# Care Ethics Analysis of Boeing 737 Max 8 MCAS Failures

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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## Introduction

On October 29th, 2018, a Boeing 737 MAX 8 traveling from Jakarta, Indonesia crashed in the Java Sea killing all 189 passengers and crew onboard ("Investigation of", n.d.). A few months later, on March 10th, 2019, another Boeing 737 MAX 8 traveling from Addis Ababa, Ethiopia crashed six minutes after takeoff killing all 157 passengers and crew onboard (Sterman, 2023; Ontiveros, 2021). Following these two fatal crashes and 346 deaths, all Boeing 737 MAX 8 aircraft were grounded for 21 months, which resulted in Boeing losing billions of dollars (Sterman, 2023). The cause of these two crashes was later determined to be the result of a new computer flight control system, Maneuvering Characteristics Augmentation System (MCAS) (Cusumano, 2020). Many ethical analyses of this case have been made, and they all reach the same conclusion, that Boeing acted in an unethical manner. However, they fail to provide insight into why Boeing's behavior was unethical. Previous authors take the harm done to the passengers and crew for granted, and they do not offer a framework to outline why Boeing acted unethical. This paper will present an argument that Boeing did act unethically in the deployment of MCAS. Boeing intentionally misled airlines and pilots by omitting MCAS in manuals and making the 737 MAX seem like an incremental upgrade when it was not. To support this claim, this paper will utilize the framework of care ethics, which considers the ethical responsibilities of care owed to people in relationship between parties. Further, this will allow the analysis of the huge power imbalance in the relationship between Boeing, airlines, and passengers, providing better insight into why Boeing acted unethically. To support my claim, this paper will analyze scholarly literature and news articles.

### **Literature Review**

The current body of research surrounding the two crashes of the 737 MAX 8, which were a direct result of MCAS failures, unanimously considers Boeing's behavior to be unethical. Herkert et al. (2020) stated, "Using almost any standard ethical analysis or framework, Boeing's actions regarding the safety of the 737 MAX, particularly decisions regarding MCAS, fall short." Herkert et al. is very forward with labeling Boeing's actions regarding the implementation of MCAS as unethical. Herkert et al. (2020) goes further by saying, "Boeing failed in its obligations to protect the public. At a minimum, the company had an obligation to inform airlines and pilots of significant design changes, especially the role of MCAS in compensating for repositioning of engines in the MAX from prior versions of the 737." This comment is a little more scathing, but it fails to provide insight relating to how the behavior was unethical. Herkert et al. states that Boeing had an obligation to protect the public and that Boeing had an obligation to inform pilots about the MCAS system as well as its reason for being installed on the plane. However, Herkert et al. does not provide a reason why this behavior is unethical. Similarly, Englehardt et al. (2021) said, "To market an aircraft that depends on pilot acuity to an airline company or to a country where such acuity is not the norm for pilot training is, at best, ethically questionable." In this section, Englehardt et al. is saying that Boeing acted likely acted unethically by selling 737 MAX aircraft to Lion Air, the airline involved in the Jakarta crash, who had the worst safety record of any airline globally. Meaning that when Boeing misled airlines by saying that pilots would need no additional training to upgrade to the 737 MAX, it did even more damage due to the horrendous safety ratings of Lion Air. The first tenet in the American Institute of Aeronautics and Astronautics (AIAA) Code of Ethics states, "Hold paramount the safety, health, and welfare of the public in the performance on their duties" ("Code of Ethics", n.d.). This code of ethics follows the lead of Herkert et al.,

implying that Boeing failed to act ethically, but it also does not give a reason. Why are any of these actions unethical?

