An Examination Into The Boeing 737 Max Crisis: Delegation, Regulation Oversight, and the Federal Aviation Administration

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Abstract

The process of aircraft certification is critical in ensuring the safety and airworthiness of an aircraft while maintaining public trust in terms of regulation. This research will examine the established relationship between the Boeing Company and the Federal Aviation Administration (FAA) to identify its regulative responsibilities and authority in aircraft certification, as to how they are practiced between the two entities, by examining its internal regulatory components and how they are implemented between Boeing and the FAA, compared to the external aircraft certification process worldwide. Authoritative oversight and delegation within the Federal Aviation Administration and Organization Designation Authorization demonstrate weak points in aircraft certification. In this paper we dive into the Boeing 737 Max crashes, the FAA's response to the accident, and the international regulatory responses.

Introduction into the Boeing 737 Max Certification

The certification of the Boeing 737 Max became one of the most closely examined failures in modern aviation history regarding regulation. While investigations would ultimately rule out flaws within the aircraft's Maneuvering Characteristics Augmentation System (MCAS), they also unraveled broader public concern in regards to how the aircraft itself underwent aircraft certification. Rather than the sole reflection of a mistake in the engineering industry, the 737 Max's production and release raised questions about the relationship between aircraft manufacturers like Boeing and regulatory entities that are held responsible for ensuring public transportation safety.

In the United States, the Federal Aviation Administration (FAA) is responsible for certifying aircraft as it determines the safety and satisfactoryness of an aircraft's integrity before entering commercial service. To succeed in managing the increasing complexity of modern aircraft and growing demands for aircraft certification, the Federal Aviation Administration has extensively relied on external authority programs to maintain efficiency with the vast increase in aircraft production throughout the world. These authority programs, such as the Organization Designation Authorization, qualify employees within manufacturers such as Boeing to perform crucial portions of the aircraft certification process on behalf of the FAA while the agency retains sufficient legal oversight for the matter.

Although delegated certification is intended to help expand the internal stability of the aircraft certification process and allow the FAA to continue to manage the growing complexity of the aviation industry, the Boeing 737 Max certification demonstrated how delegation can create regulatory concern, industry conflict, and oversight limitation. Furthermore, the Boeing 737 Max incidents shined light on a drastic lack of action in the aircraft certification process, and shortcomings of authority in the matter itself.

This paper investigates how the Boeing 737 Max served as a primary case study of the overall strengths and weaknesses of the FAA's delegated aircraft certification system. By analyzing the FAA's structure, the Organization Designation Authorization (ODA) program, the certification of the 737 Max aircraft, and the contrasting response from the European Union Aviation Safety Agency (EASA), this research evaluates how the delegation of authority places an influence on regulatory oversight and what results the aviation industry can take away from one of the most significant aircraft certification failures in human history.

