Crash of American Airlines Boeing

[December 29, 1995, mountainous terrain near the Cali Airport, Colombia]

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When a crewmember of American Airlines Flight 695 changed an approach course to an airport in order to recover from a delay in the schedule, he input only “R” instead of “ROZO” in the computer. The computer interpreted it as an input cord of "ROMEO" of Bogotá, Columbia beginning with "R" in the same way. The crew entrusted the computer to make a course change without noticing the mistake. The airplane swerved off the original course and crashed into mountainous terrain near Cali, Columbia. 159 out of 163 crew and passengers died.

1. Event

On December 20, 1995 at about 9:45 p.m. (US Eastern Standard Time), American Airlines Boeing 757 (figure 1), flight 965, from Miami, Florida to Cali, Colombia hit the west slope of a mountain at about 8,900 feet Near Cali and crashed into the West slope near the peak of the mountain. In this accident, 159 people died and 4 people were seriously injured. Among the 163 in total were 2 flight crews, 6 flight attendants and 155 passengers.

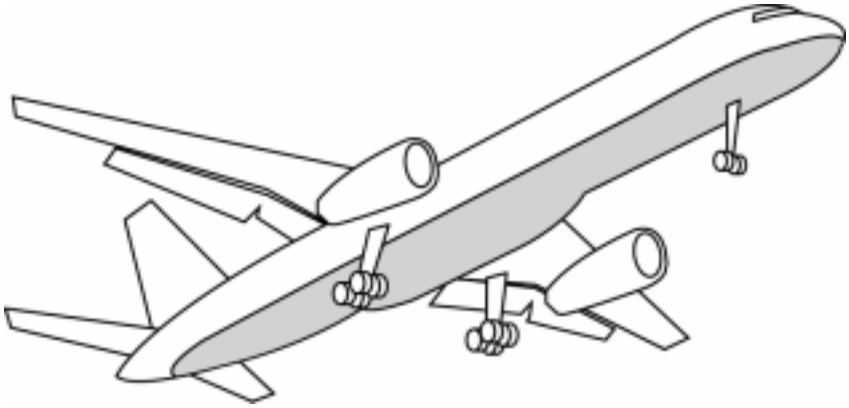

Figure 1. Boeing 757 Model

2. Course

On December 20, 1995, airplanes of Miami airport arrival services from the northeast district were behind schedule due to bad winter weather in the Northeast of America. American Airlines Boeing 757-223 (N651AA) flight 965 waited at Miami Airport for transit passengers from the Northeast region.

The plane left Miami Airport at 18:35 (US Eastern Standard Time), two hours

behind schedule, and was scheduled to arrive at Cali Airport about 21:45.

At about 19:36, the controller advised the flight crew to take the shortest approach route (ROZO One approach route) to Cali for landing. Flight 695 was traveling two hours behind schedule and the crew decided to change its route to the shortest approach route at about 19:37 to recover some of the delay.

The normal approach route to Cali flies the plane from Tulua VOR (note 1), about 57km north of Cali (Alfonso Bonilla Aragon) Airport, towards Cali VOR, about 14km south of Cali Airport, and lands it at Cali Airport by curling North, however, it could alternate to pass ROZO VOR about 17km north of the Cali Airport and directly land at Cali Airport from Tulua VOR by the ROZO One approach route. Flight 695 decided to take the ROZO One approach route from Tulua VOR, but decided to go directly to ROZO VOR because it had already passed Tulua VOR. In the course of changing the route, a crewmember input “R”, for ROZO VOR (ROZO), which was a waypoint of the route after the change, into the FMS (a flight control unit). Then flight 695 deviated to left from the course and was lost in the Andes. The captain who noticed that the course deviated to the left told the copilot to turn right, but the plane had already strayed into the mountainous terrain and GPWS (note 2) began to sound about 1 minute later. The sound of GPWS upset the crew who tried to gain elevation without closing the flight flaps that were activated for a nosedive landing. Although the crew increased the engine power to maximum, the plane crashed while grazing the mountaintop without rising (cf. figure 2).

Radio communication was lost after the crew last requested the Cali Airport for landing approach.

The plane crashed in near the mountaintop 33 miles northeast from Cali VOR. It was 10 miles away from the usual course, and at an altitude of 8,900 feet (altitude of Cali is 3,153 feet).