Other scholars approach this case from a historical perspective. Most believe that the modern problems facing the Boeing Company are a direct result of its 1997 merger with McDonnell Douglas (Cusumano, 2020). At the time, Boeing had a reputation for engineering excellence, but McDonnell Douglas had a reputation for cost cutting with an affinity to focus on stock price (Cusumano, 2020). At the time of the merger, McDonnell Douglas was in a bad financial situation (Cusumano, 2020). However, after the merger, it appeared that the McDonnell Douglas culture was overrunning the Boeing culture. So much so, that a media comment once circulated saying, "McDonnell Douglas bought Boeing with Boeing's money" (Cusumano, 2020). This created a problem where Boeing shifted from an engineering first approach to a bottom line first approach. This change in corporate culture laid the foundation for some of the problems with the 737 MAX. Englehardt et al. noted problems between management and engineers:

Engineers should not make, or be forced by management to make, unacceptable ethical or technical compromises (82). However, as the 737 Max case exemplifies, engineers were taken out of major decisions regarding the reengineering of the 737. Managers were making aeronautical decisions based on cost cutting and sales rather than the safety of their product. (p. 4)

Englehardt et al., here, notes that managers were making engineering decisions based on cost cutting, the old McDonnell Douglas way. This situation of managers making engineering decisions can create other issues, which can lead to design problems. Englehardt et al. notes concept referred to as "silo mentalities" where a group focused solely on their priorities and do not perceive how that impacts other groups within the organization. This particularly had an impact with MCAS

where it was used on a refueling aircraft contract, but it did not communicate that it requires extra redundant software to the 737 MAX team (Englehardt et al., 2021). This insight provides a deeper understanding of the problems and the corporate culture of Boeing at the time, which will allow for a better and more in-depth analysis of the disasters. The prior authors provide an outstanding summary of the history leading to the MCAS disasters, and they unanimously agree that Boeing acted unethically. However, they all fall short in addressing how its actions are unethical. This paper will provide an argument which will provide an argument which outlines the reason Boeing acted unethically.

#### **Conceptual Framework**

The analysis of this paper uses the ethical framework of care ethics developed by Carol Gilligan and Nel Noddings. Care ethics examines the relationship between actors and emphasizes care (Van de Poel & Royakkers, 2011). This is important because it allows for the examination of power dynamics between actors. In the case of the MCAS failures, care ethics allows one to determine Boeing's responsibility to care for airlines and passengers. In the same way that a structural engineer has much more power than the inhabitants of a building, Boeing has much more power than passengers and even pilots. Thus, Boeing has a duty to care for both the pilots and passengers that use its products. This duty of care allows for the connection between what is unethical and the reason that it is unethical. Previous works have established that Boeing acted unethically, but they overlooked the reason Boeing acted unethically. This assumed duty of care allows for a better understanding of why Boeings actions were unethical.

Care ethics is often criticized for being too vague in defining care and what constitutes good care (Van de Poel & Royakkers, 2011). This paper will define good care as keeping those with less power safe from otherwise avoidable harm. Care ethics is also useful in this case as it is fundamentally different from other ethical frameworks. Other frameworks approach a case as an individual decision (Van de Poel & Royakkers, 2011). They ask, "was this individual decision right or wrong?" but care ethics does not do that. Instead, care ethics just focuses on the relationships between actors. Care ethics simply asks, "Did the actor with more power provide care to the actors with less power? And if so, was the care adequate?" This allows for a conclusion of why Boeing's actions were ethical or unethical without getting too bogged down. Other frameworks, which analyze individual actions, would have to analyze multiple decisions in design and management to determine how Boeing acted. With care ethics, one is able to look at the complete picture of this case and draw a singular conclusion. This paper will utilize care ethics as the basis for its argument. Care ethics provides the necessary groundwork to prove that Boeing acted unethically due to the severity of the power dynamics between the actors.

#### Analysis

To better understand the severity of the MCAS failures, imagine oneself as an airline pilot. After takeoff, nothing appears wrong, but when the plane reaches approximately 2000ft altitude, the nose suddenly begins pitching down. Without pilot input, the plane had pitched down, but one recovered and the plane is regaining altitude. At about 6000ft, the plane begins pitching down again. After fighting the plane for numerous minutes, it finally wins and it plummets to the ground, killing everyone onboard. Figure 1 provides a chart of altitude vs time, which shows the journey



5

Figure 1: Altitude of Lion Air Flight 610 (The New York Times, 2018)

of Lion Air Flight 610. Ethiopia Air Flight 302 suffered the same fate just a few months later, crashing due to the same MCAS failure.

