

# DFMA & PFMA still didn't stop this happening! What has happened to common sense?

## Boeing believed a 737 Max warning light was standard. It wasn't

New York Times, 6 May, 2019

Confusion inside Boeing about features related to a new software system underline the flawed design and rollout of the company's troubled new jet.

When Boeing began delivering its 737 Max to customers in 2017, the company believed that a key cockpit warning light was a standard feature in all the new jets.

But months after the planes were flying, company engineers realised that the warning light worked only on planes whose customers had bought a different, optional indicator.



In essence, that meant a safety feature that Boeing thought was standard was actually a premium add-on.

Boeing detailed its initial confusion about the warning light in a statement released Sunday, adding new details to what was already known about the flawed design and introduction of the 737 Max, its best-selling jetliner.

The initial lack of knowledge about the feature's functionality, along with the delayed disclosure, add to the concern about Boeing's management of the Max's design. The revelations add to Boeing's mounting problems, which include frayed relations with airlines and customers, multiple federal investigations, growing financial costs and the remaining work to get the Max flying again.

The warning light notifies pilots of a disagreement in the sensors that measure which direction the plane is pointed, a potential sign of a malfunction. This light could have provided critical information to the pilots on two flights that crashed shortly after takeoff in recent months.

In both doomed flights — Lion Air Flight 610 and Ethiopian Airlines Flight 302 — preliminary investigations suggest there were problems with these angle of attack sensors early in the flights, activating new anti-stall software that sent the planes into unrecoverable nose-dives.

But the disagree alert worked only on planes with an optional indicator that displays the readings from the angle of attack sensors, Boeing said Sunday.

Because only 20 per cent of customers had purchased the optional indicator, the warning light was not working on most of Boeing's new jets. Neither Lion Air nor Ethiopian had the indicator.

After discovering the lapse in 2017, Boeing performed an internal review and determined that the lack of a working warning light "did not adversely impact airplane safety or operation," it said in its statement.

As a result, Boeing said it did not inform airlines or the Federal Aviation Administration about the mistake for a year.

Only after the crash of Lion Air Flight 610 in October did Boeing discuss the matter with the FAA. The company then conducted another review and again found the missing alert did not pose a safety threat, and told the FAA as much.

Boeing and the FAA put out public updates late last year that described the warning light as available only if the optional indicator had been purchased as well.

But neither statement made it clear that Boeing had intended for the disagree alert to be standard in all planes.

The FAA said Sunday that Boeing briefed it on the confusion in November, and that it deemed the issue to be "low risk."

"However, Boeing's timely or earlier communication with the operators would have helped to reduce or eliminate possible confusion," the FAA said.

The anti-stall system, created to compensate for the Max's large new engines, will push down the nose of the plane if the angle of attack sensors indicate the plane is dangerously close to stalling.

But the system relied on only one of the two angle of attack sensors, introducing a potential single point of failure into a critical flight system. And the anti-stall system was also changed late in the design process to make it much more powerful.

Airlines and pilots were not informed about the system until the Lion Air crash.

When Boeing explained to pilots in one meeting how systems on the Max worked, the company said the disagree alert would function on the ground. In the late November meeting, Boeing told pilots for American Airlines (which had bought the add-on) that their disagree alert would have notified them of problems before takeoff.

"We were told that if the AOA vane, like on Lion Air, was in a massive difference, we would receive an alert on the ground and therefore not even take off," said Dennis Tajer, a spokesman for the union representing American Airlines pilots. "That gave us additional confidence in continuing to fly that aircraft."

But in the last several weeks, Boeing has been saying something different. Tajer said the company recently told American pilots that the system would not alert pilots about any sensor disagreement until the aircraft is 400 feet above the ground.

A Boeing spokesman confirmed this, stressing that the disagree alert does not work on the ground, and thus could not have alerted the Lion Air pilots to a faulty sensor before takeoff.

Tajer said Boeing seemed to have "provided information that was not accurate" and said the pilots have asked for clarification from the company.

Tajer, who is also a 737 pilot, said he was concerned that Boeing did not seem to fully grasp how every aspect of the Max worked.

"You better start knowing things about the airplane you're building and selling because my life and the passengers that I carry safely across the globe depends on it," Tajer said.

The Lion Air crash also spurred Boeing to notify Southwest pilots about the disagree light. "We thought it worked," said Jon Weeks, president of the Southwest Pilots' Association. "If they knew it in 2017, why did we get to nearly the end of 2018 until the manual was changed?"

In the months after the Lion Air crash, Boeing quietly worked to appease some customers, according to a person briefed on the matter. In several instances, it activated the angle of attack indicator for free, which then turned on the disagree alert.

The 737 Max has been grounded for more than a month, after the Ethiopian Airlines crash. Boeing is working on a software fix that it plans to submit to the FAA soon, in hopes that the Max can return to flight this summer. The update will make the anti-stall system less powerful and reliant on both sensors.

Boeing is also developing a separate software update that will unlink the disagree alert from the angle of attack indicators, which will also be installed before the Max can fly again.

## **Before Ethiopian crash, Boeing resisted pilots' calls for aggressive steps on 737 Max,** 15 May, 2019,

Weeks after the first fatal crash of the 737 Max, pilots from American Airlines pressed Boeing executives to work urgently on a fix. In a closed-door meeting, they even argued that Boeing should push authorities to take an emergency measure that would likely result in the grounding of the Max.