Eyewitness residing in the mountainous terrain described the accident “The airplane collided with the hillside and went up in huge flames.”

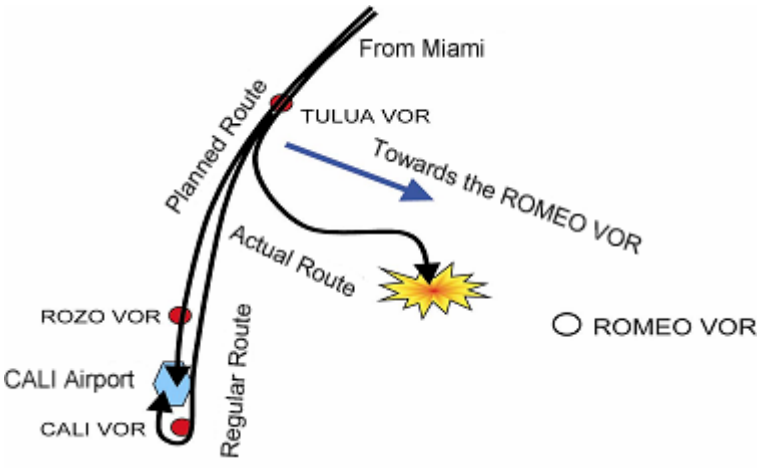

Figure 2. the planned course and actual course of AA Flight 695

Note 1) VOR (VHF Omni-directional Range)
The VOR station sends a signal of frequency 108.0 to 117.95 MHz, and a plane can determine the correct course from the VOR station in a resolution of one-degree.

Note 2) GPWS (Ground Proximity Warning System)
If a plane, or a helicopter appears headed for impact into the ground or structure, it gives an alert signal that for the human sight and hearing. With a database of all topography and structures in the world, it works based on a flight course in conjunction with sensors and GPS.

3. Cause

When a crewmember changed the approach course to the airport to regain a delay in schedule, he input only “R” instead of “ROZO on a computer.

The FMS misjudged the R with instruction to go to the capital Bogotá that had higher frequency of use than that of ROZO (FMS was programmed to choose a course of higher frequency of use when there were other way points that had the same initial nearby).

Because the crew completely depended the course change on the computer without noticing the choice of FMS and did not attempt to grasp the position by themselves, the airplane continued its descent. Due to the steep topography of the Andes around Cali, when the airplane missed the proper course and turned, it crashed into the mountains in the suburbs of Cali.

Honeywell Air Transport Systems Co. delivered the flight system of the plane, and Jeppesen Sanderson Co. was in charge of the software. 11 months before the accident, an internal memo of Jeppesen was discovered, "It could cause a large incident if these problems in the flight support system are left unresolved. They must meet customer needs by all means, now.”

According to the record of Jeppesen, 95 out of 8,000 radio signal lamps worldwide were not registered in the database, and the ROZO with low frequency was recorded in a different file in the computer.

Meanwhile, during a further lawsuit, American Airlines sued both Jeppesen and Honeywell claiming they were partially responsible for the compensation and damages paid to victims because of the problem with the computer on the plane. The final judgment held American Airlines 75% responsible, Honeywell 17%, and Jeppesen 8%.

4. Immediate Action

Immediately after the accident, people were urgently dispatched from American Airlines, the Federal Traffic Safety Board (FTSB), Federal Aviation Administration

(FAA), and Boeing the plane manufacturer.

5. Summary

This case is an example of a computer software specification intended for better human interface turning around and causing an accident. The event was a big wake up call not to put too much confidence in the computer for the modern society that is starting to fully immerse itself into the computerized society.

6. Knowledge

(1) People can fall into a pitfall if they try a shortcut without confirming the situation.
(2) A program may lack safety if it is made only for convenience.
(3) Human knowledge and concentration should provide safety instead of relying solely on the computer.
(4) An unexpected danger hides behind changing the usual routine.

7. Background

The accident airplane, Boeing-757, was a so-called "glass cockpit" type, which was the first commercial plane with autopilot. The "glass cockpit" has CRT and LCD displays for its instrumentation instead of analog meters.

This type of airplanes carries a computer called FMS, whose monitor displays navigation data, system monitors, and the flight route. FMS automatically steers the plane to the aimed route when a pilot inputs the route into the CDU from the console; it was a breakthrough airplane required only two pilots (operable from either seat) to fly.