



Case Study 05: Failure Analysis

When You Absolutely Must Understand Why An Engineering Failure Happened, And How To Prevent It From Ever Happening Again

For this Case Study, you will be self-selecting your team partners. The deadline to sign up on [the shared Google spreadsheet](#) is no later than **6:00 PM on Friday, 19 April 2024**.

INTRODUCTION

Failure is inevitable. That's not pessimism, it's just a simple fact. A good engineer can design around known issues and anticipate the most common or likely ways in which an object or system might fail.

But sometimes the unexpected happens. And when it does and failure happens, it's imperative to analyze it. How did it happen? Why did it happen? Is it going to happen again? How do we prevent that?

OBJECTIVES

The specific goals for this exercise are:

- **Examine** the recent failures in the Boeing 737 MAX planes
- **Obtain** reliable resources that will give you an unbiased understanding of what happened in each instance
- **Explain** the failure(s) which resulted in the catastrophic loss of two planes and hundreds of human lives
- **Identify** the responsible entities and analyze the corresponding ethical issues
- **Present** your analysis clearly and succinctly in a professional document or slideshow

USE RELIABLE RESOURCES



You have been provided a set of resources from reputable sources. Several of these documents are detailed and technical; it's okay if you don't understand everything in them. I have included them for you as examples of a comprehensive investigation, and they contain

information critical for understanding the causes of the disasters and the recommendations for moving forward.

Most of the articles are short and have been selected because they are both easy to read and come from respected and reliable sources. You should be able to gather information from these articles without difficulty. You might not use every article as a source for your analysis, but you should look at each document for long enough to determine whether it will support the points you are trying to make.

You may use additional articles, but you will need to include citations. I am not going to go all MLA/APA on your bibliography; if you use an online source, you must provide a valid URL. Also, be aware of the legitimacy of your sources; please do not cite *InfoWars* as a reliable source with a straight face.

ANALYZE THE FAILURE

You and your partners should analyze this case using the guidelines below:

1. Clearly identify the major players.
2. Briefly (very briefly) summarize the situation.
3. Clearly identify the failure(s). There may be more than one! Design failure? Mechanical (parts/equipment) failure? Human error? Combination of all three?
4. Can you identify who is responsible? Is this responsibility shared by more than one entity? Do you have questions that you need answered before you can assess levels of responsibility? What are those questions?
5. Is the question of culpability complicated by any ethical issues? (It is...*of course it is*). Briefly identify any ethical breaches that you perceive, and comment on whether this was an avoidable failure. Cite the appropriate section of [The NSPE Code of Ethics](#) to support your position.
6. What have the consequences of this failure been? Have any entities been held legally responsible? Financial repercussions? Changes in policies/procedures? Are there any consequences *missing*? (Things that you think *should* have happened, but have not.)

SYNTHESIZE AND SUBMIT

You're not an NTSB investigator; you are not pulling together a government report or legal document. Your goal here is to begin to really understand the far-ranging ramifications of engineering decisions, the impact of failure, the importance of failure analysis, and the depth of the resulting investigations when things go wrong.

Your analysis should be submitted in the form of either a document (by now you know which file formats are acceptable), or a slide show (exported to .pdf). Either format is acceptable, as long as the content includes the required elements outlined above.

There is no in-class presentation for this Case Study. Your finished work must be submitted via the appropriate Blackboard Assignment no later than **6:00 PM on Friday, 19 Apr 24**. All participating team members will receive the same score.



CASE STUDY: THE BOEING 737 MAX

On 29 October, 2018, 181 passengers and eight crew boarded a Boeing 737 MAX. Lion Air Flight 610 was scheduled to depart from Jakarta, Indonesia in the early morning hours (local time). After a brief one-hour flight, it should have landed safely in the Indonesian city of Pangkal Pinang.

Thirteen minutes into the flight, air traffic controllers abruptly lost contact with the aircraft.

The plane crashed into the Java Sea, approximately 21 miles north of the island of Java. There were no survivors.

Four and a half months later, on the morning of 10 March 2019, another Boeing 737 MAX prepared for take-off. One hundred forty-nine passengers and eight crew members boarded Ethiopian Airlines Flight 302 in Addis Ababa, the capital of Ethiopia, bound for the Kenyan capital of Nairobi.

The plane disappeared from radar barely six minutes after takeoff.

It impacted in an open field not quite 40 miles from Addis Ababa at an estimated speed of 700 mph. The passengers and crew were lost.

The Lion Air 737 MAX was almost new—barely three months old. And yet, pilots had reported serious flight control anomalies on the day before the fatal flight.

The Ethiopian plane had been delivered from Boeing in mid-November 2018, making it also practically new.

Two planes, identical in design and both almost brand-new. Two catastrophic failures occurring with minutes of takeoff, resulting in 346 fatalities.

What happened? Who is responsible? How do we prevent it from happening again?



ONLINE RESOURCES

NTSB Safety Recommendation Report	Indonesian Aircraft Accident Investigation Report	Ethiopian Aircraft Accident Investigation Report
Boeing 737 MAX Updates: Boeing Corporation	New York Times, 10 March 2019	Intelligencer, 09 April 2019
Reuters, 16 September 2019	Aerospace America, 26 September 2019	Reuters, 18 October 2019
Aviation Today, 28 October 2019	Business Insider, 29 October 2019	Seattle Times, 08 November 2019
Reuters, 26 November 2019	Reuters, 09 December 2019	CNBC, 10 January 2020
Bloomberg, 13 January 2020	DOJ Press Release, 07 January 2021	New York Times, 11 January 2021
FAA Updates, 08 April 2021	US Department of Justice Press Release: Former Boeing 737 MAX Chief Technical Pilot Indicted for Fraud, 14 October 2021	