STATUS OF THE BOEING 737 MAX

(116–15)

HEARING

BEFORE THE

SUBCOMMITTEE ON
AVIATION

OF THE

COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

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MAY 10, 2019

SUMMARY OF SUBJECT MATTER

TO: Members, Subcommittee on Aviation
FROM: Staff, Subcommittee on Aviation
RE: Subcommittee Hearing on "Status of the Boeing 737 MAX"

PURPOSE

The Subcommittee on Aviation will meet on Wednesday, May 15, 2019, at 10:00 a.m. in 2167 Rayburn House Office Building to hold an oversight hearing titled, "Status of the Boeing 737 MAX." The hearing will explore the Lion Air Flight 610 and Ethiopian Airlines Flight 302 accidents, the resulting international grounding of the Boeing 737 MAX aircraft, and actions needed to ensure the safety of the aircraft before returning them to revenue service. The Subcommittee will hear testimony from the National Transportation Safety Board and the Federal Aviation Administration.

BACKGROUND

The Federal Aviation Administration's (FAA) mission is to provide the safest, most efficient aerospace system in the world. According to the FAA, the risk of a fatal commercial aviation accident in the United States has been cut by 95 percent since 1997. There has only been one commercial airline passenger fatality in the United States in more than 90 million flights in the past decade.[1] Prior to that single passenger fatality in April 2018, the last fatal domestic commercial airline accident occurred in February 2009, when Colgan Air Flight 3407 crashed near Buffalo, New York, killing all 49 onboard and one person on the ground. However, in a span of five months, there have been two fatal commercial airline accidents involving U.S.-designed and manufactured Boeing 737 MAX aircraft operated by foreign air carriers outside the United States, raising safety concerns. According to the Flight Safety Foundation, worldwide, there were more than 50 fatal airline accidents a year through the early and mid-1990s, claiming well over 1,000 lives annually.[2] Fatalities dropped from 1,844 in 1996 to just 59 in 2017, then rose to 561 last year and 209 already this year (primarily due to the two 737 MAX accidents).[3]

I. FOREIGN AIR CARRIER ACCIDENTS INVOLVING BOEING 737 MAX

A. LION AIR FLIGHT 610

On October 29, 2018, Lion Air Flight 610 (JT610)—a Boeing 737 MAX—a domestic flight en route to Pangkal Pinang from Jakarta, crashed approximately 11 minutes after takeoff into the Java Sea at 450 miles per hour, killing all 189 on board (184 passengers and 5 crew).

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[1] On April 17, 2018, Southwest Airlines Flight 1380 experienced an engine failure, resulting in loss of an engine inlet and cowling. Fragments struck the airplane's fuselage and damaged a cabin window, killing one passenger onboard.

[2] David Koenig and Tom Krisher, "*Recent Airline Crashes Run Against Trend Toward Safer Flying*", U.S. News and World Reports and Associated Press, May 6, 2019, *Available at*: https://www.usnews.com/news/business/articles/2019-05-06/recent-airline-crashes-run-against-trend-toward-safer-flying/

[3] *Id*.

According to the preliminary accident report by Indonesia's Komite Nasional Keselamatan Transportasi (KNKT),[4] after departure, the aircraft's left and right angle of attack (AoA) sensors, which measure the angle between the airplane's wings and the oncoming air, provided the pilots inaccurate readings (a 20-degree difference between left and right sensors). This faulty data made the accident aircraft believe it was in a stall and therefore activated a Boeing system on the 737 MAX called the "maneuvering characteristics augmentation system" (MCAS). The MCAS—designed to help pilots avoid stalls, which occur at excessively high angles of attack—pushes the nose of the aircraft down to allow the aircraft to regain airspeed. However, due to faulty AoA data, the MCAS on JT610 reactivated (i.e., pushed the nose of the aircraft down) more than two dozen times during the 11-minute flight and the pilots' manual attempts to counter the MCAS were ultimately futile.

The preliminary report provides information on the flight crew including[5]:

- Pilot in Command: 8,122 flight hours (1,417 hours in the B737, and 103 hours in the 737 MAX)
- First Officer: 361 flight hours (207 hours in the B737, and 56 hours in the 737 MAX)

According to the preliminary accident report, there were problems reported by flight crews operating the aircraft on October 26, 27, and 28, 2018. The pilots of the flight immediately preceding the accident flight (on October 28, 2018) experienced similar problems to the accident flight. On the October 28, 2018, flight, despite experiencing problems, the pilots continued flying with manual trim and without auto-pilot until safely landing at Jakarta. They reported problems to the airline and the aircraft was serviced, tested, and determined ready for flight.

On November 7, 2019, the FAA issued an Emergency Airworthiness Directive (AD) requiring operators of the 737 MAX to "revise their flight manuals to reinforce to flight crews how to recognize and respond to uncommanded stabilizer trim movement and MCAS events."[6] Specifically, the AD stated that in the event of an "erroneously high [AoA] sensor input . . . there is a potential for repeated nose-down trim commands of the horizontal stabilizer. This condition, if not addressed, could cause the flight crew to have difficulty controlling the airplane, and lead to excessive nose-down attitude, significant altitude loss, and possible impact with terrain."[7] The AD identified existing flight crew procedures to be used in such circumstances.

The Indonesian government's KNKT is leading the ongoing accident investigation. As mentioned previously, on November 27, 2018, the KNKT issued a preliminary report on the Lion Air crash. The preliminary report was compiled prior to the recovery of the cockpit voice recorder and does not contain analysis. The final report, which will include the probable cause(s) of the accident, is expected later this year. The National Transportation Safety Board (NTSB) is assisting with this investigation.

B. Ethiopian Airlines Flight 302

On March 10, 2019, Ethiopian Airlines Flight 302 (ET302)—a Boeing 737 MAX—en route from Bole International Airport in Addis Ababa, Ethiopia, to Nairobi, Kenya, crashed approximately six minutes after takeoff. The accident resulted in the death of all 157 people on board (149 passengers and 8 crew members).

According to the Ethiopian Ministry of Transport's preliminary accident report, faulty AoA data from one sensor triggered the MCAS during flight, pulling the nose of the aircraft down, before it ultimately crashed into terrain. Unlike the Lion Air pilots, the Ethiopian Airline pilots cut off the trim (disconnecting the electric portion of the plane's stabilizer), in accordance with Boeing's emergency checklist described in the FAA's Emergency AD issued months prior. The pilots did not reduce the throttles after takeoff and the aircraft accelerated between 450 and 500 knots. As depicted in the image below, manually countering MCAS activation at excessive airspeed can be difficult or nearly impossible due to the downward force on the plane's

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[4] Translated means "Transportation Safety National Committee" or "National Transportation Safety Committee".

[5] ET302 Preliminary Report *available at* http://www.ecaa.gov.et/documents/20435/0/Preliminary+Report+B737-800MAX+%2C%28ET-AVJ%29.pdf/4c65422d-5e4f-4689-9c58-d7af1ee17f3e.

[6] Elwell, Daniel K, Federal Aviation Administration, Testimony before for the Senate Commerce Committee, Aviation and Space Subcommittee, hearing on State of Airline Safety: Federal Oversight of Commercial Aviation, p.7 (March 27, 2019).

[7] FAA Emergency Airworthiness Directive, AD # 2018-23-51 (Nov. 7, 2018), *available at* http://rgl.faa.gov/Regulatory__and__Guidance__Library/rgad.nsf/0/83ec7f95f3e5bfbd8625833e0070a070/$FILE/2018-23-51__Emergency.pdf.

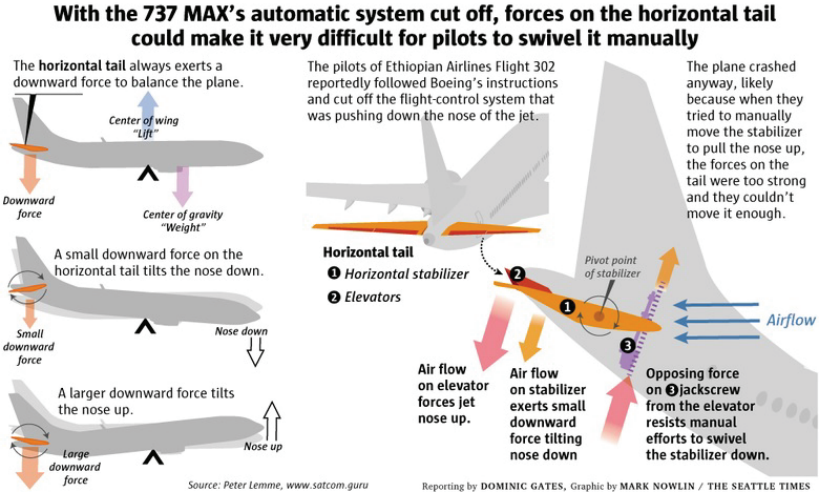
tail. According to the report, the pilots reactivated the automated system and the plane went nose down again. The pilots were unable to recover.

The preliminary report provides information on the flight crew including [8]:

- Pilot in Command: 6,028 hours (5,176 hours in the B737; hours in MAX not provided)
- First Officer: 5,174 hours (4,286 hours in the B737; hours in MAX not provided)

Immediately following the accident, foreign civil aviation authorities began grounding the Boeing 737 MAX planes. On March 11, 2019, the FAA issued a Continuous Airworthiness Notification to the International Community (CANIC) for 737 MAX operators, describing the FAA's activities following the Lion Air accident in support of continued operational safety of the 737 MAX fleet. On March 13, two days later, the FAA ordered a temporary grounding of the fleet operated by U.S. airlines or in U.S. territory. The Boeing 737 MAX remains grounded today.

The Ethiopian government is leading the accident investigation. As mentioned above, on April 4, 2019, Ethiopia's Ministry of Transport's Aircraft Accident Investigation Bureau issued a preliminary report on the Ethiopian Airlines crash. A final report detailing probable cause(s) of the accident is expected within the year. The NTSB is assisting with this investigation as well.



Seattle Times article, "Why Boeing's emergency directives may have failed to save 737 MAX," by Dominic Gates on April 3, 2019.

C. Issues to be considered in 737 MAX Accident Investigations:

An aviation accident rarely has one probable cause. Rather, accident investigators consider a number of factors, including: operations, weather, human performance, survival factors, and aircraft structures, power plants, and systems, to name a few.

In terms of the two 737 MAX accidents, as the U.S. is the state of design and manufacture, the FAA and NTSB are serving as technical experts to examine aircraft design and certification. In accordance with Annex 13 to the U.N. International Civil Aviation Organization, Indonesia and Ethiopia will (respectively) be responsible for examining a number of factors, including: pilot experience, pilot training, operational factors, and aircraft maintenance.

