

**Paper 2**  
**ENMG 656: Engineering Law and Ethics**  
**Case Study:**  
**Boeing 737 Max Problem**

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**Introduction:**

Boeing 737 Max was labelled as a failure. Why? The Boeing 737 Max is a series of planes which are involved in multiple crashes. The crashes took the lives of numerous people. Undoubtedly, one of the major issues confronting the aviation industry. The Boeing 737 Max 8 and 9 were the versions that had been involved in the crashes. A total of 346 individuals tragically lost their lives because of the crashes. All 189 passengers and crew members perished in the first tragedy, which occurred in October 2018 when Lion Air Flight 610 crashed just 13 minutes after takeoff. Following that, Ethiopian Airlines Flight 302 crashed in March 2019, killing the lives of an additional 157 travelers. The US government immediately issued a grounding order on all Boeing 737 MAX airplanes after the second tragic event. [1] Many families and the media were left grieving after this event took place where many families were torn apart. The main reason that led to this is said to be that both crashes were linked to design faults. Investigations into both crashes determined that Boeing and the favored cost-saving solutions, which ultimately produced a flawed design. (Isabel Togoh (2019)) This incident gives us an alarming indicator and sobering awareness of the many challenges confronting the aviation industry to emphasize safety in all aspects of aircraft design, maintenance as well as production.

