

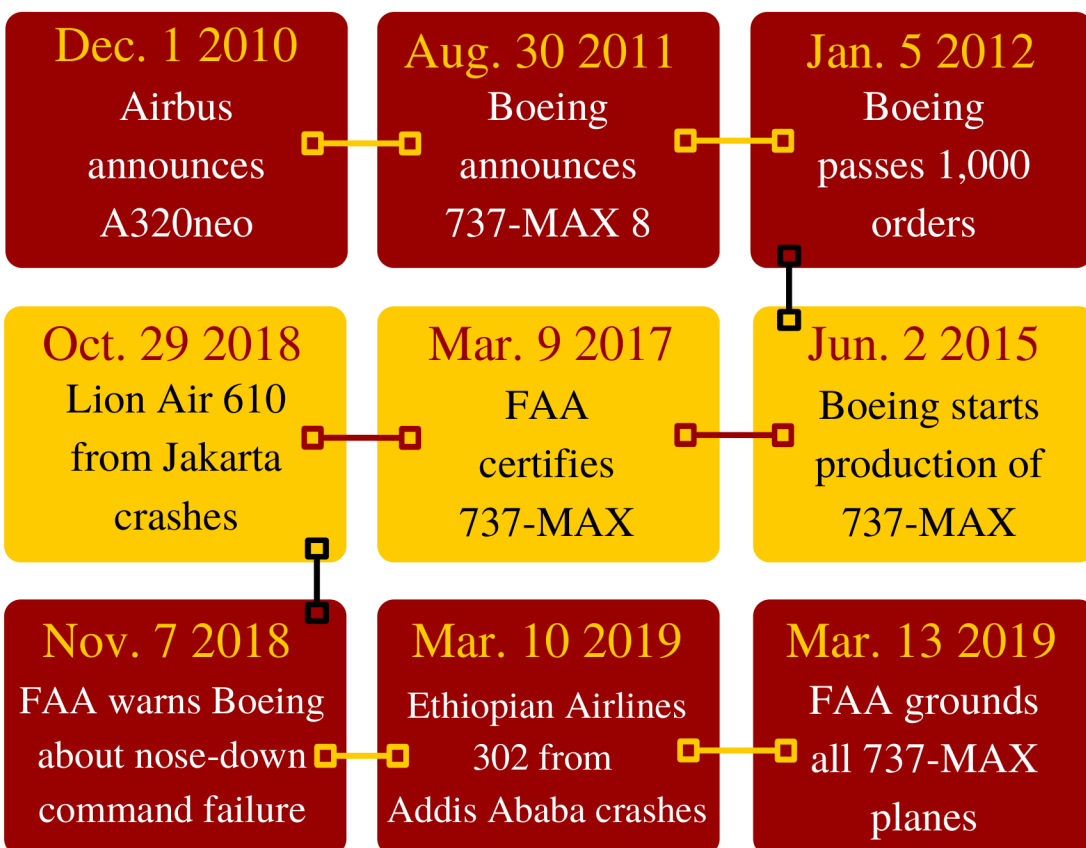
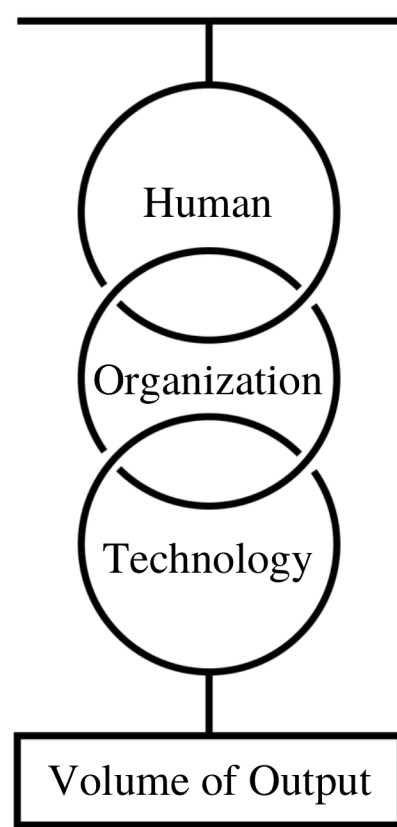
Introduction

On March 13, 2019, Boeing grounded all 737-MAX aircraft, but it was too late. Boeing had shattered its reputation and a seemingly strong relationship between airlines, airplane manufacturers, and passengers broke in an instant.

The cause, as it turned out, was a little-known piece of code called MCAS. Introduced to fix a center-of-gravity problem, its ramifications were ignored. Less than two years after its certification, it had downed its first plane. However, a faulty system was not the lone culprit in both the Lion Air flight 610 and Ethiopian Airlines flight 302 crashes.

This research examines how a total system failure led to the two Boeing 737-MAX crashes that killed 346 people, which could be used as comprehensive case study in aviation safety education.

The H.O.T. model is the relationship between human, organizational, and technological subsystems, represented by three chain links. Ideally, the three interact harmoniously to increase the reliability of the system and consistently produce the volume of output. In the Boeing 737-MAX crashes, MCAS was technology implemented in order to not have to train pilots for the plane's poor behavior at high angles of attack. In this case, the human and organizational links were weak, while the technological link was strengthened to make up for this deficiency. When the stabilizer sensor failed, the technological link (MCAS) had no strong human nor organizational backups, so the chain broke.