International Pilot Training Standards: According to International Civil Aviation Organization (ICAO) Standards and Recommended Practices, the pilot-in-command requires an Airline Transport Pilot Licence (ATP). An ATP requires a pilot have "completed not less than 1500 hours of flight time. Further, "[t]he Licensing Authority shall determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 1500 hours. Credit for such experience shall be limited to a maximum of 100 hours, of which

[8] Lion Air 601 Preliminary Report *available at* https://reports.aviation-safety.net/2018/20181029-0__B38M__PK-LQP__PRELIMINARY.pdf

not more than 25 hours shall have been acquired in a flight procedure trainer or a basic instrument flight trainer."[9]

ICAO also provides standards to obtain a Multi-Crew Pilot Licence (MPL), which "allows a pilot to exercise the privileges of a co-pilot in a commercial air transportation on multi-crew aeroplanes."[10] ICAO Standards for an MPL are set at a minimum of 240 hours "as the minimum number of actual and simulated flight hours performing the functions of the pilot flying and the pilot non-flying."[11] The ICAO Standard "does not specify the breakdown between actual and simulated flight hours and thus allow part of the training curriculum that was traditionally conducted on aeroplane to be done on flight simulation training devices."[12] The applicant pilot is required to meet "all the actual flying time for a private pilot licence plus additional actual flying time in instrument, night flying and upset recovery."

FAA Certification: Given that the FAA will need to review and approve any software fix proposed by Boeing and determine whether changes to the 737 MAX training program are needed in order to get the aircraft back in revenue service, this memorandum will focus on FAA's certification processes.

II. OVERVIEW OF THE FAA'S CERTIFICATION PROCESSES

All aircraft and aviation products are subject to FAA certification prior to their sale and usein the United States. The FAA is responsible for regulating aviation safety, which includes approvingthe design and manufacture of new aircraft and aviation products before they enter the National Airspace System (NAS).[13] The FAA's Office of Aviation Safety encompasses two offices that handle certification processes: the Aircraft Certification Service and the Flight Standards Service. See Appendix 1 for a depiction of these divisions' functions. The FAA administers regulations regarding the design and production of aircraft and their constituent systems as well as continued operational safety.[14]

A. Boeing 737 MAX

According to the FAA, the process to issue a type-certificate for the Boeing 737 MAX, from initial application to final certification, took five years.[15] The process included 297 certification flight tests, including tests of the MCAS functions. The final type certificate was issued in March 2017. The FAA reports it was "directly involved" in the System Safety Review of the MCAS.[16]

B. Aircraft Certification Service

The FAA's Aircraft Certification Service is responsible for issuing "type certificates" (approvals) to manufacturers and designers for new products that are to be used in the NAS, including aircraft, engines, propellers, and aircraft parts; ensuring the continued operational safety of those products through their life cycles; and developing regulations and guidance in this area.[17] The Aircraft Certification Service has 1,370 staff members, which includes engineers, inspectors, flight test pilots, technical advisors, and others. This staff—in local certification offices across the country—manages "certification projects" during which engineers and other specialists determine whether a new product complies with FAA regulatory standards and, if so, issues a certificate for the product. The applicant company and FAA staff work closely during each phase of the product certification process, from design conceptualization to certification, and then through the product's remaining life cycle to ensure continued airworthiness.[18]

Aircraft Certification Service staff who process and approve aircraft products also oversee the continued operational safety of those products. The staff, therefore, relies on a project sequencing system to prioritize, on a nationwide basis, certification submissions based on resource availability.[19] The FAA prioritizes overseeing the

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[9] See ICAO Annex 1, Personnel Licensing, section 2.6 Airline transport pilot (ATP) licence
[10] *See* https://www.icao.int/safety/airnavigation/Pages/peltrgFAQ.aspx#anchor24
[11] *Id*.
[12] *Id*.
[13] *See* 49 U.S.C. §§ 44702, 44704; GAO-14-829T at 1.
[14] *See, e.g.*, 14 C.F.R. part 21, *et seq*.
[15] *Supra* note 2, pg. 6.
[16] *Id*.
[17] *See* GAO-14-829T at 7. Note that the FAA may also issue "supplemental type certificates" for modifications to an original design with a type certificate.
[18] GAO-15-550T at 3-4.
[19] GAO-14-829T at 5.

continued operational safety of products already in the NAS over issuing new certifications and approvals.[20]

C. FLIGHT STANDARDS SERVICE

The FAA's Flight Standards Service is responsible for issuing certificates and approvals to pilots and operators of aircraft, ranging from large airlines to small charter outfits. Flight Standards Service grants certificates to air operators (e.g., air carriers and taxi services) and air agencies (e.g., flight schools and repair stations); ensures the continued operational safety of those persons and entities (through surveillance, inspection, investigations, and enforcement); and determines standards and regulations necessary for continued operational safety.[21] Flight Standards Service also manages the system for registration of civil aircraft and all airmen records.[22] Flight Standards Service includes 5,157 staff members, across 119 field offices. Unlike the Aircraft Certification Service's national prioritization of certification submissions, Flight Standards reviews applications on a first-come, first-served basis. According to the Government Accountability Office (GAO), the Flight Standards Service struggles to keep up with its certification workload.[23] The U.S. Department of Transportation (DOT) Inspector General in 2014 found that Flight Standards Service had a significant backlog of applications, with over 100 applicants waitlisted for more than three years.[24]

D. ORGANIZATION DESIGNATION AUTHORIZATION

Since even before the FAA was formed over 60 years ago, the federal government has delegated some safety certification responsibilities to technical experts in the industry. As airplanes, engines, and their constituent systems became increasingly complex, Congress authorized the FAA to leverage the product-specific knowledge among appropriately-qualified employees of manufacturers to determine a new product's compliance with the applicable provisions of the Federal Aviation Regulations. Through its organizational delegation authority (originally authorized by Congress in 1958), the FAA may authorize private designees (manufacturers and repair stations) to act on behalf of the agency in conducting certain safety certification actions, while the FAA retains ultimate responsibility for overseeing compliance; the FAA established the organization designation authorization (ODA) program in 2005 to consolidate all existing organizational delegation types into one program.[25] A designee may receive authority to examine, inspect, and test aircraft and persons for the purpose of issuing certificates.[26] Once a designee establishes through inspections and tests that an aviation product comports with FAA standards, the FAA will conduct a risk-based review of the designee's work, issuing a type certificate if the product meets minimum safety standards. According to the GAO, in terms of the breadth or scope of activities performed by FAA designees, designees perform more than 90 percent of FAA's certification activities.[27]

The delegation program allows the FAA to leverage limited resources to focus on the areas of highest-risk and make timely certification decisions. Under the delegation program, there are ODA unit members and individual designees. ODA unit members are appointed under the umbrella of a specific company ODA. Individual designees are assigned specific delegated functions by the FAA and can work across multiple companies and projects. To date, FAA reports 4,646 unit members and 2,653 individual designees (covering engineering and manufacturing responsibilities) supporting certification activities nationwide. Currently, there are 79 Aircraft Certification Service ODAs.

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[20] GAO-14-829T at 6.

[21] *See* 49 U.S.C. §§ 44703, 44705-10; GAO-14-829T at 7; FAA, *Flight Standards Service (AFS)*, https://www.faa.gov/about/office__org/headquarters__offices/avs/offices/afs/.

[22] *See Flight Standards Service (AFS), supra* note 12.

[23] GAO-14-829T at 6.

[24] U.S. Dep't of Transp. Office of Inspector Gen., AV-2014-056, *Weak Processes Have Led to A Backlog of Flight Standards Certification Applications, Federal Aviation Administration* 2 (June 12, 2014).

[25] *See* 49 U.S.C. § 44704(e); GAO-14-829T at 4.

[26] GAO-14-829T at 4.

[27] U.S. Gov't Accountability Office, GAO-13-442T, *Aviation Safety: FAA Efforts Have Improved Safety, but Challenges Remain in Key Areas* 3-4 (Apr. 16, 2013). In a May 7, 2019 email to Committee staff, the GAO clarified that the 90% number refers to the breadth or scope of FAA activities designees can do work on rather than the amount of certification work done by designees.

E. LEGISLATION

The FAA Reauthorization Act of 2018 (P.L.115-254) includes several provisions aimed at improving and enhancing the FAA's certification process. For example, the legislation requires the FAA to implement a safety-systems approach and encourages risk-based oversight efforts. The legislation also encourages full utilization of the FAA's existing delegation authorities (i.e., ODA) so that the agency can focus on the highest-risk items and new and novel technologies during the certification process. Finally, the legislation improves workforce training for FAA aviation safety inspectors and safety engineers for certification programs including ODA oversight.

III. NATIONAL TRANSPORTATION SAFETY BOARD

The NTSB is an independent agency charged with the investigation of transportation accidents in the United States. When an aviation accident or serious incident occurs outside of the United States, the NTSB participates in the investigation in accordance with the Chicago Convention of the International Civil Aviation Organization and the Standards and Recommended Practices (SARPS) provided in Annex 13 to the Convention.[28]

The NTSB is assisting both the Indonesian-led investigation of the Lion Air crash as well as the Ethiopian-led investigation of the Ethiopian Air crash. Boeing is serving as a technical advisor for the investigations in its role as the manufacturer of the 737 MAX. The FAA is also serving as technical advisor as the certifying authority for the 737 MAX.

IV. REVIEWS OF THE BOEING 737 MAX

Subsequent to the two fatal foreign airline Boeing 737 MAX accidents, DOT, the FAA, and Boeing have stood up various panels, including:

SAFETY OVERSIGHT AND CERTIFICATION ADVISORY COMMITTEE SPECIAL COMMITTEE

On March 25, DOT announced it would create the Special Committee to review the FAA's Aircraft Certification Process (Special Committee) under the new authority granted by the FAA Reauthorization Act of 2018.[29] The Special Committee is tasked with reviewing the procedures of the FAA for the certification of new aircraft, including the Boeing 737 MAX.[30] The Special Committee's review of the certification process includes the "FAA certification process workplan, process timeline, Organization Designation Authorization, Designated Engineering Representatives Authorization/Certification, Authorized Representation Certification and oversight thereof."[31] The Special Committee will focus primarily on the Boeing 737 MAX 8 certification process from 2012 to 2017 and make recommendations for how the process could be improved.[32] Its findings and recommendations will then be presented directly to the DOT Secretary and the FAA Administrator for their consideration.[33]

SAFETY OVERSIGHT AND CERTIFICATION ADVISORY COMMITTEE (SOCAC)

On March 25, DOT announced it will stand up the Congressionally-mandated Safety Oversight and Certification Advisory Committee. The SOCAC is required to advise the Transportation Secretary on policy-level issues related to FAA safety certification and oversight programs, including efforts to streamline aircraft and flight standards certification processes, utilization of delegation authorities, risk-based oversight efforts, and training programs. The SOCAC will develop training and continuing education objectives for FAA engineers and safety inspectors. While not directly tasked with Boeing certification, aircraft certification is a key tasking of the committee.

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[28] https://www.ntsb.gov/investigations/__layouts/ntsb.aviation/foreign.aspx.

[29] Federal Aviation Administration (FAA), *DOT Announces Special Committee to Review FAA's Aircraft Certification Process* (2019), *available at* https://www.transportation.gov/briefing-room/dot1619

[30] *Id.*

[31] Department of Transportation (DOT), *Letter to General McDew* (2019), *available at* https://www.transportation.gov/sites/dot.gov/files/docs/briefing-room/337281/gen-darren-mcdew.pdf

[32] *Id.*

[33] *Id.*

JOINT AUTHORITIES TECHNICAL REVIEW

On April 2, the FAA established a Joint Authorities Technical Review (JATR)[34] to conduct a comprehensive review of the certification of the automated flight control system (MCAS) on the Boeing 737 Max, including evaluating aspects of its design and pilots' interaction with the system, determining its compliance with all applicable regulations and identifying future enhancements that might be needed.[35]

The JATR is chaired by former NTSB Chairman Chris Hart and comprised of a team of experts from the FAA, National Aeronautics and Space Administration (NASA), and international aviation authorities, including China, Indonesia, Australia, Brazil, Canada, Singapore, the United Arab Emirates (UAE), and the European Union Aviation Safety Agency (EASA).[36] The JATR had its first meeting on April 29, 2019, and is expected to last three months from the date it was established.[37] The JATR is not tied to the FAA's decision for return to service of the 737 MAX. That decision will be based upon FAA's assessment of the sufficiency of the proposed software updates and pilot training to address known issues for grounding the aircraft.