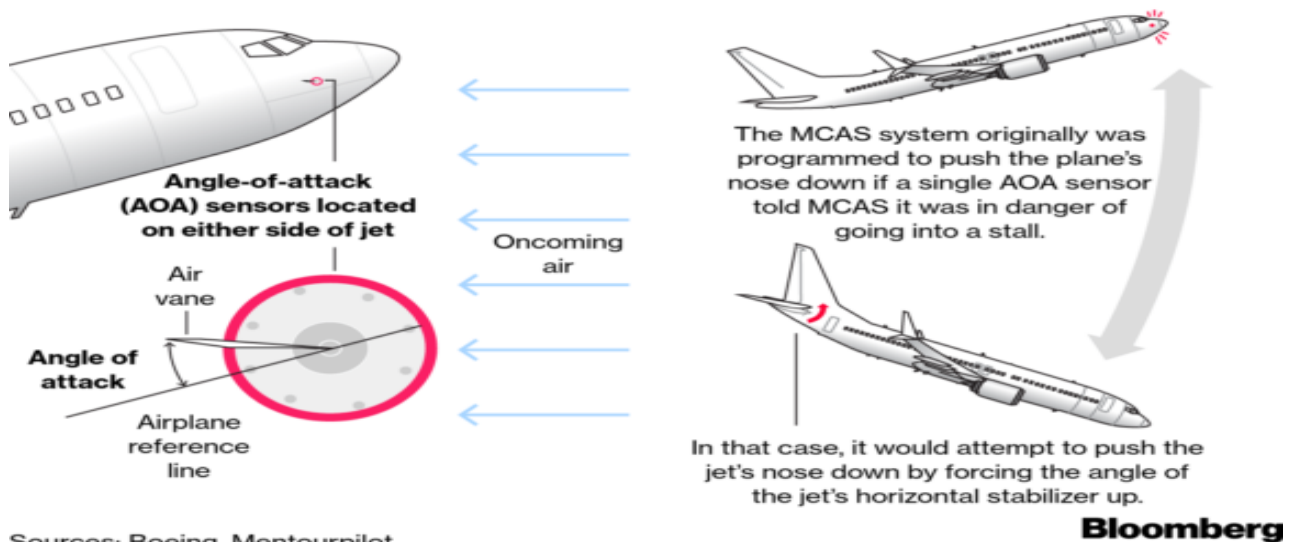
**Technical Issues:**

The main technical issue in the Boeing 737 Max was related to the MCAS - its Maneuvering Characteristics Augmentation System. Boeing unveiled the Maneuvering Characteristics Augmentation System (MCAS), a software solution. A system developed to continuously adjust the approach elevation of the airplane to prevent delays. This was instead the outcome of mechanical modifications made to cater to the elevated risk of a nose-up stall brought on by improvements to aerodynamics or a higher angle of attack. (Gregory, T. (2019)). The Maneuvering Characteristics Augmentation device (MCAS), is the device intended to engage in manual flight with the aircraft's flaps up and at an increased Angle of Attack (AOA), is the main subject of the inquiry. The Boeing MAX crashes, and vulnerabilities with the MCAS potentially caused to the catastrophes.[4] In the case of the Boeing 737-9 MAX airplane, there were several claimed instances of violations of quality assurance guidelines by this company. The FAA found non-compliance problems with Boeing's product control, parts storage and transportation, and manufacturing procedures control.[3] The lack of sufficient pilot training to handle MCAS problems exacerbated the design issues, which included depending on a single AOA sensor without redundancy in crucial systems. At first, Boeing denied software issues, alleging pilot error

for what had happened. However, these software faults worsened the situation to the point of making it more difficult for pilots to recover control. These technological concerns put to light broader questions over regulatory monitoring and aircraft certification. In the end, the defective sensor data set off MCAS, which resulted in two deadly crashes back-to-back. (Isabel Togoh (2019))

### Boeing Reprograms 737 System Linked to Crashes

A software update will prevent a single sensor from activating the Maneuvering Characteristics Augmentation System. The data from both sensors will be considered.



### Stakeholders:

There are multiple shareholders involved in the 737 MAX tragedy. Boeing is one of the main stockholders in the tragic crash. The families of the crash victims, Boeing employees, shareholders, suppliers, insurance companies, and the Federal Aviation Administration (FAA) and its international counterparts constitute the other parties concerned, as well as the pilots, passengers, and airlines flying the Boeing 737 MAX aircraft are all part of the stakeholders. The aircraft involved in crashes were developed, produced, and heavily marketed by Boeing executives and designers. After the crash, Boeing had to bear a hefty amount of money and doubled to \$18.4 billion in the estimated amount of cost that resulted from the 737 MAX grounding, as it disclosed a \$1.01 billion loss for the final quarter of 2018 and \$663 million for the whole of 2019. (Jeremy Bogaisky (Jan2020)) As many lives were lost all the people included in this suffered. Many families lost their loved ones and left everyone stunned. People lost trust in Boeing and now had to fight a legal battle to get justice. As part of its oversight methods, the FAA launched an audit swiftly, permitting Boeing 90 days to submit its action plan. The FAA is thinking about employing a third party to conduct independent quality system reviews, has placed an immediate stop on the expansion of Boeing 737 MAX production, and will continue to maintain a high level of presence due to concerns about the quality of the company's production.

The FAA has given both firms a summary of the audit findings and will closely evaluate Boeing's corrective efforts to make sure they sufficiently address the audit findings. [3]

### **Ethical Issues:**

The crashes involving Boeing include numerous ethical dilemmas and transgressions. Boeing refused to inform pilots about the MCAS problems and even acknowledged that a system malfunction was the cause of the accident. According to a former Boeing 737 Max engineer, the company put engineers in an "incredibly pressurized" environment to reduce production costs. To get beyond FAA scrutiny, the engineers were deliberately under pressure to convey major changes to the flying software as trivial adjustments. Furthermore, Boeing has refuted these allegations, stating that it puts the greatest emphasis on airplane quality and safety. Following two catastrophic crashes that occurred within six months of one another and currently all Boeing 737 Max aircraft are still grounded. The following statements made by Adam, a Boeing employee, clearly prove that illegal conduct is being engaged in. Adam stated that the culture was highly focused on expenditures, and extremely pressured, and engineers were assigned goals to minimize costs on the aircraft. Furthermore, there were undoubtedly insufficient resources to complete the task at hand. (Alexandra Ma (July 2019)). Boeing violated moral standards by outsourcing a significant part of the aircraft's design, including the crucial MCAS software, to engineers who made \$9 per hour and lacked knowledge of aircraft systems. They continued to operate the 737 Max models after the initial incident without immediately grounding them. (Robison, P. (2019)) This created a lack of transparency and a loss of trust among the public.