To understand how Boeing acted unethically, one must understand what MCAS is and why it was needed on the plane. Boeing was in a tough situation in the early 2010s, in 2011, for the first time, European aircraft manufacturer Airbus had topped Boeing as the world's largest aircraft manufacturer (Cusumano, 2020). Further, Airbus had just announced the new A320neo family of aircraft, single aisle aircraft with larger, more efficient engines (Herkert et al., 2020). Boeing did





not have time to make a completely new design, so it announced a redesign of the 737 to compete with the A320neo, this redesign would be known as the 737 MAX (Herkert et al., 2020). The new engine on the 737 MAX is more fuel efficient, but it is also bigger than the engine on the 737NG. To accommodate this bigger engine, the position had to be moved forward and higher on the wing (Herkert et al., 2020). This changed the aerodynamics and created a scenario where nose-up stall was possible. As seen in figure 2, stall occurs

when the angle of attack of an aircraft gets too high leading to the boundary layer separating too early and a huge loss in lift. Figure 3 shows angle of attack as a concept. Angle of attack is the



angle between the aircraft and the relative wind. Pitch is a similar concept, but it measures the angle between the aircraft and the horizontal plane. This means

Figure 3: Diagram of Angle of Attack and Relative Wind (Motion

Imagery Standards Board, 2014)

that moving the engines created a possibility of the aircraft pitching up, which would cause a stall condition and the plane would lose lift. To combat this Boeing installed the

Maneuvering Characteristics Augmentation System (MCAS) on the Boeing 737 MAX. The idea behind MCAS is that if the pitch angle of attack gets too high the plane would automatically pitch down to prevent the plane from stalling.

The MCAS system itself is not unethical, but the way Boeing implemented the system is the area of concern, namely it wanted the 737 MAX to seem like an incremental upgrade over the 737NP and it wanted to make the design as cheap as possible (Cusumano, 2020). Boeing had an incentive to make the new aircraft seem like an incremental upgrade to make the aircraft appear cheaper to airlines. Boeing claimed that the 737 MAX was so similar to the 737NP that 737NP pilots did not need to receive simulator training on the new 737 MAX planes, saving the airlines millions of dollars on training costs (Cusumano, 2020). To make the system cheaper, Boeing only added one angle of attack sensor (Matthews & Choi, 2019). This meant that the sensor collecting data for a system with control over the plane had a single sensor with no redundance (Matthews & Choi, 2019). This is a problem. MCAS has the ability to control the pitch of the aircraft without pilot input. With triple redundancy, the software would be able to know which of the three sensors was broken. With double redundance, MCAS would be able to know that one of the sensors was broken and it should deactivate, as it would not be able to trust either sensor. However, Boeing made this integral component single redundant meaning that MCAS makes decisions based on all of the data from the sensor because there is no way to know if it is broken. Boeing knew that this could be a problem, though, as an earlier design had two angle of attack sensors, double redundancy, but the design was changed to cut costs and make the design simpler (Matthews & Choi, 2019). This knowledge of the potential outcome was confirmed in a congressional investigation. This investigation found an email from a Boeing engineer who asked, "Are we vulnerable to single AOA sensor failures with the MCAS implementation, or is there some checking that occurs?" (Matthews & Choi, 2019). This shows that Boeing knew that having an important sensor with no redundancy was an issue, but it chose to not install any redundancy in the system because it was more expensive and complex. This paper's definition of good care requires that the actor with more power keep the actor with less power safe from otherwise avoidable harm. Boeing did not do this. The airline pilots and passengers are at distinct power disadvantages to Boeing, the designer and manufacture of the planes. Pilots and passengers have to be able to trust Boeing to build a safe plane. Boeing is expected to provide good care to pilots and passengers, and it had an opportunity to do this. Boeing had an earlier design with a double redundant sensor. Boeing had the responsibility to keep pilots and passengers safe, and it failed. Through this lens, one can determine that Boeing acted unethically by neglecting to install a fix to a problem that it already knew about and for which it had a fix.