BOEING BOARD OF DIRECTORS REVIEW COMMITTEE

On April 5, 2019, Boeing announced it was creating a panel that will examine the design and development of its aircraft.[38] According to Boeing's statement, the panel will examine "company-wide policies and processes for the design and development of its aircraft" and will also "confirm the effectiveness of [its] policies and processes for assuring the highest level of safety on the 737-MAX program, as well as [its] other airplane programs, and recommend improvements to [its] policies and procedures."[39]

V. ONGOING INVESTIGATIONS

U.S. HOUSE OF REPRESENTATIVES COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

On March 13, 2019, Chairman Peter A. DeFazio and Subcommittee on Aviation Chairman Rick Larsen launched an investigation by the Committee on Transportation and Infrastructure into the certification of the Boeing 737 MAX.

DOT INSPECTOR GENERAL

On March 19, 2019, Secretary Elaine Chao requested the DOT Inspector General (DOT IG) to conduct an audit, "to compile an objective and detailed factual history of the activities that resulted in the certification of the Boeing 737-MAX 8 aircraft."[40]

On March 19, 2019, Chairman DeFazio and Aviation Subcommittee Chairman Rick Larsen asked DOT IG to investigate the certification process for the Boeing 737 MAX, including how each of the new features on the plane, including the AoA sensors and the MCAS, were tested and certified. The request also seeks investigation of the FAA's decision not to revise pilot training programs and manuals to reflect flight critical automation systems; how new features of the aircraft were communicated to airline customers, pilots and foreign civil aviation authorities; whether ODA authority contributed to any of the factors FAA considered in its decision-mak-

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[34] FAA, *FAA Updates on the Boeing 737 MAX: FAA Establishes Joint Authorities Technical Review (JATR) for Boeing 737 MAX* (2019), *available at* https://www.faa.gov/news/updates/?newsId=93206

[35] On March 26, 2019, Chair of the House Committee on Transportation and Infrastructure Peter DeFazio (D-OR) and Chair of the Subcommittee on Aviation Rick Larsen (D-WA) sent a letter to Acting Administrator Daniel K. Elwell of the Federal Aviation Administration (FAA), urging the FAA to engage an independent, third-party review composed of individuals with the technical skills and expertise to objectively assess the corrective measures proposed for the 737 MAX by Boeing.

[36] *Id.*

[37] *Id.*

[38] Boeing, *Statement from Boeing CEO Dennis Muilenburg: We Own Safety—737 MAX Software, Production and Process Update* (2019), *available at* https://boeing.mediaroom.com/2019-04-05-Statement-from-Boeing-CEO-Dennis-Muilenburg-We-Own-Safety-737-MAX-Software-Production-and-Process-Update

[39] *Id.*

[40] The IG reports similar audit requests were submitted by the Chairman and Ranking Member of the Senate Committee on Appropriations, Subcommittee on Transportation, Housing and Urban Development, and Related Agencies; and Senator Richard Blumenthal (D-CT). *See* https://www.oig.dot.gov/sites/default/files/Audit%20Annoucement%20-%20FAA%27s%20Oversight%20of%20the%20Boeing%20737%20MAX%20Certification.pdf.

ing; and a status report on how corrective actions have been implemented since the Lion Air crash in October 2018.

On March 29, 2019, Chairman DeFazio, Ranking Member Sam Graves, Aviation Subcommittee Chair Larsen, and Aviation Subcommittee Ranking Member Garret Graves requested that the DOT IG launch an investigation of international pilot training standards and training for commercial pilots operating outside of the United States, including training for the Boeing 737 MAX.

U.S. DEPARTMENT OF JUSTICE

According to multiple news sources, it was reported that the Department of Justice (DOJ) is conducting a criminal investigation into the FAA's certification of the Boeing 737 MAX.[41] Reports indicate the investigation began after the October 2018 Lion Air crash and is primarily focusing on the certification process.[42] According to news reports, the FBI Seattle Office and the Justice Department's criminal division in Washington state are leading the investigation.[43]

VI. NEXT STEPS

After the October 2018 Lion Air crash, Boeing announced that the company is working on a design change to implement a software patch for the MCAS. Boeing continues to work on the certification documentation required to certify the MCAS software enhancement and the associated pilot training material. The FAA is responsible for reviewing and approving this and any other design changes to the 737 MAX. According to the FAA, the "737 MAX will return to service for U.S. carriers and in U.S. airspace only when the FAA's analysis of the facts and technical data indicate that it is appropriate.[44]"

There are more than 370 Boeing 737 MAX worldwide, with fewer than 100 operated by U.S. airlines and grounded at this time.[45] Southwest Airlines is the top 737 MAX operator in the United States.

WITNESSES

- Daniel Elwell, Acting Administrator, Federal Aviation Administration, *Accompanied by* Earl Lawrence, Executive Director Aircraft Certification, FAA
- Robert L. Sumwalt, Chair, National Transportation Safety Board, *Accompanied by* Dana Schulze, Acting Director, Office of Aviation Safety, NTSB

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[41] *See* Steve Miletich, *FBI Joining Criminal Investigation into Certification of Boeing 737 MAX*, The Seattle Times, March, 20, 2019, *available at* https://www.seattletimes.com/business/boeing-aerospace/fbi-joining-criminal-investigation-into-certification-of-boeing-737-max/; Evan Perez and Shimon Prokupecz, *Justice Department Issues Subpoenas in Criminal Investigation of Boeing*, CNN, March 21, 2019, *available at* https://www.cnn.com/2019/03/20/business/boeing-justice-department-subpoenas/index.html

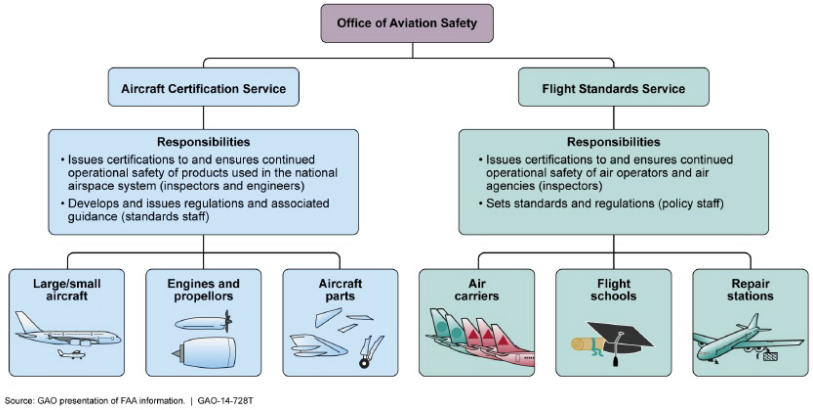
[42] *Id.*

[43] *Id.*

[44] Elwell, supra note 5, pg. 9.

[45] https://www.cnbc.com/2019/03/13/boeing-shares-fall-after-report-says-us-expected-to-ground-737-max-fleet.html

APPENDIX 1. CERTIFICATION IN THE FAA'S OFFICE OF AVIATION SAFETY.



Source: GAO presentation of FAA information. GAO–14–728T

STATUS OF THE BOEING 737 MAX

WEDNESDAY, MAY 15, 2019

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON AVIATION,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
Washington, DC.

The subcommittee met, pursuant to notice, at 10 a.m. in room 2167, Rayburn House Office Building, Hon. Rick Larsen (Chairman of the subcommittee) presiding.

Mr. LARSEN. The subcommittee will come to order. I want to thank folks for coming this morning. We will get started here.

The ranking member of the subcommittee and full committee will be here soon enough. And I want to thank Mr. Mitchell for sitting in.

Good morning, and thank you today to the witnesses for joining the subcommittee's discussion on the status of the Boeing 737 MAX.

Three hundred and forty-six people died in the Ethiopian Airlines flight 302 crash near Addis Ababa, Ethiopia, and the Lion Air flight 610 crash en route to Jakarta, Indonesia.

Congress has an obligation to the traveling public, and the victims of these accidents and their families, to ensure the safety of air travel. If the public does not feel safe about flying, then they won't fly. If they don't fly, airlines don't need to buy airplanes. If they don't need to buy airplanes, then airplanes don't need to be built. And if there is no need to build airplanes, we don't need jobs in aviation. Therefore, it is very clear that the foundation of the U.S. aviation system is safety.

And this committee will continue to maintain safety as its guiding principle, and will use the tools at its disposal to reduce the likelihood of tragedies like this from happening again.

I want to start by updating the subcommittee members and the public on the committee's work to date. Chair DeFazio and I continue to engage with the FAA, the National Transportation Safety Board, Boeing, pilots, aviation stakeholders, and others about these accidents.

First, on March 19th, Chair DeFazio and I requested the Department of Transportation inspector general, or the DOTIG, assess the FAA's approach to certifying the Boeing 737 MAX.

Second, the committee's oversight and investigations team continues to work with the FAA and Boeing on the records request Chair DeFazio and I sent on the certification of the MAX.

Third, the committee sent a separate, bipartisan DOTIG request to evaluate aircraft cockpit automation and international pilot training standards.

Fourth, following a request from Chair DeFazio and I for a third-party review of the certification of Boeing's anticipated 737 MAX software update and related training, the FAA established a Joint Authorities Technical Review, or JATR, and a Technical Advisory Board, or TAB.

The JATR's independent review will ensure thorough oversight of the process, and rebuild public confidence that the U.S. is the global standard in aviation safety.

In addition, the TAB, composed of the U.S. Air Force, the Volpe National Transportation Systems Center, and NASA, will provide an independent review of the proposed software change and integration into the MAX flight control system.

I encourage all members of the subcommittee to personally continue monitoring the situation, and staff is available for any questions you might have surrounding the investigation, and can provide you with updates as they become available.

What I hope to hear from witnesses today: Acting Administrator Elwell and Chairman Sumwalt, the subcommittee understands certain information about actions cannot be publicly discussed at this time because some investigations are ongoing. However, there is still important information that this subcommittee can learn in today's hearing.

For instance, Mr. Elwell, I will look forward to hearing more about the FAA's decisionmaking regarding the certification of the 737 MAX. I want you to clarify the ODA process, as well as the agency's role in determining risk assessments assigned to key safety features on the aircraft, most notably the angle of attack, or AOA, sensors, and the Maneuvering Characteristics Augmentation System, or MCAS, and whether these features should have been designated as safety critical.

A recent Wall Street Journal article reported an internal FAA review concluded the agency itself failed to perform proper oversight of the certification of the MCAS system. If that is, in fact, true, the ODA program is not working as Congress intended.

I also want to hear more about FAA's role in the development of associated pilot training for the MAX, including opportunities for input from pilots and engagement with Boeing on the related flight manuals.