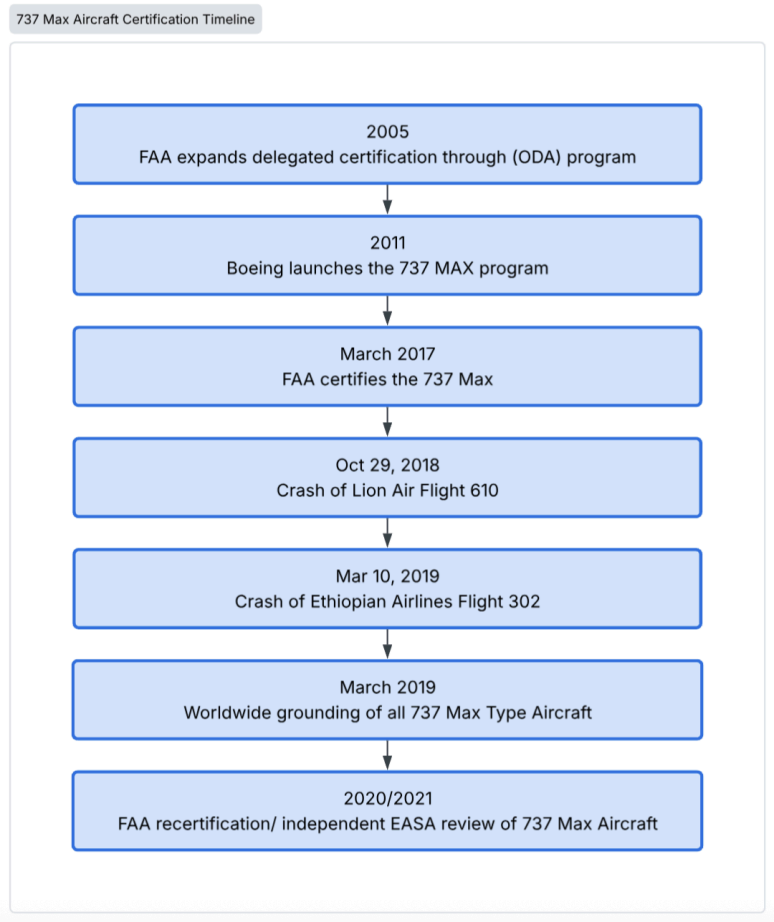

Figure 1: 737 Max Certification Crisis Event Timeline

Regulatory Framework Behind the 737 Max Aircraft Certification

In terms of why the Federal Aviation Administration was put into effect, the aircraft certification process was implemented to ensure the safety of each aircraft design. Traditionally, the administration would employ engineers to conduct a variety of experiments on aircraft systems and controls to determine the airworthiness of an aircraft. [1] Each test would involve strict documentation ruling the design and reliability of the given aircraft type. However, over the past few years, the complexity of aircraft certification has not met the efficiency that the Federal Aviation Administration (FAA) strived for. The systems of aircraft would become more advanced,

such as flight control software, and the implementation of digital avionics into every aircraft. [2] As a resort to avoid the pressure the administration was facing, an external delegation system would be implemented into the administration's authority. This system would formally be known as the Organization Designation Authorization (ODA).

The program would allow large-scale aircraft manufacturers such as Boeing to perform an individual examination of their own aircraft, and they would do so under their own entity. [3] Although the FAA would continue to maintain the program, oversight standards were not met, allowing the company to self-regulate aircraft under its own terms. As modern-day aircraft incorporated a higher complexity of systems, the Federal Aviation Administration expanded the (ODA) program, giving personnel such as qualified engineers within a manufacturing organization, such as Boeing, the ability to perform tests regarding the (FAA) while the agency would maintain authority. [4] Essentially, while the administration would handle the fundamentals of aircraft certification itself, it promoted engineers as the primary workhorse of evaluating aircraft themselves and reporting their findings back to the agency. [5] The Organization Designation Authorization would allow the Federal Aviation Administration to sustain efficiency with proper resources; however, critics strived for the fact that the system was flawed and allowed for conflict in how Boeing chose to self-certify certain aspects of their aircraft. [3]

Although the structure of Boeing’s self-certification stems from the FAA’s standards, manufacturers under the (ODA) are provided authority to sign airworthiness certificates under the FAA’s behalf. Through Type and Production certificates for a given aircraft type, Boeing certifies new aircraft as airworthy without review under circumstances that no design change falls under a New Type Certificate requirement. This structure has unwillingly allowed major commercial aircraft manufacturers such as Boeing to self decide whether and how it will comply with intended federal regulation under the Federal Aviation Administration. [2] This framework remained uninterrupted prior to the 737 Max incidents, where decisions leading up to the accidents showed a heavy reliance on internal assessments solely made by the Boeing company. [6]

Oversight Limitations During the 737 Max Aircraft Certification

Entities such as the Boeing Company, taking aircraft certification into their own hands, introduced large-scale conflicts between the corporation's objective and the demand for safety standards and their coexisting aspects. Although the Boeing corporation was an aviation workhorse for the United States, the company strived for profits, which saw the entity reduce the cost of aircraft production to accelerate aircraft orders and deliveries, while remaining a competitive player in the thriving aviation industry. Certifying an aircraft properly puts weight on the arms of the company, and if addressed properly, the company's aircraft production would bear more burdens in delays. Therefore, Boeing failed to test its own aircraft for flaws in a proper manner, which would create wide-scale conflicts later down the road.