### **Engineers' Responses to Ethical Problems:**

The MCAS system's nose-down specifications, which were based on incorrect sensor data, aroused concerns among the engineers involved, but oversight overlooked them. Former Boeing engineers stated that the safety of the Boeing 737 Max was compromised by the company's focus on boosting production and reducing costs. (Alexandra Ma (July 2019)) Based on what they believed to be parallels between the accidents, individual engineers suggested removing the aircraft while the incident was being investigated. In fact, according to the study, one engineer even projected initially that there was a 13-fold higher chance of another tragic tragedy than the FAA norm. Following reports, the FAA acknowledged that engineers had calculated that, if the

planes were left unfixed, there would be a 25% chance of an accident in 60 days. Nevertheless, the estimate was not subject to managerial review because there was insufficient flight data, and FAA officials neglected this warning. The final significant international regulator to ground the 737 Max was the FAA. The planes were not given new permission to fly. (Justin Klawans (April 2023))

### **Corporate responses to the ethical problems:**

The corporate Boeing approach to this problem was diverse. Following the initial plane disaster, Boeing failed to appropriately handle the problem and tried to link all of it to pilot error and inadequate pilot training. Despite of the safety at risk and the engineers' warnings, they continued to operate the 737 Max. Unfortunately, this led to another crash. Boeing intended to solve the issues it identified with the MCAS system and sensor data. Boeing attempted to conceal several MCAS-related problems. The FAA wasn't made aware of the modifications until after the initial incident. The FAA intervened and requested that Boeing give operators maintenance and inspection guidelines. Boeing 737-9 MAX aircraft will have their operations suspended until operators complete expanded inspections following a thorough inspection by the FAA. Before returning any aircraft to functioning, operators must finish the necessary restoration measures based on the inspection results. [3]

### **Professional codes or standards:**

Some professional codes and standards were crucial to follow which includes integrity, security, openness, responsibility and compliance with regulations. Boeing tried to fix the issues related to engineering ethics. After the 346 fatalities in the Max disasters, which damaged public trust in Boeing and the FAA, the oversight of the ODA system came under investigation. According to investigations, the reason the airplanes plunged into fatal dives on both occasions was a fault in an automatic mechanism that had escaped inspections for safety throughout the planes' design. (Ian Duncan (Sept 2022)) However, executives at Boeing have acknowledged that the company must improve the quality and safety of their aircraft. Speaking to investors on the company's most recent financial losses, Boeing CEO Dave Calhoun stated, "Boeing is accountable for what happened, whatever final conclusions are reached." "This kind of incident cannot occur on an aircraft that departs from our factory. For the benefit of our clients and their guests, we must only perform better. (Chris Isidore, CNN (March 2024))

**Role of government oversight or regulation:**

Following their involvement in the Boeing 737 Max incidents, the FAA announced that the Boeing 737-9 MAX aircraft would remain grounded until operators had finished enhanced inspections, which included checking the fasteners, cabin door components, and exit plugs on both the left and right cabin doors. Before returning any aircraft back into service, operators must also fulfill the requirements for corrective action based on the inspections' results. The National Transportation Safety Board's investigation into Alaska Airlines Flight 1282 will continue to receive assistance from the FAA. The inquiry is being overseen by the NTSB, who will also be giving any updates. The impacted aircraft has been grounded by the FAA, and it won't take off again until the agency is satisfied that it is safe. Certain Boeing 737-9 MAX airplanes flown by American carriers or on American soil are temporarily grounded, citing an order from the Federal Aviation Administration Administrator Mike Whitaker stated, "The FAA is requiring immediate inspections before any Boeing 737-9 MAX aircraft are allowed to resume operations." [3]

**Preventions and recommendations:**

Details matter and flaws should not be disregarded if crashes like the Boeing 737 Max are to be prevented. Organizations can plan their strategies and notify all stakeholders on them. Being transparent is crucial for fostering trust both inside the organization and with the public. The most important component that Boeing 737 Max overlooked was "safety," preferring to concentrate on creating technologies that were economical. The developers' and engineers' warnings were to be followed. The pilots were held responsible for the crash even though, they were not properly trained and were unaware of the MCAS system. For the pilot of an aircraft to save lives, it is critical that they are fully always informed. Establishing a safety culture in the aviation sector is crucial. It should be encouraged for employees to express any worries they may have regarding safety and to take prompt, decisive action to address those concerns.

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