Additionally, I am interested in the JATR and the TAB's future processes, and how the work of these two groups align with the recently established Safety Oversight and Certification Advisory Committee, as mandated under the FAA bill we passed last year.

And finally, from you I want to hear what steps the FAA will take between now and when the 737 MAX is permitted to fly again.

Mr. Elwell, the FAA has a credibility problem. The FAA needs to fix its credibility problem. This committee will work with the FAA as it rebuilds public and international confidence in its decisions. But our job is oversight, and the committee will continue to take this role seriously.

Chairman Sumwalt, I look forward to learning more about the NTSB's collaboration with foreign investigation authorities, and

your insights on the preliminary reports for JT610 and ET302 accidents.

Congress must find answers to what happened surrounding these two accidents and ensure the safety of the Boeing 737 MAX for the sake of the flying public.

The FAA must take steps to restore public confidence in the ability to maintain the safest aerospace system in the world.

Today's hearing comes at the beginning of the committee's investigative process, and is the first of what will likely be a series of hearings on the MAX. The committee will continue its thorough investigation until it fully understands all the issues surrounding the 737 MAX accidents. And the committee will not hesitate to act to ensure the safety of the U.S. aviation system.

I will continue to work with Chair DeFazio throughout this process, as well as subcommittee members, the FAA, the NTSB, Boeing, aviation stakeholders, and families of the victims.

Thank you again to the witnesses today. I look forward to hearing you address these issues I have outlined in my statement.

[Mr. Larsen's prepared statement follows:]

Prepared Statement of Hon. Rick Larsen, a Representative in Congress from the State of Washington, and Chair, Subcommittee on Aviation

Good morning and thank you to today's witnesses for joining the Subcommittee's discussion on the "Status of the Boeing 737 MAX."

Three hundred forty-six people died in the Ethiopian Airlines Flight 302 crash near Addis Ababa, Ethiopia and the Lion Air Flight 610 crash en route to Jakarta, Indonesia.

Congress has an obligation to the traveling public and the victims of these accidents and their families to ensure the safety of air travel.

If the public doesn't feel safe about flying then they won't fly; if they don't fly, airlines don't need to buy airplanes; if they don't need to buy airplanes, then airplanes don't need to be built; and if there is no need to build the airplanes, then there will be no jobs.

Therefore, the foundation of the U.S. aviation system is safety.

This Committee will continue to maintain safety as its guiding principle and will use tools at its disposal to reduce the likelihood of tragedies like these from happening again.

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I encourage all Members to personally continue monitoring this situation.

Staff is available for any questions you may have surrounding the investigation and can provide you with updates as they become available.

WHAT I HOPE TO HEAR FROM WITNESSES

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However, there is still important information this Subcommittee can learn in today's hearing.

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Finally, I would like to hear what steps the FAA will take between now and when the Boeing 737 MAX is permitted to fly again.

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NEXT STEPS

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Today's hearing comes at the beginning of the Committee's investigative process and is the first in what will be a series of hearings on the 737 MAX.

The Committee will continue its thorough investigation until it fully understands all the issues surrounding the 737 MAX accidents.

The Committee will not hesitate to act to ensure the safety of the U.S. aviation system.

I will continue to work with Chair DeFazio throughout this process as well as Subcommittee members, FAA, NTSB, Boeing, aviation stakeholders and families of victims.

Thank you again to today's witnesses and I look forward to hearing you address the issues I outlined in my opening statement.

Mr. GRAVES OF MISSOURI. A lot of Graveses in there.

Mr. LARSEN. A lot of Graveses.

Mr. GRAVES OF MISSOURI. Thank you, Chairman Larsen, and I do want to thank you and Ranking Member Graves for holding this hearing.

I want to extend my condolences to the families and friends of the accident victims. Their loss is why it is important that we un-

derstand what occurred and what is needed to get the 737 MAX safely back in the air.

Safety is the highest priority, and we have to regularly examine our safety programs. And while we are in early stages of this investigation, many appear to have already concluded that the FAA's process is to blame. Should the various investigations reveal problems with the certification of the 737 MAX, then Congress can and should act. But any actions Congress or regulators consider have to be based on facts, and not panicked desire just to do something.

I reviewed the Lion Air and the Ethiopian preliminary accident reports and I feel strongly about sharing my thoughts with this committee based on my experience and perspective as a pilot with an ATP rating.

First, with Lion Air, there were flight control problems reported by the pilots flying the same aircraft on the 3 days prior to the accident flight. On the flight the day before the accident flight the pilots experienced the identical issues, yet they flew more than an hour with the autopilot off and trimmed the plane manually. Unfortunately, it doesn't appear that they fully reported the problems. Yet based upon those reports, the aircraft was serviced and it was cleared for flight.

The preliminary accident report prepared by Ethiopian authorities concludes that the pilots followed proper procedures, but there are several facts that absolutely contradict that conclusion.

First, the aircraft accelerated throughout the entire flight. The pilots never pulled the throttles back after setting them for full thrust at takeoff. The aircraft actually accelerated to between 450 to 500 knots, which is far beyond the maximum speed, certified speed, of the MAX 8 of 340 knots. That fundamental error appears to have had a domino effect on the events that followed after that.

After an apparent faulty sensor caused the planes MCAS to pitch the plane's nose down, the pilots did follow procedures by turning off the automated system, and they tried to manually trim the airplane. However, they were simply going too fast to manually trim that plane. If you can imagine driving down the road in a car going 100 miles an hour and trying to push the door open, you know what I am talking about.

The pilots, both in their twenties, with less than 160 total hours combined time in the 737 MAX, then reactivated the automated system. The plane went nose down again, and the pilots were unable to recover that aircraft.

No operating procedure that I know of or have ever heard of directs a pilot to reactivate a faulty system. The Lion Air and Ethiopian pilots desperately tried to save their passengers, but the facts and the preliminary report reveal pilot error as a factor, one of the factors—and there are always many factors in these situations, in these tragically fatal accidents.

To focus on one single cause fails to see the forest for the trees. So we are developing an MCAS software fix, but we can never eliminate every risk or anticipate all scenarios, no matter how much technology is in the cockpit. Failures will occur. That is the reason why I have stated this time and time again, that the most important safety feature you can have in any aircraft is a well-

trained pilot that can fly the aircraft, regardless of what the investigations conclude.

Airlines have to ensure that their pilots are sufficiently trained and experienced to handle the aircraft in which they are in. Pilots can master the cockpit's technology, but they have to be able to fall back on their training to fly the plane. That is first and foremost: fly the plane, not just fly a computer.

For me, the action report reaffirms my belief that pilots trained in the United States would have successfully been able to handle this situation. The reports compound my concerns about quality training standards in other countries, and that is why I have asked the DOT inspector general to look at international pilot training.

And in the end these facts are irrefutable: the U.S. aviation system is the world's safest, thanks to our FAA leadership. And despite sensational reports claiming that the agency's international standing is in question, our FAA remains the gold standard for safety in the United States. In the last decade in the United States there have been nearly 7 billion passengers flown on 90 million flights with 1 fatality. And this includes 57,000 flights in the MAX 8, 737 MAX 8. While one loss of life is too many, that is a remarkable safety record that we can be proud of here in the U.S.

And one reason our system is safe is the collaborative process between the FAA, pilots, manufacturers, airlines, mechanics, everybody up and down the line. This decades-old system or structure has worked so well that last Congress we overwhelmingly voted to uphold and improve the agency's aircraft certification process. And I caution those who want to blame the FAA process that jumping to conclusions only serves to erode confidence in the U.S. aviation system when the safety record absolutely speaks for itself.

We have preliminary information, we do not have the final reports, nor the benefit of the investigative work that has yet to be completed. But what we do know does not justify abandoning the FAA's proven system that has made air travel here in the United States the safest mode of transportation in history.

And again, I want to thank you all for holding this hearing, and I would yield back the balance.

[Mr. Graves of Missouri's prepared statement follows:]

Prepared Statement of Hon. Sam Graves, a Representative in Congress from the State of Missouri, and Ranking Member, Committee on Transportation and Infrastructure

Thank you Chairman Larsen and Ranking Member Graves for holding this hearing.

I want to extend my condolences to the families and friends of the accident victims. Their loss is why it is important we understand what occurred and what is needed to get the 737 MAX safely back in the air.

Safety is the highest priority, and we should and do regularly examine our safety programs.

While we are early in the investigations, many appear to have already concluded that the FAA's processes are to blame. Should the various investigations reveal problems with the certification of the 737 MAX, Congress can and should act. But any actions Congress or regulators consider must be based on facts, not a panicked desire to "do something."

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The preliminary accident report prepared by the Ethiopian authorities concludes that the pilots followed proper procedures, but there are several facts that contradict that conclusion.

First, the aircraft accelerated throughout the flight; the pilots never pulled back the throttles after setting them at full thrust for takeoff. The aircraft actually accelerated to between 450 and 500 knots—far beyond the maximum certified speed of 340 knots. That fundamental error appears to have had a domino effect on all the events that followed.

After an apparent faulty sensor caused the plane's MCAS to angle the plane's nose down, the pilots did follow the procedures by turning off the automated system and trying to manually trim the plane. However, they were simply going too fast to manually level the plane—imagine trying to open a car door at 100 mph.

The pilots—both in their 20s and with less than 160 total hours combined flying a 737 MAX—then *reactivated* the automated system. The plane went nose-down again, and the pilots were unable to recover. No operating procedures that I know of direct a pilot to reactivate a faulty system.

The Lion Air and Ethiopian pilots desperately tried to save their passengers, but the facts in the preliminary reports reveal pilot error as a factor in these tragically fatal accidents. To focus on a single possible cause fails to see the forest for the trees.

Boeing is developing an MCAS software fix, but we can never eliminate every risk or anticipate all scenarios, no matter how much technology is in the cockpit. Failures will occur.

The most important safety feature in any cockpit is a well-trained pilot. Regardless of what the investigations conclude, airlines must ensure their pilots are sufficiently trained and experienced to handle the aircraft. Pilots can master the cockpit's technology, but they must be able to fall back on their training to fly the plane—not just fly a computer.

For me, the accident reports reaffirm my belief that pilots trained in the United States would have successfully handled the situation. The reports compound my concerns about quality training standards in other countries. That is why I asked the DOT Inspector General to look at international pilot training.

In the end, these facts are irrefutable: the U.S. aviation system is the world's safest thanks to FAA's leadership. And despite sensational reports claiming the agency's international standing is in question, the FAA remains the gold standard for safety.

In the last decade in the United States, there have been nearly 7 billion passengers on 90 million flights, with only one fatality; this includes 57,000 flights of the 737 MAX. One life lost is one too many, but that is a remarkable safety record.

One reason our system is safe is the collaborative process between FAA, pilots, manufacturers, airlines, and mechanics. This decades-old structure has worked so well that last year, Congress overwhelmingly voted to uphold and improve the agency's aircraft certification process.

I caution those who want to blame FAA's process that jumping to conclusions only serves to erode confidence in the U.S. aviation system when the safety record speaks for itself. While we have preliminary information, we do not have the final reports, nor the benefit of the investigative work yet to be completed. What we do know does not justify abandoning FAA's proven system that has made air travel the safest mode of transportation in history.

Mr. LARSEN. Thank you, Representative Graves. I recognize Chair DeFazio.