In fact, the FAA's lack of oversight for Boeing further complicated the rising issue. A report from the United States Department of Transportation found that engineers employed by the FAA were prone to challenges, including the organization of certification duties they were assigned to, and often prioritizing efficiency over evaluations. Engineers and inspectors from the administration would be overtasked with maintaining multiple delegated organizations at a time. This would

weaken authority from the administration, allowing companies such as Boeing to abuse their aircraft certification opportunity. [5] In fact, engineers were pushed to the point where it was noted that, in some rare circumstances, the certification of an aircraft was deemed airworthy through the manufacturer's data itself, and with no proper proof of originality, verifying an aircraft was improper and potentially dangerous to its users. [6] The same would be said for the engineers of the Boeing company, where many faced being scheduled to work in various sectors at the same time, making it fairly impossible to properly analyze the airworthiness of an aircraft. Investigations found that the FAA heavily relied on engineers delegated by manufacturers such as Boeing to fulfill the majority of the aircraft certification process. Reviews of the engineers raised concerns about the lack of expertise found among engineers, some not informed about the crucial design changes in aircraft, such as the redesigned 737 Max aircraft. [4] Due to these internal issues, the regulatory wall once held in place to protect the public in air transportation was weakened and would be put to the test.

Case Study: The 737 Max Aircraft Certification

The certification of the Boeing 737 Max serves as a primary example of the regulatory failure that occurred within the Boeing company itself. In the year of 2018, Lion Air flight 610 plummeted into the ground shortly after takeoff. The accident came as a shock to the world and challenged aviation safety. Then, in the year of 2019, Ethiopian Airlines flight 302 would plummet into the ocean, identical to Lion 610. The aftermath of the fatal incidents was a result of the aircraft's faulty Maneuvering Characteristic Augmentation System (MCAS). The Maneuvering Characteristic Augmentation System implemented into the 737 Max fleet relied on inputs from a single angle of attack (AOA) sensor, which was intentionally designed to help address pilots with the engine configurations and safe angles of attack while in the pilot seat. Through the (AOA) sensor, the aircraft would automatically input trim movement into the control surfaces in the wings of the aircraft and ailerons. [7]

Through the incidents involving both the Ethiopian and Lion Air aircraft, investigations would find a fatal flaw in the aircraft's (MCAS) system, resulting in the ground stop of all 737 Max aircraft around the world. After investigation, it was found that the design was inefficient and incomplete, as well as not being fully examined by Boeing engineers in the certification industry. In fact, so little was tested on the system that training programs for the 737 Max did not address the system. It was because of this that the pilots involved in the 737 Max crashes were unaware of what was causing the aircraft to make a sharp nose-down position into the ground, and how the system itself made improper calculations.

Furthermore, investigators would find significant failures regarding the Federal Aviation Administration and the Boeing Company. Reports stated that portions of engineers delegated by the FAA failed to see consistent oversight. [8] As for the FAA, specialists were not informed about the changes made to the 737 Max’s flight software, including the MCAS and its corresponding angle-of-attack implementation. [4] After addressing Boeing’s teams responsible for certifying the 737 Max, it was found that information regarding the (MCAS) system was not disclosed or completely forgotten about in an incomplete manner. Because the Federal Aviation Administration relied on external certifications with the Boeing company, they also did not evaluate the (MCAS) system on the 737 Max fleet. And because of these flaws, the price of

lives lost was paid, along with airlines around the world losing a severe amount of their fleet to the 737 Max ground stop following the accidents. The aftermath would bring widespread conflicts regarding the regulatory systems of aircraft certification, and remain present to this day.