Recommendations

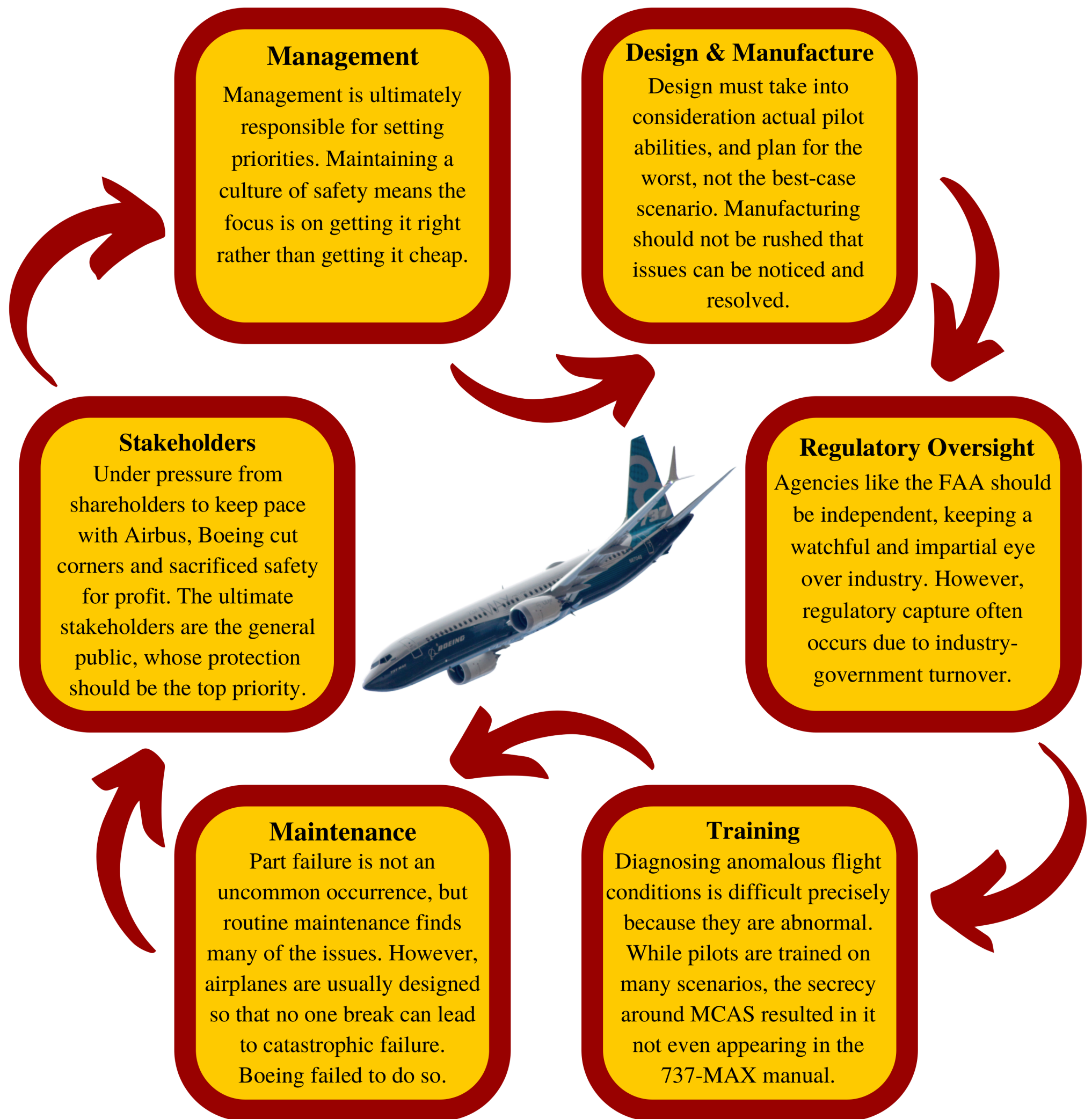
- Implementation of a strong and resilient culture of safety that leads to effective transparency.
- End FAA delegation and fully fund regulatory agencies.
- Prevent direct industry-regulatory transitions to prevent regulatory capture.
- Airplane manufacturers and airlines must ensure their pilots are fully trained on every aspect of a new airplane.
- The FAA should establish a group dedicated solely to receiving anonymous reports about aviation safety flaws and violations, then investigate every claim.



Shown in red: the buttons that shut off MCAS

Impact

346 lives were lost as a result of a system that failed them. Their loss will not be in vain. The industry must learn from what went wrong and improve in ways that will prevent such a catastrophic breakdown of both physical safeguards and communications. The safety of the public must not be jeopardized for the sake of saving money.



Global Implications

On Ethiopian Airlines 302, passengers came from 35 different countries. Boeing, an American company, made reckless decisions which cost the lives of people all around the world. Immediately following the crashes, Boeing only worsened the animosity between America and other countries by blaming foreign pilots. Boeing CEO David Calhoun blamed their lack of training, saying "[foreign] pilots don't have anywhere near the experience that they have here in the US".

Ethiopian officials did not cite pilot error as a cause of the crash. In response to the crashes, the FAA commissioned a Joint Authorities Technical Review committee, where civil aviation authorities from ten countries around the world worked together to make recommendations on how to improve the FAA's certification process, operations, and training. The recommendations emphasize a focus on human factors throughout the design and certification processes, and updating out-of-date certification processes.

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Requests for information

Scott Stocker, Vice President of Manufacturing and Safety, Boeing	No response
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Air Line Pilots Association	No response