Mr. DEFAZIO. Thank you, Mr. Chairman. You know, I don't want anyone to think that we are going to walk out of here today with all the answers; we aren't. We are very much in the beginning of our investigation. The FAA has only begun to turn over documents which we requested a couple of months ago, but the Secretary assures me they will be fully cooperative.

On the other hand, Boeing has yet to provide a single document. I am hoping they will provide the documents we have requested voluntarily, and in the not too distant future.

This is a very complex issue, and it has raised questions that do, worldwide, question the FAA and its certification process. And we have got to get to the bottom of this.

First, I want to recognize the parents who are here today of 24-year-old Samya Stumo.

And I am sorry for your loss, it shouldn't have happened.

So they deserve answers and accountability, as does the flying public in the United States and worldwide. The subcommittee chairman went through the investigations we have begun and asked for. Those are ongoing.

I have been on the committee a long time. It was only after the ValuJet tragedy this committee had rejected my amendment to strip the FAA of an ancient promotional authority left over from the time of the beginnings of flight. And I had been defeated in committee, it wasn't in the Senate bill. But, strangely enough—I was a pretty junior Member—I got a phone call saying, "Where would we put your provision in the bill?"

I said, "Well, it is not conferenceable. It was rejected in my committee, it is not in the Senate bill." In those days we followed the rules; we don't anymore. I was surprised. But they put it in the bill, and we took away, ostensibly, the promotional authority.

And then for years I questioned the number of hours required to sit in the second seat in the cockpit. I pointed out that it took three times as many hours to be a hairdresser in the State of Oregon as to be copilot in a commercial aircraft. And it was only after Colgan that we changed the rules.

You know, we shouldn't have to have tragedies to change the rules, if the rules need to be changed. And now we have another tragedy. Now the question is what were the factors.

Now, I find it—you know, the ranking member said a number of things I could agree with about training and that.

But I got a question. Why, until the plane went down, the first plane, Lion Air, it wasn't even in the manual that this automated system existed. It wasn't in the manual. Now, that is odd, because the pilots were the redundancy. How the hell are you the redundancy if you don't know something?

There is something called a startle factor. And yes, I am not a commercial pilot, but I have got to tell you if you are at a low altitude and suddenly the plane starts automatically pitching itself down every 10 seconds, there is going to be a lot of people who are going to have trouble dealing with that. And you know, so why wasn't it known?

And, in fact, also the disagree light issue. The disagree light was disabled unless you bought an optional package. We now hear, oh, that was an accident, a software problem. We weren't trying—but people thought the disagree light was there. They didn't know it was inoperable. And Boeing knew for more than a year before that crash, that the disagree light didn't work unless you bought their optional package, which Lion Air didn't, and a whole heck of a lot of other people didn't buy.

How did that get certified? How can we have a single point of failure on a modern aircraft, single point of failure, one faulty sensor, one sensor sheared off by a bird, whatever happened in Ethiopia. One faulty sensor installed improperly, whatever happened in Indonesia. How can you have a critical safety system certified? Those are the questions we have got to answer as we go through this process.

I have got a whole list of things here. I am not going to go through them because I want to get to the witnesses. But I got to say this is—you know, we shouldn't have to be here today.

[Mr. DeFazio's prepared statement follows:]

Prepared Statement of Hon. Peter A. DeFazio, a Representative in Congress from the State of Oregon, and Chair, Committee on Transportation and Infrastructure

Thank you, Chair Larsen, for calling today's oversight hearing on the "Status of the Boeing 737 MAX." And, thank you to everyone for attending our first hearing on the Boeing 737 MAX.

I say first because I want to be clear: I am under no illusion that we will walk out of here today with all of the answers we are in search of.

The issues surrounding the Boeing 737 MAX are complex and far-reaching, and this Committee is still in the early stages of what will be a deliberate, robust investigation. This is the first in a series of hearings. As more information becomes available through the Committee's oversight work, we will have additional hearings.

But here's what we do know for sure right now.

The tragedies of the two fatal Boeing 737 MAX accidents in a span of five months have shocked the aviation industry and the flying public around the globe.

We lost 346 lives, people with families and loved ones whose lives will never be the same.

That includes the parents of 24-year-old Samya Stumo—who are here in the audience today.

Their daughter was flying from Ethiopia to Kenya for work when Ethiopian Airlines flight 302 went down.

They deserve answers and accountability, as does the general flying public.

That's why I, along with Subcommittee Chair Larsen, launched an investigation immediately following the Ethiopian Airlines accident to conduct vigorous oversight of the Federal Aviation Administration (FAA) and Boeing, to examine what went wrong with the 737 MAX, and how we can make certain it never happens again. We have also requested the Department of Transportation Inspector General examine the FAA's certification process for the 737 MAX. We will not leave any stone unturned.

For 30 years, I have been a staunch safety advocate. My responsibility, this Committee's responsibility, is to ensure the flying public it is safe. So please be assured, I plan to continue my decades long record of advancing safety at no expense. When changes need to be made, we will make them. As I've said before, the FAA exists to protect the public. It does not exist to promote or protect any part of the regulated industry.

Today, we will receive testimony from the National Transportation Safety Board on what we know to date about the two aviation accidents and ongoing investigations into their probable cause or causes; and an update from the Federal Aviation Administration (FAA) on what it knows to date, the work being undertaken to audit and review issues surrounding the certification of the 737 MAX, and how it plans to make certain that this aircraft is safe to fly before it is ungrounded.

MCAS and AoA Sensors:

Since FAA grounded the fleet in March, we have learned that pilots were not made aware of this new system on the MAX, the maneuvering characteristics augmentation system, or MCAS. We have also read troubling reports that certain safety features were installed but not operational, or optional and not required.

Aviation is a system based on checks and cross-checks. How can an aircraft be certified if the failure of a single Angle of Attack (AoA) sensor results in MCAS activation, pulling the nose of a plane downward without pilot command? Where was the redundancy? If pilots were supposed to be the backstop for an AoA failure, why

were pilots not informed the new system was on their plane and expected to know how to respond appropriately?

There are many questions we need to examine.

Pilot Training:

- In light of increased automation, are some of the safety assumptions made by the FAA and Boeing the right assumptions?
- Do we need to improve the process for determining and evaluating what pilots are trained on before they fly a new aircraft?
- Do we need to enhance international pilot training standards?
- What is the role of the FAA and manufacturer for certifying U.S. aircraft that we know will be flown by pilots with varying levels of training and experience?

Optional Safety Features:

- Who made the decision that AoA indicators or gauges—that could have given pilots an early and clear indication of what was happening to the plane—are optional?
- Why did the AoA disagree light, which is standard on the previous 737s and supposedly on the 737 MAX, not work without the extra cost optional indicators?

FAA Certification/Organization Designation Authorization (ODA):

The agency's stellar record and leadership is now being questioned. Did Boeing design a system that was flawed, or was the FAA fully knowledgeable of the system?

Since the 1950s, the FAA has relied on a system of delegating certain certification authorities to manufacturers. And it has done so safely.

However, for years, I have raised questions about how the FAA oversees the work of manufacturers that have been delegated these responsibilities. And I am going to continue to ask them.

- Does the FAA have sufficient resources to oversee the delegation program?
- Does the FAA have enough internal expertise to oversee the most sophisticated engineering work in the world?
- What firewalls exist between manufacturers and its FAA-designated representatives to ensure proper oversight and that there is no undue influence placed on them?

We must get to the bottom of these questions and where precisely decisions were made and why. These decisions cost lives. They are tough questions and I plan to get answers. Our Committee's investigation is going to be thoughtful and deliberate; we are going to get it right.

Returning the plane to service:

MAX aircraft are currently sitting idle. There is tremendous pressure to get the planes back up in the air. But before that happens, the FAA must make sure that every problem is identified and fixed, and every pilot that is certified to fly the plane knows everything there is to know and is properly trained.

Chair Larsen and I have called for a third-party review of what Boeing proposes to improve the design of the MCAS and what pilot training is deemed necessary.

This will be critical to inform FAA's decisionmaking as well as ensure public confidence in the process. And to that end, I am pleased that the FAA has launched a Joint Authorities Technical Review (JATR) to review the certification of the MAX as well as a Technical Advisory Board (TAB).

Comprised of experts from the U.S. Air Force, the Volpe National Transportation Systems Center, and NASA, the TAB has been tasked with conducting an independent review of Boeing's proposed software change and its integration into the 737 MAX flight control system.

Restoring public confidence and trust in the FAA's decisionmaking and in the safety of Boeing's airplanes will be critical to the restoration of the MAX to revenue service.

The world is watching, and the FAA and Boeing must get it right. This third party review panel, with independent expertise, will help to ensure that the FAA has all the information needed to make its decision.

Nearly 12 million people fly each day around the world, and many on U.S.-certified aircraft. We must ensure that safety is the top priority at every turn—for manufacturers, suppliers, airlines, the FAA, and all involved in the aviation industry.

Again, this will be the first in a series of hearings. I assure you that we are monitoring the FAA's decisions at every turn, and we will go as far as the investigation takes us.

I look forward to hearing from the witnesses. Thank you and I yield back.

Mr. DEFAZIO. And you know, with that, I am going to yield back the balance of my time.

Mr. LARSEN. Thank you, Chair DeFazio. I recognize the ranking member of the subcommittee, Representative Graves.

Mr. GRAVES OF LOUISIANA. Thank you, Mr. Chairman, and I want to thank you for holding this hearing today.

This is about people. And I don't think any of us need to lose sight of that. And I want to express my sympathy for your loss and for the loss of all of the victims of these tragic crashes. I am going to say it again. This is about people, and this isn't about politics, it is not about emotion. This is about people.

And we need to take every single lesson we can extract from these accidents and make sure that we learn from them, and make sure that we apply them to future flights because, while the air travel today is the safest form of transportation, it doesn't mean we should at all rest on our laurels and say we are good. We need to continue learning. We need to figure out every mistake, error that was made in this case, and make sure that it doesn't happen again.

As we know, the 737 MAX has been grounded since March 13th, following the second international incident in 5 months, the Lion Air and the Ethiopian Air accidents. While the accident investigations into both crashes continue, and we need to make sure we understand all the factors that contribute to the accidents, it is clear that the Maneuvering Characteristics Augmentation System, or MCAS, does appear to be a factor in both accidents. Boeing has announced that they are working on a software fix, and we await its submission to the FAA for certification.

There are multiple investigations underway by the Department of Transportation, by the inspector general, and others. And as those investigations continue, it is important that we set the record straight. It is important that we, as I said, learn, and that we make air travel even safer.

It's been very concerning, watching folks in many cases being pseudo experts. Look, it takes thousands of hours to even get to the flight deck of a plane in the United States. And, look, let's be honest. With the exception of Sam, the ranking member of the full committee, not many of us have an extraordinary amount of experience in flying planes.

This is a technical issue. There is a lot that goes on behind the scenes and a very, very technical process. We need to be very careful to make sure that we are not acting on emotion, that we are not making this political, that we are operating on facts, and we are truly taking steps that are going to improve aviation safety to make sure that every single lesson can be extracted and applied.

No one gets applause when a plane lands safely after an uneventful flight. The baseline for safety for commercial aviation is zero, zero fatalities and zero accidents. It took a long time to reach that level of safety. And sadly, many of our safety gains followed tragic accidents. Any deviation from our current baseline means that we have to look at how the accident occurred and how to prevent in the future.

