, it is the extent of the pilot error and the interaction with other variables, that are being examined here. Pilot error should be defined as an accident that has not been caused by weather, mechanical failure, ATC or biomedical factors but only by pilot's failure to fly the aircraft appropriately due to diversion of attention over trivia. Pilot error is no longer an acceptable label. If human failure

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has occurred, the whole sequence leading up to the error should be explored. Bellings et al had studied other factors that caused Human Factor accidents [2], in Civil Aviation.

### **Materials and methods**

General description of the research design: This analytical study involved a census of Civil aircraft accident during the period 1987-94. There were 32 accidents and 64 incidents during this period. The aim of this study was to obtain relevant information with reference to epidemiological profiles.

### **Cases studied**

Court/Committee and Inquiry reports maintained by the office of the Directorate General Civil Aviation were studied. The epidemiological data collected of these numerous accidents were analysed. In this study, the various factors leading to pilot error in aircraft accidents in civil aviation were looked into. However, this paper discusses 03 accidents, where extraneous factors played an important role in bringing about the human error.

### **Accident Summaries**

The first accident occurred to a Boeing 737 aircraft, which took off from Aurangabad for Bombay on 26.4.93 at 1300 hrs, with 118 persons on board [3]. The aircraft taxied, entered runway, turned right and backtracked to beginning of runway and commenced a rolling take off. It lifted at the end of 6000 ft runway and impacted with a lorry carrying cotton bales, on a high way running perpendicular outside the airport. The aircraft continued to fly, with the left landing gear liberated, went through high tension electric wire running at about 35 ft above ground level at a distance of 3 kms. The fuselage split into 2 parts

aft of wing. Cabin sections at both edges caught fire. 55 persons comprising of 2 crew members and 53 passengers died. Others escaped from the left side.

Cause of this accident was shown as pilot error. Pilot initiated late rotation following wrong rotation techniques. The factors leading to this accident were :

- a) The aircraft was overloaded by more than 2 tons.
- b) Aurangabad airport and surroundings are not properly maintained. The runway needs to be extended by a length of minimum 3000 ft.
- c) The mobile traffic on bead road during aircraft operations is not properly regulated, and this unregulated traffic is not shown in the obstruction chart.

Though, the causative factor as per this accident was pilot error, the pilot would have been forced to backtrack or initiate rotation to commence a rolling take off, due to excessive load. Or, due to shortage of runway length he was compelled to backtrack to beginning runway. Had the National Airport Authority of India (NAAI) regulated mobile traffic during aircraft operations or had this unregulated traffic shown in the obstacle chart, thus preparing the pilot for emergency, this accident might have been prevented.

The second example where pilot error was assigned as the primary cause, but other agencies induced or influenced this pilot error is the accident that occurred to Indian Airlines Boeing 737 aircraft, where the aircraft crashed into the hill near Imphal in Manipur on 16.8.91[4]. The flight had 6 crew and 63 passengers on board. It was to land at Imphal airport but crashed at Thanjing hill about 300 ft below hill peak at a distance of 2.19 nautical miles from Imphal airport.

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Crew did not follow operational flight plan. He did not go overhead Agartala but flew directly to mphal. The pilot also commenced descent nearly 10 minutes before the top of descent prescribed in operational flight plan. The reason for crash was given as pilot not adhering to operational flight path and ILS (Instrument Landing System) let down chart. Not realising that early descent to 10,000 ft and turning right for outward bound without reporting overhead, VOR would result in loss of time reference and in misplace him in hilly terrain. The sequence leading to the event would read like this :

- The weather was above weather minima for ILS approach.
- The Locator Beacon at ILS marker was not provided.
- Status Indicator lights of ILS was not functioning in the Control Tower.
- Distance Measuring Equipment (DME), which is co-located with Very High Frequency Omni Range (VOR) was not installed (NAAI had provided the same).
- No equipment for Runway Visual Range (RVR) was provided, this equipment is very vital to pilots for instrument approach.
- ATC multi channel tape recorder not installed (though procured by NAAI in 1983). Since no ATC tape was available, monitoring the ATC officer was difficult.
- ATCO did not have sufficient familiarisation with flights and also he was not formally rated by NAAI.
- Neither refresher courses nor proper licensing of ATC officers effected.
- The aerodrome was also not licensed.
- There were no maintenance schedules for ground navigation, communication and landing aids.

- Aircraft was not on localiser or glide path.
- No emergency condition was communicated by crew.
- Ground Proximity Warning System (GPWS) came on about 6 seconds prior to crash but it was not possible to clear the hill.

From this accident it is very clear that there were many interlinked factors that led to the pilot error accident. Most obvious ones were the unserviceability of the landing instruments and the incompetence of the ATCO.

To complete the narration of these leading factors, I would like to mention one as other accident due to changes brought about by automation in the cockpit and the errors that accompany these changes. It was an Indian Airlines Air bus 320 aircraft that had a crash landing at Bangalore in February 90.