A Comparison to the International Regulatory Process

In contrast to the certification structure of the Federal Aviation Administration, international authorities involved in aircraft certification remain centralized in control compared to the (FAA). Agencies such as the European Union Safety Agency (EASA) withhold direct involvement in evaluating and enforcing aircraft certification. While every regulatory system may be susceptible to a flaw, the ethical approach of oversight and the different approaches taken can balance efficiency and safety, something Boeing and the Federal Aviation Administration has failed to succeed in. In fact, the EASA did not rely on any certification decisions made by the United States about the 737 Max after the incidents, but rather conducted its own technical review on aircraft flying in its designated airspace, and would not allow aircraft operated by European airlines to return to service until a thorough review had been done. [9] However, with the regulatory division present between the two entities, people worldwide have raised questions about the integrity of the FAA and Boeing. Whether aircraft certification across the world is going to be standardized more strictly or reconstruction is an unsolved issue today.

The European Union Safety Agency's Response

Following the incidents of the Boeing 737 Max, the European Union Aviation Safety Agency would perform more independent approaches in their aircraft certification process compared to their relations with the Federal Aviation Administration and certification process that was used traditionally with the organization. A wide scale of European pilots and aviation communities would criticize the FAA and ODA's failure to delegate aircraft certification and viewed it as flawed. Alongside, pilots would argue that the close relationship between the FAA and Boeing was an underlying cause of the weakened safety oversight that was uncovered. The European Cockpit Association which strived for safety standards within the nation stated the significance of how the 737 Max crashes exposed critical flaws within aircraft that had been existing for many years, as well as the corrupt design, regulation, and certification of aircraft in the United States. As a result, the EASA would withdraw from its sole reliance on the Federal Aviation Administration's findings and conduct a fully independent review of aircraft, including flight testing, simulation, and a thorough analysis of aircraft systems. The EASA Executive Director Patrick Ky emphasized the importance of the agency's independent review of American-built aircraft. [10]

Unlike any previous certification practice put into place, the European Union Aviation Safety Agency refused to place its reliance within the exclusive hands of the FAA's recertification process of aircraft such as the Boeing 737 Max. Instead, the EASA strived for the experimentation of its own flight testing, simulator evaluations, and individual engineering review. The agency would also require Boeing to incorporate additional safety practices beyond what the FAA originally demanded. This demonstrated an underlying regulatory philosophy that was the first to be centered on an independent verification of such aircraft rather than the delegation of trust. Herkert, Borenstein, and Miller argued that the EASA's approach would mirror growing international concern in regards to the Federal Aviation Administration's heavy

dependence on delegated aircraft certification and the lack of regulatory oversight that contributed to the 737 Max incidents. And rather than accepting the FAA's conclusions on the matter, EASA demonstrated that an independent verification is crucial in terms of striving to restore the sense of confidence in aircraft certification that is important today. The EASA's decision emphasizes how international regulators questioned whether manufacturers should be involved in the significant role of certifying aircraft to begin with. This particular shift reinforced many concerns that excessively delegating authority within the FAA had compromised the objective of aviation safety regulation that the world aims for.

Herkert, Borenstein, and Miller would state that as a concluding result, aircraft certification would no longer rely on the FAA's decisions or actions over the matter. This specific analysis suggests that the overall consequences of the Boeing 737 Max disasters extended beyond Boeing and altered how foreign aviation authorities viewed the FAA and its practices. Their findings included that the issue was not simply a software malfunction aboard a specific aircraft type, but the weakness lies in the certification of the aircraft itself. The 737 Max would become an international example of how insufficient authority and oversight has the ability to undermine the safety of aviation as a whole, and public trust in the industry. [7]

The overall consequences of flawed aircraft certification range beyond individual accidents the immediate safety concern they entail. Such failures unravel weaknesses in regulation, public confidence, and raised questions about the integrity of aircraft certification and what the process entails. While the 737 Max incidents did present gaps in public trust for the FAA and Boeing, it does not solve the fact that many lives may still be at risk while traveling on board an aircraft. Alongside, citizens today challenge the fundamentals of the agencies. Often, pilots and passengers question whether the certification of an aircraft is intended to ensure safer flying conditions, or solely for the economics themselves.