But I want to be clear: the changes and the reforms that we make in the wake of these accidents must be based on fact, and must preserve the essence of the aviation system that has led to this unprecedented level of safety right here in the United States.

Aviation accidents are the result of a series of events. There is not just one cause often. As we all know, the two accidents that we are discussing today did appear to have multiple factors that were included. We are going to wait for that final conclusion to ultimately determine what exactly contributed, but we believe that there were multiple steps.

While reviewing the FAA certification process it is also important that we look at those other factors, including the operations, the maintenance programs, the pilot experience requirements, the pilot training programs of the air carriers involved, and how those factors may have also applied to or affected the outcome.

We need to understand the whole system, and whether the checks and balances and redundancies that are needed in any airline safety program are present and adhered to in these accidents, in these disasters.

Today is not an investigative hearing. We are a long way from the final accident reports and the completed investigations. We are here today to learn more about the Nation's response to these accidents, and what the next steps are before the 737 MAX possibly returns to service.

I want to commend the FAA Acting Administrator, Dan Elwell, for your leadership and for your accessibility. While we await the Senate's confirmation of the FAA Administrator, I do know the FAA is in good hands. I want to hear more from the witnesses about the various reviews and accident investigations, including FAA's Technical Advisory Board and Joint Authorities Technical Review. But I also want to be clear. No matter what other countries say, I have not seen anything that questions my confidence in FAA's safety judgment to date, and I continue to plan to work with you on a daily basis to ensure we understand all the facts. Thanks again, Mr. Chairman. And I yield back the balance.

[Mr. Graves of Louisiana's prepared statement follows:]

Prepared Statement of Hon. Garret Graves, a Representative in Congress from the State of Louisiana, and Ranking Member, Subcommittee on Aviation

Thank you, Mr. Chairman, for calling today's hearing.

I want to express my condolences for the families and friends of those tragically lost in the two accidents.

As we know, the Boeing 737 MAX has been grounded in the United States since March 13, following its second international accident in five months. While the accident investigations into both crashes continue, and other factors certainly contributed to those accidents, it is clear that the Maneuvering Characteristics Augmentation System (MCAS) played a role in both accidents. Boeing has announced that it is working on a software update to address issues with the MCAS, and we await its submission to the FAA for certification.

Multiple investigations into several different aspects of these accidents are underway, including by this Committee and the DOT Inspector General. As those investigations continue, it is important to begin setting a record so that we can ensure that we learn from these accidents and make international aviation even safer.

We all say it so often that it's almost trite, but safety is the top priority of the aviation industry and this subcommittee.

No one gets applause when a plane lands safely after an uneventful flight. The safety baseline for commercial aviation is zero fatalities, zero accidents. It took a long time to reach this level of safety; and sadly, many of our safety gains followed tragic accidents. Any deviation from our current baseline means that we have to look at how the accident occurred and how to prevent it in the future.

But I want to be clear, the changes and reforms we make in the wake of these accidents must be based upon fact and must preserve the essence of an aviation system that has led to an era of unprecedented safety here in the United States.

Aviation accidents are the result of a series of events; there is never just one cause.

As we all know, the two 737 MAX accidents occurred in Indonesia and Ethiopia. While we are reviewing the FAA's certification processes, it is equally important that we look closely at the operations; maintenance programs; pilot experience requirements; and the pilot training programs of the two air carriers involved. We need to understand the whole system, and whether the checks and balances and redundancies that are needed in any airline safety program were present and adhered to in these accidents.

Today is not an investigative hearing. We are a long way from the final accident reports and completed investigations. We are here today to learn more about our Nation's response to these accidents and about what the next steps are before the Boeing 737 MAX returns to service.

I want to commend Acting Administrator Dan Elwell for his exemplary leadership during the past several months. While we await the Senate's confirmation of the President's nominee to be the next FAA administrator, I know that FAA is in good hands. I want to hear more from the witnesses about the various reviews and accident investigations, including the FAA's Technical Advisory Board and Joint Authorities Technical Review. But I also want it to be clear that, no matter what other countries say, I have complete confidence in the FAA's aviation safety judgment.

Mr. LARSEN. Thank you, Mr. Graves. I am now going to move to questions, and I want to welcome our witnesses.

I know I have you seated Elwell to Sumwalt, but I actually want to go Sumwalt to Elwell, in terms of order, to let Chair Sumwalt discuss a little bit about the investigations as they sit today. But I want to welcome our witnesses.

Mr. Dan Elwell, Acting Administrator, Federal Aviation Administration. He is accompanied by Earl Lawrence, Executive Director of Aircraft Certification of the FAA, and I understand Mr. Lawrence is here for technical support, is available to answer questions, but Mr. Elwell will be giving the testimony.

And then Mr. Sumwalt is Chair of the National Transportation Safety Board, and he is accompanied by Ms. Dana Schulze, Acting Director, Office of Aviation Safety of the NTSB.

As well, Chair Sumwalt will give the testimony for NTSB, and Director Schulze is available to help with any technical questions.

Without objection, our witnesses' full statements will be included the record.

Since your written testimony has been made part of the record, the subcommittee does request you limit your oral testimony to 5 minutes.

And Chair Sumwalt, you are recognized now for 5 minutes, thank you.

TESTIMONY OF HON. ROBERT L. SUMWALT III, CHAIRMAN, NATIONAL TRANSPORTATION SAFETY BOARD; ACCOMPANIED BY DANA SCHULZE, ACTING DIRECTOR, OFFICE OF AVIATION SAFETY, NATIONAL TRANSPORTATION SAFETY BOARD

Mr. SUMWALT. Thank you, and good morning, Chairman Larsen, Ranking Member Graves, Chairman DeFazio, and Ranking Mem-

ber Graves, members of the subcommittee. Thank you for allowing the NTSB to testify before you this morning.

As you mentioned, accompanying me this morning is Ms. Dana Schulze, who is the acting director of the NTSB's Office of Aviation Safety.

As you are well aware, during a recent 5-month period there have been two crashes involving the 737 MAX. Tragically, these two crashes have claimed 346 lives. And I say this next statement with all sincerity, it is not a cliche, but our thoughts and prayers go to the families of those victims.

Now, unlike the NTSB's involvement in domestic aviation accidents, where we have a statutory responsibility to investigate every civil aviation accident that occurs within the U.S., our involvement with international investigations is vastly different. The NTSB's role in accident investigation in accidents that occur outside of the United States is governed by Annex 13 to the Convention of the International Civil Aviation Organization, to which 193 countries, including the U.S., are signatories.

Annex 13 states that a safety investigation be led in the country in which the accident occurs, known as the state of occurrence. Thus, the KNKT of Indonesia is leading the investigation into last year's Lion Air crash. And likewise, the Ethiopia Accident Investigation Bureau is leading the investigation into the Ethiopian Airlines crash.

When the accident involves a U.S. operated or registered aircraft, or U.S. designed or manufactured aircraft, as these aircraft were, the NTSB appoints an accredited representative. This is a highly skilled NTSB investigator whose purpose is to coordinate the input of all U.S. interests, including NTSB, FAA, and U.S. companies such as the manufacturers and others that can provide technical expertise.

It is important to note that the state of occurrence leads the investigation and controls the release of public information from that accident investigation, not the NTSB. Now, that said, NTSB participation in foreign accident investigations enables access to investigative data and information needed by the FAA, the manufacturer, or the operator to address safety deficiencies, as well as by the NTSB, so we can issue safety recommendations when necessary. We work closely with the involved accident investigation authorities to ensure that we receive the information we need to sufficiently address safety deficiencies.

Following last year's Lion Air crash we immediately dispatched investigators to Indonesia to participate in the Indonesian Government's investigation. An NTSB investigator was stationed onboard one of the search vessels to help identify recovered aircraft components. And once the cockpit voice recorder was recovered in January, we recalled four investigators who were furloughed during the partial Government shutdown. Their role was to assist with the recorder download and analysis.

We responded immediately to the Ethiopian Airlines crash by sending a team of investigators to Ethiopia. And once the recorders were sent to our aviation counterparts in France, the BEA, we dispatched investigators to France to assist with the recorder download and read-out.

Within 30 days of each crash the Indonesian and Ethiopian authorities issued a preliminary report regarding their respective investigations. NTSB provided technical comments for each of these reports.

Last week Ms. Schulze traveled to Addis to meet with Ethiopian officials regarding the investigation, and in the coming weeks the U.S. team will return to Ethiopia to work further with those authorities.

Because the U.S. is the state of design and certification of the 737, we are also examining the design certification process as a part of our participation in these foreign-led investigations. Our review is continuing, and if we uncover safety deficiencies we are prepared to quickly issue safety recommendations aimed at correcting such deficiencies.

Our commitment to the traveling public, and especially to those families affected by these two tragic events, is to bring all of our experience and expertise in support of the international effort to determine why these accidents occurred and, most importantly, to ensure that no similar accident like these occurs again.

Thank you. We will be happy to answer your questions.

[Mr. Sumwalt's prepared statement follows:]

Prepared Statement of Hon. Robert L. Sumwalt III, Chairman, National Transportation Safety Board

Good afternoon, Chairman Larsen, Ranking Member Graves, and Members of the Subcommittee. Thank you for inviting the National Transportation Safety Board (NTSB) to testify before you today.

Congress established the NTSB in 1967 as an independent agency within the United States Department of Transportation (DOT) with a clearly defined mission to promote a higher level of safety in the transportation system. In 1974, Congress reestablished the NTSB as a separate entity outside of the DOT, reasoning that "no federal agency can properly perform such (investigatory) functions unless it is totally separate and independent from any other . . . agency of the United States."[1] Because the DOT has broad operational and regulatory responsibilities that affect the safety, adequacy, and efficiency of the transportation system, and transportation accidents may suggest deficiencies in that system, the NTSB's independence was deemed necessary for proper oversight.

The NTSB is charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation—highway, rail, marine, and pipeline. We determine the probable cause of the accidents we investigate, and we issue recommendations to federal, state, and local agencies, as well as other entities, aimed at improving safety, preventing future accidents and injuries, and saving lives. The NTSB is not a regulatory agency—we do not promulgate operating standards nor do we certificate organizations and individuals. The goal of our work is to foster safety improvements, through formal and informal safety recommendations, for the traveling public.

Our Office of Aviation Safety investigates all civil domestic air carrier, commuter, and air taxi accidents; general aviation accidents; and certain public-use aircraft accidents, amounting to approximately 1,400 investigations annually. We also participate in investigations of major airline accidents in foreign countries that involve US carriers, US-manufactured or -designed equipment, or US-registered aircraft.

For the last decade, the US aviation system has experienced a record level of safety, and the number of US-registered civil aviation accidents has declined overall.[2] Aviation deaths in the United States decreased from 412 in 2016 to 350 in 2017. Nearly 94 percent of aviation fatalities (330 instances in 2017) occur in general avia-

[1] Independent Safety Board Act of 1974 § 302, Pub. L. 93–633, 88 Stat. 2166–2173 (1975).

