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Report for 1MD017

Accident Investigation Report

Group 09

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1 Background

In this modern world, many accidents do happen but you seldom hear that the object has disappeared. The Air France flight 447, took off from Rio de Janeiro Galeão airport, Brazil on 31st May 2009 with 228 passengers and crew on board. The flight was expected to land at Paris Charles de Gaulle airport in about 11 hours. Unfortunately, flight 447 crashed after 3 hours. At that time it was the greatest mysteries in the modern aviation world because when the flight crashed, the modern technical gadgets were unable to locate the flight location. It took another 5 days to find out the location of the wreckage and the debris. Out of 228 victims, only 50 bodies were recovered. A crucial part that helps to figure out the cause of the accident i.e. black box was found after 2 years of the accident. After the crash, the investigation team was ordered to find out the exact cause of the accident which consisted of experienced test pilots, atmospheric scientists, structural engineers, air accident experts etc. The investigation team found out that after 3 hours of flight, at 1:35 am pilot made a routine call to ATC in Brazil and reported the position and altitude of the aircraft which was 350 miles away from the coast of Brazil, this was the last message received from the AF 447. At this time the aircraft was going to shift the contact from Brazil ATC to Africa ATC. The Brazil ATC, at 1:36 am tried to confirm from AF 447 that when it's going to handover communication to Africa ATC but never received a reply. At 1:48 am the flight disappeared from Brazil's ATC radar screen and the flight was never picked up by Africa's ATC radars. At the same time, the flight AF 447 was in the vicinity of the thunderstorm, but the flight's weather radar was failed to detect that the flight is going to enter a larger thunderstorm. At 14:10 flight's autopilot mode turned off, due to pitot tubes blockage by the ice crystals. After a few moments, the flight crashed into the Atlantic Ocean.

2 Review of the authors' statements and conclusions about the accident

The investigation report "Bureau d'Enquˆetes et d'Analyses (BEA)" published after the Air Crash Accident of flight AF-447 describes in detail the succession of events and the factors involved in it which caused the horrible accident to happen. According to authors, some of those factors which contributed the most in the succession of events that lead to the accident are briefly discussed below.

The first and foremost was the obstruction of pitot tubes by ice crystals which caused inconsistency in airspeed due to which autopilot stopped functioning and turned off.

Another fact was the unresponsive behaviour of the Captain when the plane was entering into the Inter-Tropical Convergence Zone (ITCZ). The PF (Pilot Flying) raised several concerns and suggested some alternates to avoid ITCZ but Captain didn't respond with clear decisions, strategy or any recommendations.

The Captain seemed not worried about the ITCZ zone and worst he decided to rest during this critical phase of the flight. Normally, all crew members are expected to be attentive while crossing ITCZ due to the dynamic conditions and uncertainty involved. If the Captain would have stayed during this phase, things might be different and chances of the plane would have become much less.

It is also discussed that the captain's choice of time was understandable up to some extent as the fact that ITCZ most certainly seemed normal to him and the co-pilot was experienced but captain didn't appoint anyone as a responsible relief captain after him before going to rest, leaving the flight management at risk as the non-flying pilot was more experienced than pilot flying.

In the investigation report, point is raised concerning the pilots training, as it was not enough to deal with this sort of situation. The pilots had not been properly trained to capture STALL-warnings. The pilots were not exposed to deal with such situations at high-altitude during their training. Not only this but more worst was that the Captain didn't gave any specific instructions about crossing ITCZ to lack of trained PF and PNF before leaving. (Final Report by BEA, pg 167-169) [1].

Authors has discussed the communication gap between PF and PNF which resulted as a failure of making a joint action plan. Considering the factors that there was no reliable speed indication due to the blockage of pitot tubes and pilots was also inexperienced to fly at high-altitude, there should have been a joint action plan to take the flight out of risk.

According to authors, ergonomics also played a major role in creating confusions for crew members to understand the situation, as after the auto-pilot's failure, ECAM was also failed to show failure message indicating air-speed detection, then the instantaneous occurrence of warnings made them clueless about the actual situation. Moreover, the pilots were failed to identify various aural warnings which was another contributing factor in the failure of identification of actual situation.

Generally, turbulence can cause discomfort or injuries to the crew or passengers and thus is avoided by deviating the flight path.

The BEA investigation report mostly focuses on human factors involved in occurrence of the accident. All the succession of events described, and the factors mentioned by the authors are summarized at the end of the report. Among these factors, the most basic was the failure of identifying the loss of air speed information due to poor feedback mechanism. Another major factor was the captain's negligence in the situation which resulted in poor management in the high-risk situation and the pilots' incapability to deal with the situation. Lack of trained professionals was also a key factor in the incident leaving the flight in more danger. Then the factors like not taking STALL-warnings into account, pilots' inability to identify various aural warnings and no visual warning regarding the loss of air-speed information causing confusion for pilots to identify actual speed of the plane added fuel to the problem which ultimately caused

the horrible accident to happen.

