MEMO Number CMPE 349 Ethics paper
DATE: 9-April-2021
TO: E.F.C LaBerge
FROM: Nem Negash
SUBJECT: The 737 Max vs. Fiction

---

1 INTRODUCTION

The purpose of this paper is to look at the ethical issues that lead to the 737 Max plane crashes and the airplane incident that occurred in the book, "Airframe". Engineers have ethical rules commonly known as the Code of Ethics that is implemented in different forms at all engineering companies. These rules are applied to ensure the honesty, integrity, and professionalism of the employees and the organization and maintain trustworthiness with the public. The Code of Ethics that will be used to examine the two topics are the IEEE Code of Ethics, the National Society of Professional Engineers (NSPE) Code of Ethics, and the Air Line Pilots Association (ALPA) Code of Ethics.

Background

The 737 Max incidents that occurred on October 29, 2018, and March 10, 2019, lead to the death of 346 people. The first accident known as "Lion Air Flight 610" was a domestic flight in Indonesia that crashed into the Java sea thirteen minutes after takeoff killing all aboard the plane. About five months later another incident occurred now identified as 'Ethiopian Airlines Flight 302" which was an international flight from Addis Ababa, Ethiopia to Nairobi, Kenya. The plane faced some technical difficulties right after takeoff and crashed six minutes after.

The novel "Airframe", by Michael Crichton, is a story about a plane incident that led to the death of four people with several injured and the investigation by the aircraft manufacturing company, Norton Aircraft, of the incident to decipher the cause of the issue. Casey Singleton, Quality Assurance executive for Norton Aircraft, is the lead of the investigation and faces a lot of adversity to get to the truth with unionized workers trying to have the company take fault for the incident to ensure the future of their jobs and higher management trying to take no responsibility for the incident to close a crucial aircraft deal with China.

2 DISCUSSION

The Boeing Company decided to make an updated version of their already highly demanded workhorse plane, the 737 NG, called the 737 Max. Rather than having to go through the lengthy process of designing and certifying a completely new plane, they decided to simply re-design the 737 NG and make the 737 Max feel and behave like the 737 NG. This made the certification process much quicker and saved airlines millions since they didn't have to train pilots on a new plane and can have them fly the NG or Max interchangeably [4]. Referencing the NSPE Code of Ethics, this is a violation of code II1 which states, "Engineers shall hold paramount the safety, health, and welfare of the public" [5]. Boeing was more focused on saving time and saving money for their customers rather than ensuring the safety of the plane to the utmost degree.

The 737 Max incidents occurred for mainly two reasons. The first being the Maneuvering Characteristics Augmentation System (MCAS) was taken out of the pilot's user manual. This software when originally created by The Boeing Company on the 737 NG was dependent on two independent thresholds, the angle of attack and the G-Force, to determine if the nose of the plane needed to be pushed down. The updated version of MCAS used in the 737 Max only used the angle of attack sensor and if the angle is too high the feature would swivel the horizontal tail to lift the plane's tail and move the nose down. The pilots were not aware of the software let alone what it did. This was because in March of 2016, Mark Forkner, the 737 Max's chief technical pilot, sent an email to Federal Aviation Administration (FAA) officials to remove MCAS from the pilot's manual [2]. The FAA approved this since they were briefed on the original MCAS software which put them under the impression that the software was rarely used not knowing Boeing was working on a newer version. The updated version was a lot more engaged and is more likely to activate compared to the original version. Forkner asked it to be removed from the pilot's manual since he knew updating the system would cost airlines millions in new training and wasn't aware of how involved the updated version of MCAS was on the plane. According to the NSPE code of ethics, this is a violation of code II2b which states, "Engineers shall not affix their signatures to any plans or documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control" [2]. Forkner wasn't fully aware of the changes to MCAS yet he asked the FAA to take the entire system from the pilot's manual. This

led to pilots who were completely unaware of the existence of the system and have no idea how to handle it if it was to misfire as it did for the two crashes.

The second main reason was design flaws in the MCAS. The entire system was dependent on the angle-of-attack of the plane. The angle of attack is collected by two sensors, but the system only took data from one sensor. During the investigation of the two crashes by the House Committee on Transportation and Infrastructure, a Boeing internal email was obtained from an Aero-Stability & Control group employee that raised some concerns about the MCAS being dependent on a single sensor saying, “Are we vulnerable to single AOA[angle of attack] sensor failures with the MCAS implementation or is there some checking that occurs?” [1]. This shows that they were clearly aware of the vulnerability of the system using a single sensor, yet nothing was implemented to make sure the system doesn’t easily misfire. According to the IEEE code of ethics, this is a violation of code I1 which states, “to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices…” [6]. The engineers working on the MCAS software clearly were aware of the faulty dependency that the system had, yet they still proceeded to finalize the design and install it into the 737 Max. While these engineers most likely had no intention of sabotaging the system the carelessness to make sure all safety measures were taken led to the death of 346 people.