[2] National Transportation Safety Board, 2017 preliminary aviation statistics [https://www.ntsb.gov/investigations/data/Documents/AviationAccidentStatistics_1998-2017_20181019.xlsx]. Accident data for calendar year 2018 are still being validated and have not yet been released.

tion accidents, with the remainder primarily in Title 14 Code of Federal Regulations (CFR) Part 135 operations, which include charters, air taxis, and air medical services flights. Until 2018, there had been no passenger fatalities as a result of accidents involving US air carriers operating under the provisions of 14 CFR Part 121 since the crash of Colgan Air flight 3407 in 2009. Between February 2009, when Colgan Air crashed near Buffalo, New York, and April 2018, there were no passenger fatalities involving 14 CFR Part 121 US air carriers.[3] On April 17, 2018, a Boeing 737–700 experienced an engine failure at cruise altitude, resulting in damage to a cabin window and the partial ejection of a passenger, who subsequently died from her injuries.[4] Over the last several decades, significant advances in technology, important legislative and regulatory changes, and more comprehensive crew training have contributed to the current level of aviation safety. However, we continue to see accidents and incidents that remind us of the need to be ever vigilant.

This testimony will explain our role in international investigations and inform the subcommittee about our current participation in recent accidents involving Boeing 737 MAX 8 aircraft in Indonesia and Ethiopia.

NTSB'S ROLE IN FOREIGN INVESTIGATIONS

The NTSB participates in the investigation of aviation accidents and serious incidents outside the United States in accordance with the Chicago Convention of the International Civil Aviation Organization (ICAO) and the Standards and Recommended Practices (SARPS) provided in Annex 13 to the Convention.[5] If an accident or serious incident occurs in a foreign state involving a US-registered civil aircraft, US operator, or US-designed or manufactured aircraft, and the foreign state is a signatory to the ICAO Convention, that state is responsible for the investigation and controls the release of all information regarding the investigation.[6]

In accordance with the ICAO Annex 13 SARPS, upon receiving a formal notification of the accident or serious incident that may involve significant issues, the NTSB may designate the US Accredited Representative and appoint technical advisors to carry out the obligations, receive investigative information and updates in accordance with the annex, provide consultation, and receive safety recommendations from the state of occurrence. The advisors may include NTSB investigators with subject matter expertise, as well as others from US manufacturers, operators, and the Federal Aviation Administration (FAA).

The following are the key objectives of our participation in international aviation accident investigations:

- Identify safety deficiencies affecting US aviation interests
- Capture safety lessons learned to prevent accidents in the US
- Facilitate credible and comprehensive accident investigations where US interests are concerned

Given the international nature of air transportation and the leading role the United States plays in developing aviation technology, our participation in foreign investigations is essential to enhancing aviation safety worldwide. In 2018, we appointed accredited representatives to 324 international investigations, and traveled to support work on 17 of those investigations.[7]

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[3] National Transportation Safety Board, *Loss of Control on Approach, Colgan Air, Inc., Operating as Continental Connection Flight 3407, Bombardier DHC 8 400, N200WQ* [https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR1001.pdf], Rpt. No. AAR–10/01 (Washington, DC: NTSB, 2012). In 2013, there were two fatal accidents involving nonscheduled cargo flights operating under Part 121—National Air Cargo crash [https://app.ntsb.gov/pdfgenerator/ReportGeneratorFile.ashx?EventID=20130429X12734&AKey=1&RType=Final&IType=MA] after takeoff at Bagram Air Base, Afghanistan, and United Parcel Service flight 1354 [https://app.ntsb.gov/pdfgenerator/ReportGeneratorFile.ashx?EventID=20130814X15751&AKey=1&RType=Final&IType=MA] crash during approach in Birmingham, Alabama.

[4] The Southwest Airlines flight 1380 [https://www.ntsb.gov/investigations/Pages/DCA18MA142.aspx] investigation is ongoing. An investigative hearing [https://www.ntsb.gov/news/events/Pages/2018-DCA18MA142-IH.aspx] was conducted on November 14, 2018.

[5] ICAO is a UN specialized agency that manages the administration and governance of the Convention on International Civil Aviation (Chicago Convention), (https://www.icao.int/about-icao/Pages/default.aspx).

[6] There are 193 Member States of ICAO, including both Indonesia and Ethiopia, (https://www.icao.int/MemberStates/Member%20States.English.pdf).

[7] The NTSB appointed an accredited representative to 203 accidents, 97 incidents, and 24 other safety-related occurrences in 2018. NTSB traveled in support of 9 of these accidents and 8 of the incidents.

RECENT BOEING 737–MAX 8 CRASHES

On October 29, 2018, a Boeing 737 MAX 8, operated by Lion Air, crashed into the Java Sea shortly after takeoff from Soekarno-Hatta International Airport, in Jakarta, Indonesia, killing all 189 passengers and crew on board. The Komite Nasional Keselamatan Transportasi (KNKT) of Indonesia, who is leading the investigation, released a preliminary report on the accident on November 27, 2018.[8] On March 10, 2019, a Boeing 737 MAX 8, operated by Ethiopian Airlines, crashed after takeoff from Addis Ababa Bole International Airport in Ethiopia, killing all 157 passengers and crew, including 8 American citizens. The investigation is being led by the Ethiopia Accident Investigation Bureau (AIB), which released a preliminary report on April 4, 2019.[9]

Because the MAX 8 was designed, certified, and manufactured in the United States, in accordance with ICAO Annex 13, the United States is afforded the right to participate in both investigations. Accordingly, the NTSB appointed accredited representatives to assist in both ongoing investigations.

Following last year's Lion Air crash, the NTSB immediately dispatched investigators to Indonesia to participate in the Indonesian government's investigation. An NTSB investigator was stationed onboard one of the search vessels during the search for the critical "black boxes"—the flight data recorder (FDR) and cockpit voice recorder (CVR). When the CVR was recovered on January 14, 2019, the NTSB recalled four investigators from furlough (due to the partial government shutdown) to assist with properly transcribing the recorder's content.[10]

In response to the Ethiopian Airlines crash, the NTSB also appointed an accredited representative, whom we dispatched to Ethiopia with a team of investigators. Once the recovered recorders were sent to the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile, we sent recorder, flight crew operations, and human factors investigators to France to assist with downloading and reading out the recorders' contents.

In accordance with ICAO Annex 13, technical advisors from the FAA, Boeing, and General Electric have accompanied NTSB investigators to the Lion Air and Ethiopian Airlines accident sites to provide their specialized technical knowledge regarding the aircraft and its systems.

Although the NTSB is actively involved in these investigations, ICAO Annex 13 requires that, as the states of occurrence, Indonesia and Ethiopia are responsible for leading their respective investigations. As such, they control the release of all investigative information to the public related to those accidents. Annex 13 provides for other involved states to gain timely access to investigative information for the purposes of continued operational safety, however. As a result, NTSB participation in foreign accident investigations enables safety deficiencies to be promptly addressed by the FAA, the manufacturer, or the operator, as well as others deemed appropriate, and through NTSB safety recommendations, when needed. Because the United States is the state of design and certification of the aircraft involved in these accidents, we are examining relevant factors in the US design certification process to ensure any deficiencies are captured and addressed, including by NTSB safety recommendations, if necessary.

Summary of Lion Air 610 Preliminary Report

The FDR recovered from the Lion Air crash contained about 69 hours of data, covering the last 18 flights prior to the accident flight. The preliminary report released by the KNKT indicated that the left angle-of-attack (AOA) sensor[11] on the accident aircraft was replaced on October 27, 2018, due to an ongoing airspeed and altitude issue that had been reported by previous flight crews (there was a difference be-

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[8] Komite Nasional Keselamatan Transportasi, Preliminary Report No. KNKT.18.10.35.04 [https://knkt.dephub.go.id/knkt/ntsc_aviation/baru/pre/2018/2018%20-%20035%20-%20PK-LQP%20Preliminary%20Report.pdf].

[9] Ethiopia Accident Investigation Bureau, Report No. AI–01/19 [http://www.ecaa.gov.et/documents/20435/0/Preliminary+Report+B737-800MAX+%2C%28ET-AVJ%29.pdf/4c65422d-5e4f-4689-9c58-d7af1ee17f3e].

[10] Due to a lapse of appropriations from December 22, 2018, through January 25, 2019, the NTSB furloughed all investigative staff. In accordance with the provisions of the Anti-Deficiency Act (including sections 1341(a)(1)(B) and 1342 of Title 31, United States Code), allowable agency functions were limited to those where "failure to perform those functions would result in an imminent threat to the safety of human life or the protection of property." Due to the potential safety issues associated with the Lion Air crash, the NTSB responded by recalling four investigative staff from furlough to participate in the CVR readout.

[11] Angle of attack (AOA) is the angle between the relative wind and the wing chord line. The 737 MAX has two AOA sensors, one on each side of the forward fuselage, that measure the direction of airflow relative to the airplane during flight using a mechanical vane in each sensor.

tween the captain's and first officer's displayed airspeed and altitude). The aircraft's next flight—which was also the flight prior to the accident flight—occurred on October 28, 2018, from Ngurah Rai International Airport in Bali to Jakarta. On this flight, the FDR data indicate that the captain's AOA data was approximately 20 degrees higher than the first officer's AOA data, from airplane startup until the end of the flight. The FDR data also indicate that the captain's stick shaker activated immediately after rotation, followed by an airspeed and altitude miscompare warning.[12] As the airplane continued its climb after takeoff, the captain noticed that the stabilizer was automatically trimming in the airplane nose down (AND) direction. As a result, the captain engaged the automatic trim system cut-out switches and adjusted the stabilizers manually. The flight crew informed air traffic control (ATC) that they had an urgent situation and then conducted three different non-normal checklists. The flight crew elected to continue to their destination, Jakarta, and the remainder of the 96-minute flight was uneventful. After landing in Jakarta, the captain wrote up two issues in the maintenance logs: 1) there was a disagreement between the captain's and first officer's airspeed and altitude data, and 2) there was a fault in the elevator feel system. The maintenance personnel flushed the left pitot/static system and cleaned the electrical connector plug for the elevator feel computer. Both systems were then tested on the ground and no faults were noted.

The next day, October 29, 2018, Lion Air flight 610 departed from Jakarta. The FDR indicated that the captain's AOA data was about 20 degrees higher than the first officer's AOA data, from airplane startup until the end of the flight. The FDR data indicates that the captain's stick shaker activated immediately after rotation, followed by an airspeed and altitude miscompare warning. The first officer asked ATC to advise them of their airspeed and altitude, then indicted that they were experiencing a flight control problem and subsequently asked to return to the airport for landing. After the flaps were retracted, the data show that there was a 2.5-degree automatic AND stabilizer activation, followed by the flight crew commanding airplane nose up (ANU) stabilizer with ANU trim. The FDR data show that another automatic AND stabilizer activation occurred several seconds after the first, which was countered by the flight crew with ANU trim. The flight crew then extended the flaps, which stopped the automatic AND trim inputs. About 2 minutes later, the flight crew again retracted the flaps. There were then 25 automatic AND stabilizer activations that occurred until the end of the flight (approximately 6:20 minutes). The flight crew commanded ANU stabilizer trim after each of these automatic inputs. In the last 50 seconds, the ANU input by the crew was not sufficient to completely counter the AND inputs, and the stabilizer moved to almost the full AND position before the end of the data.

The captain of the accident flight had about 6,000 total flight hours, with about 5,100 hours on the Boing 737. The first officer had about 5,200 total flight hours, with about 4,300 hours in the Boeing 737. We do not have information regarding the number of flight hours in a Boeing 737 MAX.