The aircraft took off from Bombay at 1159 hrs on 14.2.90 with 146 persons on board [5]. The flight was uneventful till few seconds prior to landing. At 1302 hrs, the aircraft first contacted ground at Karnataka Golf Association in Bangalore about 2300 ft short of runway beginning. The aircraft went up in the air and again contacted ground on all three gears at the 17th green. Fuselage and the disintegrating wing flew over the road near by, came to rest on marshy area outside boundary wall of airport. Aircraft was destroyed due to impact and fire. The front portion caught fire and passengers escaped through rear left door. However, there were 94 fatalities. Findings included the following :

Weather was clear.

Landing procedures were completed but go around altitude was not set. Aircraft was slightly higher with higher speed when landing clearance was given, but came to proper profile for approach to land.

After the first impact aircraft started coming down below profile. When the side stick control was pulled off to pitch up the nose to arrest sink rate, aircraft entered alpha protection zone, (alpha floor is activated with side stick movement to full back position).

Alpha functioning is meant for protection against wind sheer but pilots thought it was to increase the power of engines in emergency. Alpha floor is a self activating system.

CVR (Cockpit Voice Recorder) and FDR (Flight Data Recorder) revealed that 38-40 seconds prior to the impact, the aircraft was in proper auto thrust speed mode. Then it went into idle/open descent mode (not known what the pilot did) with aircraft altitude less than 400 ft. above ground level.

Aircraft could not sustain the height and speed because of fixed idle thrust in idle/open descent mode. Pilot did not realise the gravity of the situation, the throttle movement was done too late and the aircraft crashed. The sequence that led to this pilot error would summarise like this.

The pilot had occupied left hand seat after more than 2 months of operating right hand seat without simulator or aircraft training.

Power awareness is deficient in A320 when auto thrust is active.

There is no warning when auto thrust brings thrust to idle.

Idle/open descent mode, which is an emergency configuration, is indicated in 'green' and not 'red'.

Movement of one side stick control is not reflected on the other.

When auto thrust is active, static thrust levers remove the feel of thrust lever movement.

Idle/open descent mode emergency is not a part of simulator profile training.

Indian pilots of Boeing 737 fly with basic Auto pilot and Flight Director System. It has no Auto Throttle System. There are vast differences in the panel of both aircrafts, any movement of one control in Boeing is reflected on the other pilot's control column. For conversion to A 320, 100 hrs of co-pilot experience and 10 mandatory route checks are required. Both pilots had only 28 hrs of simulator training. Commander of this aircraft had only 68 hrs of co-pilot training and only 03 route checks.

It could be argued that the crash could have happened just as easily on non-automated equipment. In most routine flights, these differences may not be significant, but it is in the emergency situation when actions are required to be smooth and rational, the crew member will revert to action sequences that are not always relevant [6, 7]. The automated flight deck changes the nature of the pilot's relationship with the machine in special ways. The system may have become so complex that the pilot cannot understand without proper training, how it works but believe what the screen says. Too often accidents are pigeon holed under such factors as 'weather', 'aircraft failure' or 'pilot error'. It is not surprising therefore, to find accidents involving other factors like poor planning/training or co-ordination.

It is upto accident investigators not just to comment on or to explain the circumstances of

individual accidents, but to put together information from so many accidents and incidents as possible, in order to extract general principles. The interesting combination of direct and indirect relationships between pilot and associated risk parameters should be analysed and projected as causative factors. It is not sufficient to know what happened and when but it is the task of the Human Factor group to establish, why. Changes in our concept and practice can elevate air safety.

In depth analysis of incidents is a precursor to accident prevention. To achieve this, we must look into existing ordinary data for extraordinary collaborative purposes. The benefit of regularly reviewing ordinary data from accident/incident reports is subtle but extremely important for the safety of air passengers of the future. The advantage of this data corroboration has the potential to grow, if the Airline industry and Aviation authorities have formal data sharing with research workers.

As can be seen from these accidents, agencies other than the pilot can play a vital role. These extraneous factors must be properly documented and studied as causative factors leading to human error and crash. Accident prevention starts with studying all minor/major risk

parameters in depth and maintaining proper vigilance over those possible contributors. Human failure or pilot error is an old concept but other factors, which very well result in precipitous action that lead to an accident are more crucial for analysis. We can then hope to practice air safety more effectively and serve the pilots and public as better Aviation Medical specialists.

#### References :

1. Hemming FO. Aircraft accidents and human factors. *Aerospace Med.* 44:682, 1973.
2. Charles E Bellings and William D Keynard. Human Factors in Aircraft Incidents: Results of a 7 year study. *Aviat. Space Environ. Med.* 55:960-969, 1984.
3. Mohita VA. Court of Inquiry Report: Indian Airlines Boeing 737 aircraft VT-ECQ at Aurangabad on 26th April 93.
4. Sawant PB. Court of Inquiry Report: Indian Airlines Boeing 737 aircraft VT-EPL at Imphal on 16th August 91.
5. Shivshankar Bhat. Court of Inquiry Report. Indian Airlines Airbus-320 aircraft VT-EPN at Bangalore on 14th February 90.
6. Murphy MR. Analysis of eighty-four commercial aviation incidents: Implications for a resource management approach to crew training. *Proc. Annual Reliability and Maintainability Symposium*, 1980.
7. Costin R. General accidents. An epidemiological approach. 34th Scientific meeting. *Aerospace Medical Association* 1963.