In the novel Airframe, Norton Aircraft had to have an investigation for an incident that occurred in Flight 545 with their N-22 plane. This accident led to the death of four people and several injured which made it a large situation Norton Aircraft had to deal with while being on the verge of signing an aircraft deal with China that was worth billions. The investigation originally was planned to take about a month but John Marder, the COO of Norton Aircraft, rushed the investigation to a week saying, “We have a week…. I fly to Beijing Sunday, to join Hal and sign the letter of intent with the minister of transport. He's going to want to know what happened to Flight 545” [3, pp. 28], at an IRT(Incident Response Team) meeting. Marder decided rather than pushing the signing date due to the industrial accident, he would rush the investigation and have some form of closure to the incident where Norton Aircraft has no fault in the situation. No engineer in the IRT meeting spoke up about how this will not be in the best interest of the public who need to have a thorough explanation of what caused the accident, who was responsible, and how it will be fixed for the future. This is a violation of code III2 of the NSPE Code of Ethics

which declares, “Engineers shall at all times strive to serve the public interest.” [5]. Rushing the investigation can lead to missing details that will highlight the cause of the accident and further prevent it from happening again.

During the investigation, Marder explained the urgency of the situation in a rather demanding way saying “The future of Norton Aircraft is riding on this investigation. So I don't want to hear anything but answers. And I want them inside a week…” [3, pg. 29]. Some of the engineers reacted upset and unsettled like Kenny Burne who said, “This is his idea of motivating the troops? F*** him.” [3, pp. 29]. According to the IEEE Code of Ethics, this is a violation of code II7 which states, “to treat all persons fairly and with respect, and…” [6]. Cussing at a fellow employee and especially the COO of the company is unacceptable ethical behavior. This showed the ignorant and disrespectful side of Burne’s character.

The cause of the accident for Flight 545 was found to be a counterfeit slat locking pin installed by the maintenance crew when the plane landed in Singapore due to some minor slat issues. This counterfeit part would later cause the plane some sensor issues which gives the pilot error warnings. The pilot simply had to deploy the slats and have the autopilot retract the slats to clear the error warnings. The pilot, Thomas Chang, who is actually the inexperienced son of the chief pilot, John Chang, instead took manual control to try and fix the issue which led to the plane nose-diving. John was in the back of the plane getting coffee while his son, Thomas, was handling the error messages from the plane. This is a violation of code I of the ALPA Code of Ethics as it states, “An Air Line Pilot will keep uppermost in their mind that the safety, comfort, and well-being of the passengers who entrust their lives to them are the Pilot’s first and greatest responsibility” [7]. John let his untested son handle a situation he is unprepared for and put the lives of hundreds of people on the line. This is a huge act by Chang that is wrong in more than just an ethical aspect by also in legal stands.

The 737 Max incidents with Boeing and Norton Aircraft in the novel, Airframe, had some similar focuses that lead to them violating Codes of Ethics. Boeing was focused on saving time and airlines money so, rather than have pilots be trained on the updated MCAS software they simply removed it from the pilot’s manual. Norton Aircraft also was focused on closing the investigation as soon as possible with no fault attached to the company to get the China deal done

rather than trying to take time to really figure out what caused the incident. Lucky for Norton Aircraft the cause of the incident was found to be a counterfeit part and pilot error. Nonetheless, both companies put money and time over the safety of the public which is highly unethical in any profession.

3 CONCLUSION

Boeing and the rest of the engineering world have learned a lot from the 737 Max affair. New engineers can also learn a lot from the incident about the importance of ethics in the profession of engineering. The MCAS's single sensor vulnerability issue that led to the two crashes teaches a valuable lesson to new engineers about the importance of acknowledging all vulnerabilities of a system and finding ways to fix them, especially when working on a project that can have a significant impact on the well-being of the public. Forkner's lapse of judgment in asking the FAA to remove the MCAS from the pilot's manual is also an important lesson for new engineers. Making such a drastic decision about a project without the full knowledge of the system is an unwise decision that can cause catastrophic accidents. It is important to only make decisions and provide input on subject matters that an engineer is educated and experienced in. Lastly, the 737 Max affair shows that prioritizing money and time over the safety of the product can lead to devastating situations for the public and for the company as well. As engineers, we must be able to stand up against business-minded employees who prioritize money and time over high-quality products and the general safety of the public.

References

[1] L. Josephs, “Boeing employees raised concerns about 737 Max before crashes, documents show,” *CNBC*, 31-Oct-2019. [Online]. Available: https://www.cnbc.com/2019/10/30/boeing-engineer-raised-concerns-about-737-max-years-before-crashes-documents-show.html. [Accessed: 12-Apr-2021].

[2] J. Nicas, N. Kitroeff, D. Gelles, and J. Glanz, “Boeing Built Deadly Assumptions Into 737 Max, Blind to a Late Design Change,” *The New York Times*, 01-Jun-2019. [Online]. Available: https://www.nytimes.com/2019/06/01/business/boeing-737-max-crash.html. [Accessed: 12-Apr-2021].

[3] M. Crichton, *Airframe*. 1996.

[4] D. Slotnick, “The first Boeing 737 Max crash was 2 years ago today. Here's the complete history of the plane that's been grounded since 2 crashes killed 346 people 5 months apart.,” *Business Insider*, 29-Oct-2020. [Online]. Available: https://www.businessinsider.com/boeing-737-max-timeline-history-full-details-2019-9. [Accessed: 12-Apr-2021].

[5] “Code of Ethics,” *Code of Ethics | National Society of Professional Engineers*. [Online]. Available: https://www.nspe.org/resources/ethics/code-ethics. [Accessed: 12-Apr-2021].

[6] “IEEE Code of Ethics,” *IEEE*. [Online]. Available: https://www.ieee.org/about/corporate/governance/p7-8.html. [Accessed: 12-Apr-2021].

[7] “Code of Ethics,” *ALPA*. [Online]. Available: https://www.alpa.org/en/about-alpa/what-we-do/code-of-ethics. [Accessed: 12-Apr-2021].