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Ethics Case Study: Boeing 737 MAX

In 2018 Boeing was in the process of introducing a new generation of airplanes, the 737 MAX. This new series of planes was intended to be more fuel-efficient while remaining similar to the previous generation of 737's that was popular in the flight industry so that adopting the new line of planes would require little pilot training. To do this they included larger engines placed in a different location on the wing, being slightly higher and forward (2). This introduced a problem; it slightly changed the aerodynamics of the plane itself. To counter-act this change Boeing developed the MCAS system, an automated software that was designed to ensure the plane's nose would stabilize in the event the plane approached a stall and as such would remove the uncertainty of functionality that the new generation would introduce and make functionality near identical to the prior generation (3). As such Boeing likely believed the plane could still be operated in a similar way to the previous generation and marketed it as such. The assumption that pilots could use these new planes without additional training was attractive to prospective customers. But the problem that arose from this was that the plane in fact did not operate the same as the previous generation and should have been marketed as such. The result of this oversight was a line of planes with two major fatal crashes in just 2 years (1). These crashes were caused by pilots not being properly trained in the operation of this new line of planes and lazy design choices made in the development of MCAS.

The MCAS (Maneuvering Characteristics Augmentation System) was designed to account for the new aerodynamics of the 737 MAX and was intended to deal with them such that the other operations were the same as previous generations so pilots would require no new training to operate the 737 MAX (2). In theory it was the perfect plan, to make a better aircraft that was more fuel efficient while not introducing any new variables to its operation. Unfortunately, the MCAS was designed in such a way that it relied on just one AoA (Angle of Attack) sensor (2). This sensor would measure the angle between the wing and the direction of air movement around the wing. Since there was only one sensor, an incorrect reading could not be overridden and would take effect. In this scenario the sensor may continue to misread and continually push down the nose of the plane, thus forcing the plane towards the ground and potentially causing crashes if the pilot cannot override the error.

That exact scenario is what caused both the crash of both Lion Air Flight 610 in 2018 and the crash of Ethiopian Airlines Flight 302 in 2019 (1). These two disasters together resulted in 346 deaths and were both attributed to a sensor failure and subsequent incorrect MCAS activation (1). The planes would incorrectly read its trajectory as having it's nose upwards and when it adjusted to pull the nose downwards (to be forward) the actual trajectory of the plane would be downwards instead of straight ahead. Subsequent upward adjustments by the pilot would then be read similarly and the plane would continue to be pushed downwards by MCAS (3). This self-sustaining loop would be impossible to completely override, and the plane would inevitably crash.

In this scenario there are many stakeholders, those being: Boeing engineers and management, FAA regulators, airlines, pilots, and passengers. The 737 MAX was Boeings attempt to keep up with and compete against the new Airbus A320neo (5). The A320neo was a highly fuel efficient plane released in 2014 and started seeing commercial success in 2015 (5). The plane would continue to take away from the market share of the then dominant Boeing mounting pressure against the company to release a new line of planes that could compete with the A320neo on a tight schedule. To achieve this Boeing chose a route that may have been ethically immoral. For one, they chose to use only one senor and claimed that this one sensor was enough to ensure that the plane could be operated on prior training for the previous generations of 737's (2). This design choice allowed Boeing to claim that the MCAS system was simple and required little to no training to use effectively in an attempt to bypass possible regulatory procedures that would inevitably delay the release of the line further (2). This was a problem for Boeing management as they could not afford to allow Airbus to get further ahead of them. If Boeing's market share continued to fall then the company would have faced issues with profits and likely internal restructuring. The management thus chose the option that, on paper, gave them the best development period and product while minimizing risk and cost (2). It was the choice that was best for the success of the line and the company at the time. From the perspective of the engineers at Boeing however, this was a choice made poorly. The engineers were concerned that relying on a single sensor with no sort of redundancy was a risky choice and that some sort of fail safe should have existed (2). For example, simply adding another sensor to provide redundancy in the process. Another option would have been to add some sort of logic that checks the legitimacy of readings. But these proposals were ignored as adding another sensor would have likely required Boeing to go through a more difficult certification process involving making a new training procedure for pilots. Both of which would have greatly delayed the timeline for the 737 MAX and in turn greatly increase the cost of the project. As a result the FAA (Federal Aviation Administration) was unable to properly asses the safety of the 737 MAX (2). Had they known of the differences that this new system implemented they

likely would have forced Boeing to identify the craft as a new line instead of a new version of the 737. But this was also a problem partially created by the FAA themselves. Over time the FAA began to rely on Boeing to asses their own crafts safety with limited FAA oversight in the ODA (Organization Designation Program) (4). This allowed Boeing to self-certify themselves with little outside guidance and as such directly allowed the 737 MAX to be certified despite the possible concerns of engineers at Boeing (4). This oversight was thus an injustice to those whom would pilot these planes and those whom would be passengers in these planes. These two major stakeholders would think that since the plane was certified by the FAA that they would be safe and reliable to use. However, this trust was taken advantage of and the rights of those stakeholders were violated.