Not only did Boeing design MCAS with no redundancy, but it also made an attempt to conceal the existence of the system from pilots. Cusumano (2020) claims that, "Boeing had decided that pilots were the 'backup' for MCAS, but the company did not explain in the 737 MAX operations manual how MCAS worked and how little time the pilots had to respond" (p. 24). This statement points out two damaging facts about the MCAS deployment. First, Boeing did not include any mention of MCAS in the operations manual. This is important as, again, MCAS has the ability to maneuver the aircraft without pilot input. The second problem that this poses is that Boeing expected pilots to be a backup for a system that they did not know existed. Pilots are human, they do not have superpowers, so one cannot expect pilots to be perfect. In spite of this, Boeing placed a large burden on them by expecting them to be able to quickly solve a problem, in a high stress situation, that they did not already have knowledge of how to solve. Most authors agree that this behavior is unethical, but one can use care ethics to answer why this unethical. Again, referring to this paper's definition of good care, Boeing did not meet its burden. Boeing had the obligation to keep its pilots and passengers safe from otherwise avoidable harm. By neglecting to include any information about MCAS in the operations manual, Boeing made the 737 MAX a more attractive aircraft to airlines as this allowed airlines to save money by not training pilots on new aircraft. This decision proved to have fatal consequences. Boeing had the opportunity to include MCAS in the operations manual, and it had the opportunity to recommend that pilots receive simulator training on the new aircraft. Instead, Boeing chose to put both pilots and passengers at risk by concealing this important information about MCAS.

To further examine why this happened, it is important to look at Boeing's corporate culture. In the 1990's Boeing acquired McDonnell Douglas, a rival company in a poor financial situation. After the acquisition, many former McDonnell Douglas employees took top jobs at Boeing and changed to company culture to focus on cost control (Saporito, 2024). McDonnell Douglas was not unaccustomed to safety issues. The DC-10, a civil aircraft produced by them, was frequently labeled a "death trap" by news outlets following a crash that killed 346 people after multiple rear cargo door failures (Memon, 2024). This cost cutting management mentality is also voiced by Engelhardt et al (2020), "Managers were making aeronautical decisions based on cost cutting and sales rather than the safety of their product" (p.11). In this situation, managers made engineering decisions on a cost basis, rather than an engineering basis. However, some would argue that Boeing is a for-profit company, and that it has an obligation to its shareholders to attempt to make a profit. Looking through this lens, cost cutting itself is not unethical. Though, in the case of the 737 MAX, the cost cutting is unethical. This is because Boeing decisions to cut costs directly conflicted with its obligation to provide good care to pilots and passengers. Further, making a plane safe and making a plane profitable are not mutually exclusive. Boeing could have added redundancy in the angle of attack sensors, and it could have provided information about MCAS in the operations manual, and it could have recommended that pilots receive simulator training on the new aircraft. Instead, Boeing focused on cost cutting and, as a result, put pilots and passengers, the people it had the obligation to care for, in danger, killing 346 people.

## Conclusion

In conclusion, Boeing acted unethically by misleading airlines and passengers about the scale of the design changes from the previous 737 model to the 737 MAX 8. By misleading airlines and pilots, pilots were not given proper training, nor were they even notified of MCAS and its power over the aircraft. This behavior led to the deaths of 346 people, and it caused the Boeing Company to lose billions of dollars in revenue (Sterman, 2023). The arguments outlined in this paper show a clearer image of why Boeing had an obligation to ensure the safety of the public and

how it violated that obligation. Care ethics was utilized to demonstrate that the power imbalance between Boeing, airlines, and passengers created a duty of care for Boeing notwithstanding the AIAA code of ethics. This creates a new lens to view the ethics of disastrous Boeing 737 MAX 8 crashes.

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