FAA vs. EASA Comparison		
Agency	**FAA (United States)**	**EASA (European Union)**
Regulation / Delegation	Large scale use of delegated certification through the (ODA)	Greater reliance on independent technical reviews through aircraft certification
Performance	Manufacturer (Boeing) engineers perform significant portions of certification work	Agency specialists conduct a direct evaluation rather than external sources
Review	Reliance solely on Boeing's certification findings before the 737 Max accidents	Conducted an independent review on the 737 Max following both accidents
Outcome	High focus on efficiency through delegation and oversight	Greater stance on independent verification before allowing the 737 Max to return to service

Figure 2: FAA vs. EASA Comparison in regards to their aircraft certification process and implementation of regulation and delegation.

The Underlying Impacts of the 737 Max Incidents

The border consequence of the 737 Max certification failures heavily exposed organizational flaws to an extent beyond common technical design flaws of aircraft. Chary for instance argues

that the Boeing 737 Max disasters revealed systemic issues with organization, including regulatory reports, a weakened employee reporting, and corporate pressure that solely discourages engineers from raising their overall concern in regards to how safety standards are practiced within the aviation industry. Rather than the representation of isolated engineering failure, these issues have demonstrated that organizational culture and delegated authority overrides the regulatory oversight and practice needed to ensure safety within the aviation industry. Such general findings suggest that being able to reform aircraft certification not only requires improving technical systems within the industry, but structuring changes that protect engineering independence and strive for direct communication between manufacturing companies and fellow regulators. [11]

The internal regulatory factors are susceptible to the lack of expertise, allocating resources, and running corporate entities independently. Attending to these issues is crucial to rebuilding the dismembered regulatory system in terms of aircraft certification. Ultimately, the impacts of the 737 Max and its certification failures introduce an issue that extends beyond a single aircraft program as a beginning. As scholarly research and governmental investigations have concluded, a meaningful reformation of aircraft certification requires a deeper sense of transparency, and a regulatory system in the practice of independent safety evaluation. Without such changes, the weaknesses that were revealed in incidents such as the 737 Max, may continue to place a threat on public confidence in regards to the industry and the integrity of aircraft certification.

737 Max Certification Aftermath

Following the Boeing 737 Max incidents, Boeing would face a series of consequences including a grounding of aircraft worldwide, cancelled aircraft orders, and a plummet in the company's stock market. The CEO of the company would ultimately be ousted amid congressional conflict. [2] As for the Federal Aviation Administration, oversight and the (ODA) program would undergo reformation between 2021 and 2022 that would assign dedicated (FAA) personnel to directly overlook Boeing allowing an ensured establishment of fair working conditions to employees. [3] Boeing’s certification privileges were thus disbanded, and the (FAA) would gain a greater share of aircraft certification authority for the 737 Max and other aircraft of interest. [6]

Conclusion

The certification of the Boeing 737 Max is a significant representation of regulatory conflict in modern aviation and demonstrates how delegated certification is vulnerable when factors such as independent oversight, communication, and accountability within organizations are insufficient. While the Organization Designation Authorization program was solely intended to help the Federal Aviation Administration manage the evolution of aircraft certification complexity, the aftermath of the 737 Max accidents uncovered that efficiency improperly replaces an effective manner of regulative oversight.

This paper's findings suggest that the failures being associated with the 737 Max was not the sole result of a flawed software system or isolated decision in the engineering industry. Rather, they reflect the broader weakness in regards to the relationship between the FAA and Boeing during the aircraft certification process. The contrasting response by the European Union

Aviation Safety Agency provides that independent verification directly strengthens overall public confidence in the process of aircraft certification.

The analysis of the relationship between the Federal Aviation Administration (FAA) and Boeing underlines the outcome of the aircraft certification process and several weak points within the system itself. This includes the failed external authority programs, limited oversight, and a lack of communication. This relationship in particular exemplifies how a regulatory framework can inadvertently discourage its purpose when responsibility is not upheld in a rightful manner. As a case study, the Boeing 737 Max illuminates the importance of balancing efficiency with regulatory integrity in modern world aviation. While eliminating delegated authority may not entail a meaningful reformation of the industry, it improves oversight while ensuring that safety is a primary objective for future aircraft certification. Lessons learned from the 737 Max will remain essential for regulators that seek to preserve aviation safety while maintaining public trust.

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