The 737 MAX is a goldmine of ethical dilemmas; pressure to compete against prioritizing safety, minimizing costs and development period against transparency and proper procedure, and listening to possible concerns of engineers against releasing the most profitable product you can as quickly as you can. To analyze these ethical dilemmas, it is helpful to take on various ethical perspectives and apply different moral principles. From a deontological approach, which means to do what is proper/what is right, Boeing should not have proceeded with the 737 MAX as they did. They should have taken the concerns of the engineers seriously and made an effort to ensure safety in regards to proper engineering procedure. But from a consequentialist perspective the company made the correct choice. On paper they would be able to create a product that was better than the previous generation without investing too heavily into new certifications. The 737 Max would be more fuel efficient and better for the environment and the sooner the model was released, the more impact it could have on reducing pollution. For those that would purchase these planes the 737 MAX was simply an upgrade of the previous generation and would not require them to invest more time into pilot training as opposed to purchasing a brand new model that would require brand new manuals and training. So, even though there may have been some mismanagement involved in the process by ignoring the engineers, the project on paper was set to have a majorly positive impact for not only the company, the passengers, but also the airlines that purchase these planes. A new generation plane with improved fuel-efficiency and performance without the shortcomings of a brand new model would, in a consequentialist lens, have the best outcome for those involved. But if analyzed through the lens of reflexive principlism it falls short. Notably, in respect for autonomy. They violate this principle by creating a product that on paper claims to be safe and one that makes its way through certifications and safety checks when it most likely isn't. The principle of respect for autonomy states that individuals have a right to make informed decisions regarding their own lives. In this case, knowing that should they choose to take the flight, they are doing so with the understanding that they will be

safe. By marketing the plane how they did they are lying about the actual safety of the plane and as such are giving the impression to passengers and pilots that they are making informed decisions. This dishonesty is also in contrast to beneficence. Knowingly disregarding safety is not acting to promote well being. With that same logic it fails to uphold nonmaleficence (to do no harm) as it does not aim to do so. The final principle of reflexive principlism is Justice. Justice is a principle that aims to ensure that the distribution of effects are fair. That the benefits, risks, and responsibilities are allocated in a fair way. In this case they are not. The benefits are almost exclusively given to Boeing in the form of reduced costs. While the risks are given almost exclusively to the pilots and passengers. This unequal distribution fails to uphold justice.

To determine if Boeing made the right decision is fairly simple, because the only ethical framework to uphold the decision ended up failing it's own test in the long term. As a result of the two disastrous fatal crashes Boeing would face scrutiny and the 737 MAX would be grounded worldwide permanently hurting the reputation of Boeing as a company as a result. It fails deontology by not making the choice they ought to have made by taking these risks further into account and following through with proper engineering procedure and taking time to undergo thorough certification of the product. And it thoroughly fails reflexive principlism as discussed earlier. Or does it?

All of these ethical assessments have been made through the lens that the ones who get final priority are the passengers and the passengers alone. But did Boeing actually do the passengers wrong? Were they consciously bringing risk to them? It is hard to say. Boeing made their adjustments to the 737 MAX and on paper, they accounted for those changes by introducing the MCAS system in order to make the plane safe to operate for already experienced pilots whom had used the prior generation. In this lens, the choice was the best for the safety of the passengers as their was less risk of mistraining or misoperation by a pilot used to the prior generations. So one could argue the choice that Boeing made was correct.

Regardless, using the ethical lenses discussed in this case study, I simply cannot agree with the choices of Boeing. The fatal flaw in the process was that the engineers that worked on it did not believe in the design. This should have been the determining point for Boeing that the approach they were taking was poor. This information being given to them by the engineers thus made it so that they were clearly aware of the consequences of releasing the model as it was and as such, they were knowingly putting passengers in possible danger, no matter how good their intentions were. As such, Boeing breached the ethical framework developed in this case study by making a choice they ought not to (deontology), knowingly releasing a product that could have problems down the line

(consequentialism), and finally by betraying the trust of those involved and intentionally doing harm (reflexive principlism).

Works Cited

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Links included. All sources cited in case study by #

1- A timeline of the Boeing 737 Max jetliner's troubled history | AP News
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