3 Our own analysis about the accident

How can the pilot behaviours and errors be explained? During the accident, it is evident that confusion in cockpit was among the contributing factors as Pilots due to their lack of experience and training were not able to understand the situation and react accordingly. It was obvious that there was a communication breakdown between human crew and the system. As mentioned in the accident report, few causes were; the crew's failure in identifying the approach to stall, to diagnose the stall situation and their lack of immediate response. All of which speak volumes about the state of interaction between humans and complex systems in a stressful environment (Vicente, 2004, Part 1) [2]. The combination of too much technology in the cockpit, the complicated task and the short response-time confused and overwhelmed the pilots, hence the critical chain of events. The deteriorating situation made them react and tackle the problem individually. Consequently breaking communication between the two pilots and making it impossible to recover. After listening to the black-box, the first mistake was perpetrated by the captain himself when he decided to take a break just before 'the main event' a crucial part of the Journey well known to aviation. Followed by the less experienced co-pilot who takes control and within minutes fails to understand and diagnose the flow of events. The situations further deteriorate when co-pilots Robert and Bunin both take control simultaneously unknowingly leading to the disastrous consequences. Although technology proved to be unreliable at that point, it was ultimately the human crew who failed to make sense of the events. The human error discussed before was the determining factor; multiple errors and violation of rules were indisputable.There was also a systematic migration of organizational behavior towards the accident under the extreme influence of pressure (Rasmussen and Svedung 2000, Pg 13-15) [3]. To date, no expert understands the actions of co-pilot Bunin who continuously pulled up the stick causing the plane to stall despite the numerous warnings.The pilots ignored vital operational procedures, they should have turned off the flight director as soon as they lost their speed readings but they did not. This new advanced modern technology makes it simple to fly but they are rather complex for humans. It is therefore necessarily required to train pilots specifically to handle these sort of situations, and let them acquire skills needed to fly modern planes.

What role do the technical systems play? The whole situation started with a failure of the system : the pitot tubes getting blocked and conflicting airspeed indicators shown to the pilots. It can be argued that there was a system in place that resulted in the auto pilot turning off and handing control of the plane to the pilots and the pilots had to keep things in control. Although the captain was resting and PF was not as experienced, the system should have given better feedback so that even an experienced pilot could have avoided the disaster. Rasmussen and Svendung say "Even when decision-makers have

the necessary information and competence their risk management will not be effective if they are not aware of the need to consider the potential risk involved in their decisions" (Rasmussen and Svedung 2000, Pg 50) [3] and the systems in this case failed to effectively deliver the feedback on the pilot inputs to the pilots, that would have led to them having a better situational awareness. One of the causes of the accident was the fact that there was a communication gap between the PN and PNF. In this case, the system also failed to make up for this lack of effective verbal communication. The PNF did not have any idea what inputs the PF was giving to the system i.e placing the plane in a nose up position. If the PNF would have known that through the system displaying that to him or through physical stimulus such as the PNF's sidestick moving to reflect the input given by the PF (on many airplanes when one pilot moves his stick, the other pilots stick moves as well but not on Airbus and this particular plane), then he could have taken corrective action sooner. Another system fault was the fact that the plane was not able to connect to the ATC in Africa. If the connection was there, the ATC could have informed the pilots that the aircraft was descending and the problem could have diagnosed.

What can be done in order to avoid a similar accident? It was recommended in the French investigation that pilots need additional training to fly all modern fleet of aircraft. A major concern in the industry that has come with the new wave of modern technology, is the fact that many pilots are now using automatics, and therefore in the long run they can have their manual flying skills degraded. One could argue that all three of the pilots are to take full blame for the incident, which surely could be true, however, could, for example, the design of the cockpit have hindered the pilot not flying to notice that the side-stick was held back by the pilot flying which put the airplane in a nose up position. The fact the pilot not flying was made aware of this issue 40 seconds before the plane hit the water, rendered his knowledge useless because he did not have enough time or air-height to perform the action needed to save the plane from crashing. Since the airplane in question was manufactured by the Airbus, and their cockpit design does not use a joke, like their competitor Boeing. The plane had something called a side-stick as highlighted in the image below.

Figure 1: Photo of a Airbus cockpit, with the side-sticks highlighted.

The Boeing design with a joke is shown below, the joke design Boeing uses are mechanically connected, which means that actions taken by the pilot flying are represented exactly the same on the joke in front of the pilot not flying since they move in unison. Having this advantage could have lead to the pilot not flying noticing that the plane was put in a nose up position. Would it have

made a difference? Perhaps, but it still only speculations, however, the pilot not flying would have been aware of the plane being in the nose up position from the beginning.

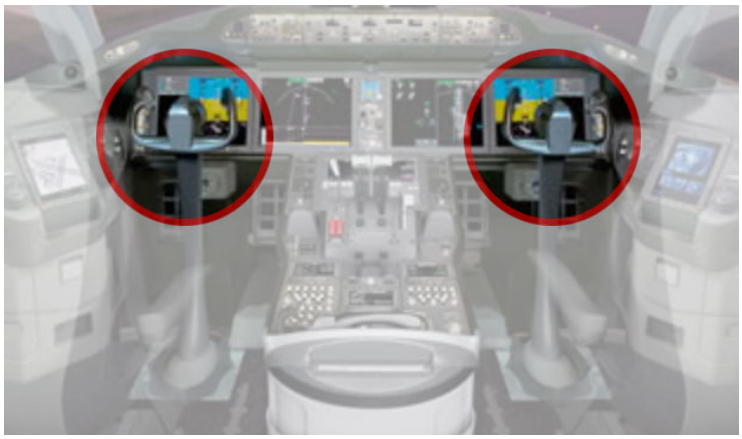

Figure 2: Photo of the Boeing cockpit with the jokes highlighted.

So what can be said about the accident? Well, there are a lot of decisions made by all three pilots that can be questioned, why was the senior captain on break while the plane was crossing the ITCZ? When he in hindsight had no business leaving the other two pilots at that time. Also, why did the pilot with the least amount of experience take control over the plane when the autopilot disengaged? Many questions can be raised by the actions taken by the pilots, sadly not many can be answered.

References

[1] BEA, 2012, "Final Investigation Report: Flight AF-447".

[2] K.vicente, 2004, "A threat to our quality of life: Technology beyond our control", The Human Factors part 1.

[3] J. Rasmussen and I. Svedung, 2000, "Risk management in a dynamic society", Proactive Risk Management in a Dynamic Society, 1st Edition, pg: 10-14, Karlstad, Sweden.