The Boeing executives resisted.

Mike Sinnett, a vice president at Boeing, acknowledged that the manufacturer was assessing potential design flaws with the plane, including new anti-stall software. But he balked at taking a more aggressive approach, saying it was not yet clear that the new system was to blame for the Lion Air crash, which killed 189 people.

"No one has yet to conclude that the sole cause of this was this function on the airplane," Sinnett said, according to a recording of the November 27 meeting reviewed by The New York Times.

Less than four months later, an Ethiopian Airlines flight crashed, killing all 157 people on board. The flawed anti-stall system played a role in both disasters.

Boeing is facing intense scrutiny for the design and certification of the Max, as well as for its response to the two crashes. There are multiple investigations into the development of the Max. And in recent days, pilots from American Airlines and Southwest Airlines have received federal grand jury subpoenas for any documents related to Boeing's communications about the jet, according to three people with knowledge of the matter.

The Federal Aviation Administration is also under fire for its role in approving the Max, and its decision to wait for days after the second crash to ground the plane. At a Wednesday congressional hearing, lawmakers will grill federal regulators about how the Max was certified.

Boeing declined to comment on the November meeting. "We are focused on working with pilots, airlines and global regulators to certify the updates on the Max and provide additional training and education to safely return the planes to flight," the company said in a statement.

American Airlines said in a statement that it was "confident that the impending software updates, along with the new training elements Boeing is developing for the Max, will lead to re-certification of the aircraft soon."

The hour long November meeting, inside a windowless conference room at the Fort Worth headquarters of the American Airlines pilots' union, was confrontational at times. At the table was Sinnett, along with Craig Bomben, a top Boeing test pilot, and one of the company's senior lobbyists, John Moloney. They faced several union leaders, many of them angry at the company.



Debris lays piled up just outside the impact crater after being gathered by workers during the continuing recovery efforts at the crash site of Ethiopian Airlines flight. Photo / Getty Images

Michael Michaelis, an American pilot, argued that Boeing should push the FAA to issue what is known as an emergency airworthiness directive.

The FAA had already issued one directive after the Lion Air crash, instructing airlines to revise their flight manuals to include information on how to respond to a malfunction of the anti-stall system

known as MCAS. But Michaelis pushed Boeing to consider calling for an additional one to update the software.

Such a procedure would have required Boeing and airlines in the United States to take immediate action to ensure the safety of the Max, and would have likely taken the jet out of service temporarily.

"My question to you, as Boeing, is why wouldn't you say this is the smartest thing to do?" Michaelis said. "Say we're going to do everything we can to protect that traveling public in accordance with what our pilots unions are telling us."

Sinnett did not budge, saying that it remained unclear that the new software, which automatically pushes the plane's nose down, was responsible for the Lion Air crash. He added that he felt confident that pilots had adequate training to deal with a problem, especially now that pilots — who were not initially informed about the new system — were aware of it.

"You've got to understand that our commitment to safety is as great as yours," Sinnett said in the meeting. "The worst thing that can ever happen is a tragedy like this, and the even worse thing would be another one."

The pilots expressed frustration that Boeing did not inform them about the new software on the plane until after the Lion Air crash.

"These guys didn't even know the damn system was on the airplane, nor did anybody else," said Michaelis, the union's head of safety.

Another American pilot, Todd Wissing, expressed frustration that no mention of the system had been included in the training manual for the 737 Max.

"I would think that there would be a priority of putting explanations of things that could kill you," Wissing said.

Mike Sinnett, Boeing's Vice President, balked at taking a more aggressive approach to the issues with the 737 Max during a meeting with American Airline pilots in November. Photo / AP

The Boeing executives, Sinnett and Bomben, explained that the company did not believe that pilots needed to know about the software, because they were already trained to deal with scenarios like the one on the doomed Lion Air flight. All pilots are expected to know how to take control of



an aircraft when the plane's tail begins moving in an uncontrolled way because of a malfunction, nudging the aircraft toward the ground.

"The assumption is that the flight crews have been trained," Sinnett said in the meeting. He added later: "Rightly or wrongly, that was the design criteria and that's how the airplane was certified with the system and pilot working together."

When the pilots pressed Boeing to consider encouraging the FAA to issue an emergency airworthiness directive, Sinnett made the case against moving too quickly.

"We don't want to rush and do a crappy job of fixing the right things and we also don't want to fix the wrong things," Sinnett said, later adding, "For flight-critical software, I don't think you want us to rush, rush it faster."

Sinnett acknowledged that the company was looking into potential mistakes in the design of the jet.

"One of the questions will be, is our design assumption wrong?" Sinnett said. "We're going through that whole thought process of, were our assumptions really even valid when we did this?"

But he remained steadfast that pilots should know how to handle a malfunction of the new software on the plane, given their existing training.

As the meeting was concluding, Dennis Tajer, spokesman for the union, asked the Boeing executives whether they were still confident in the Max.

"Do you feel comfortable that the situation is under control today, before any software fix is implemented?" he asked.

Sinnett replied immediately: "Absolutely."