Summary of Ethiopian Airlines 302 Preliminary Report

On March 10, 2019, Ethiopian Airlines flight 302 departed Addis Ababa. According to the preliminary report released by the AIB, the FDR data indicate that during startup, taxi, and takeoff ground roll, the captain's and first officer's AOA data was normal and identical. The throttle levers were set to takeoff and remained in the takeoff position for the entire flight. Several seconds after rotation, the captain's AOA data stepped up to about 75 degrees and his stick shaker activated, while the first officer's AOA data remained in the normal range throughout the flight. Concurrently, the flight crew received an airspeed and altitude disagree warning (the captain's airspeed and altitude values were lower than the first officer's values). Shortly after this, the flight crew also received an anti-ice warning. The captain then attempted to engage the autopilot three times; the autopilot engaged after the third attempt, as the airplane climbed through about 1,000 feet above the ground. The airplane continued to accelerate, and the flight crew retracted the flaps when the airspeed was about 240 knots. The flight crew then requested to maintain the runway heading (instead of turning on course), and reported that they were having flight control problems.

Shortly after the autopilot disengaged, an AND command moved the stabilizer approximately 2.5 degrees in the nose down direction (from 4.6 to 2.1 units), and the airplane momentarily descended as the Enhanced Ground Proximity Warning System (EGPWS) annunciation alerted. Approximately 3 seconds after the AND stabilizer movement stopped, the flight crew commanded ANU stabilizer input of about

[12] The stick shaker warns a pilot of an impending wing aerodynamic stall through vibrations on the control column, providing tactile and aural cues.

0.3 degrees (from 2.1 to 2.4 units). Approximately 5 seconds after the end of the ANU stabilizer motion, a second automatic AND stabilizer command occurred, and the stabilizer moved about 2.0 degrees AND (from 2.4 to 0.4 units). The flight crew interrupted the automatic movement by commanding 1.9 degrees of ANU stabilizer trim (from 0.4 to 2.3 units). During this time, the captain asked the first officer to help him, and there were three EGPWS aural alerts. Shortly after, the first officer stated "stab trim cut-out" two times. The captain agreed and the first officer confirmed that the stabilizer trim cut-out switches were engaged. The FDR data indicates that, after that, there was another AND command recorded without any corresponding movement of the stabilizer (which is consistent with the stabilizer cut-out switches being engaged). The first officer told ATC that the flight would like to level off at 14,000 feet, and that they were having flight control problems. For the next approximately 2.5 minutes, the stabilizer position moved about 0.2 degrees AND (from 2.3 to 2.1), and aft force continued to be applied to the control columns, which remained aft of the neutral position. During this time, the captain asked the first officer if the trim was functional. The first officer replied a short time later that the trim was not working but asked if he could try it manually. The captain told him to try. About 8 seconds later, the first officer replied that it was not working. About 32 seconds before the end of the recording, at approximately 13,400 feet, the flight crew commanded two ANU momentary electric trim inputs, and the stabilizer moved about 0.2 degrees ANU (from 2.1 to 2.3 units). Then, about 5 seconds after the last crew-commanded electric trim inputs, an automatic AND stabilizer command moved the stabilizer about 1.3 degrees (from 2.3 to 1.0) over approximately 5 seconds, and the airplane began to pitch nose down. The flight crew applied additional aft column force, but the airplane continued to pitch nose down, eventually reaching 40 degrees nose down. During the pitch over, the captain's airspeed increased to about 460 knots, and the first officer's airspeed reached about 500 knots; the captain's AOA data decreased and varied proportionally to the normal load factor.

The captain of the accident flight had about 8,100 total flight hours, which included about 1,400 hours in a Boeing 737 and about 100 hours in the Boeing 737 MAX. The first officer had about 360 total flight hours, including about 200 hours in the Boeing 737 with about 56 hours in a Boeing 737 MAX.

CONCLUSION

Thank you again for the opportunity to be here today to discuss the NTSB's role in international aviation accident investigations and to highlight our current participation in recent accidents involving Boeing 737 MAX 8 aircraft in Indonesia and Ethiopia. I will be happy to answer any questions.

Mr. LARSEN. Thank you, Chair Sumwalt.

I now recognize Acting Administrator Dan Elwell for 5 minutes.

TESTIMONY OF DANIEL K. ELWELL, ACTING ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION; ACCOMPANIED BY EARL LAWRENCE, EXECUTIVE DIRECTOR OF AIRCRAFT CERTIFICATION, FEDERAL AVIATION ADMINISTRATION

Mr. ELWELL. Chairman Larsen, Ranking Member Graves, Chairman DeFazio, Ranking Member Graves, thank you for the opportunity today to discuss aviation safety and the issues surrounding the Boeing 737 MAX.

I also want to take this opportunity to express my sincerest condolences on behalf of the entire FAA to the victims and their families of both Ethiopian Airlines flight 302 and Lion Air flight 610.

I want to emphasize at the outset that the FAA welcomes scrutiny that helps make us better. That is how our global leadership and aviation safety will endure.

As you all know, the FAA grounded the U.S. 737 MAX fleet on March 13th, 2019. That decision was based upon crash site findings and satellite data that together indicated some similarities between the Ethiopian and Indonesian accidents that warranted further investigation of the possibility of a shared cause. And I will

focus my remarks today on events since the grounding—in particular, the various ongoing reviews of the FAA's processes and the work being done towards safely returning the 737 MAX to service.

Our commitment to safety and fact-based, data-driven decision-making has been the guiding principle in all of this. After the grounding, several reviews were initiated to assess the FAA processes, separate from evaluating any particular technical fix for the 737 MAX.

On March 19th, Secretary Chao asked the Department of Transportation's inspector general to conduct an audit of the Boeing 737 MAX 8 certification with the goal specifically to compile an objective and detailed history of the activities that led to certification. That audit is ongoing, with the cooperation of the FAA.

Secretary Chao on March 25th announced the establishment of a special committee to review the FAA's procedures for the certification of new aircraft, including the Boeing 737 MAX. The special committee is an independent body whose findings and recommendations will be presented directly to the Secretary and the FAA Administrator.

On April 2nd the FAA launched a Joint Authorities Technical Review, JATR, to review the certification of the 737 MAX automated flight control system. The JATR is chaired by former NTSB Chairman Christopher Hart, and comprises a team of U.S. experts and international aviation authorities.

The 737 MAX return to service is not contingent on these reviews. Rather, the reviews are geared towards developing systemic improvements for the future. Now I will talk about the FAA's efforts to safely return the 737 MAX to service here and abroad. As the FAA discussed in an informational notice for 737 MAX operators on March 20th, Boeing has been working on a service bulletin that would specify the installation of new flight control computer operational program software, and has developed flightcrew training related to this software.

On April 12th the FAA met with safety representatives of the three U.S.-based commercial airlines that fly the Boeing 737 MAX, as well as the pilot unions for those airlines. And this unprecedented meeting was an opportunity for the FAA to hear individual views from operators and pilots. The FAA recently solicited public comment on a draft report prepared by the FAA's Boeing 737 MAX Flight Standardization Board. That board consists of pilots, and we use it to evaluate Boeing's proposed training associated with Boeing's proposed software enhancements for the 737 MAX.

On May 6th we initiated a multi-agency Technical Advisory Board, or TAB, to review Boeing's MCAS software update and system safety assessment. The TAB includes experts from the U.S. Air Force, NASA, Volpe, and the FAA. And none of these experts were involved in the original certification of the 737 MAX. The TAB's recommendations will directly inform our decisions on the 737 MAX fleet's return to service.

And next week, on May 23rd, the FAA will host a meeting of directors general of civil aviation authorities from around the world to discuss the FAA's activities toward ensuring the safe return of the 737 MAX to service. This meeting is part of the FAA's efforts to work with other civil aviation authorities to address specific con-

cerns related to the 737 MAX, in keeping with the FAA's long-standing cooperation with our international partners.

As our work continues I want to offer this assurance: In the U.S., the 737 MAX will return to service only when the FAA's analysis of the facts and technical data indicate that it is safe to do so.

This concludes my prepared statement. I welcome your questions.

[Mr. Elwell's prepared statement follows:]

Prepared Statement of Daniel K. Elwell, Acting Administrator, Federal Aviation Administration

Chairman Larsen, Ranking Member Graves, Members of the Subcommittee:

Thank you for the opportunity to appear before you today to discuss aviation safety and the issues surrounding the Boeing 737 MAX. On behalf of the United States Department of Transportation and the Federal Aviation Administration, we would like to take this opportunity to, once again, extend our deepest sympathy to the families of the victims of the Ethiopian Airlines and Lion Air accidents.

Safety is the core of the Federal Aviation Administration's mission and our top priority. With the support of this Committee, we have worked tirelessly to take a more proactive, data-driven approach to oversight that prioritizes safety above all else inside the FAA and within the aviation community that we regulate. The result of this approach is that the United States has the safest air transportation system in the world. Since 1997, the risk of a fatal commercial aviation accident in the United States has been cut by 94 percent. And in the past ten years, there has been one commercial airline passenger fatality in the United States in over 90 million flights. But, one fatality is one too many, and a healthy safety culture requires commitment to continuous improvement.

Our commitment to safety and fact-based, data-driven decision making has been the guiding principle in the FAA's response to the two fatal accidents involving the Boeing 737 MAX airplane outside the United States. Today, I would like to provide you with an overview of the FAA's certification and oversight processes, our current actions with respect to the 737 MAX, and the steps that the FAA is taking to foster safety enhancements here and abroad.

THE FAA IS A DATA-DRIVEN AGENCY FOCUSED ON SAFETY

As the aerospace system and its components become increasingly more complex, we know that our oversight approach needs to evolve to ensure that the FAA remains the global leader in achieving aviation safety. In order to maintain the safest air transportation system in the world, during the past two decades the FAA has been evolving from a prescriptive and more reactive approach for its safety oversight responsibilities to one that is performance-based, proactive, centered on managing risk, and focused on continuous improvement. A key part of this transition has been the adoption of safety management systems, or SMS, within the FAA. The evolution toward SMS began internally at the FAA more than 15 years ago, starting with the FAA's Air Traffic Organization and expanding across the FAA to include all of our lines of business. Consistent with recommendations of the International Civil Aviation Organization (ICAO), we have been working towards implementation of SMS in various sectors. For example, as of March 9, 2018, scheduled commercial air carriers, regulated under 14 CFR part 121, are required to have an SMS.

Safety is not just a set of programs that can be "established" or "implemented." It is a way of living and working, and it requires the open and transparent exchange of information. We know that it takes collaboration, communication, and common safety objectives to allow the FAA and the aviation community to come together, to identify system hazards, and to implement safety solutions. This approach gives us knowledge that we would not otherwise have about events and risks. Sharing safety issues, trends, and lessons learned is critical to recognizing whatever might be emerging as a risk in the system. The more data we have, the more we can learn about the system, which in turn allows us to better manage and improve the system.

To be clear, the SMS approach does not diminish the FAA's role as a safety regulator. Any party that the FAA regulates remains responsible for compliance with the FAA's regulatory standards, and the FAA does not hesitate to take enforcement action when it is warranted.

AIRCRAFT CERTIFICATION

Information sharing is a cornerstone of aviation safety and has significantly contributed to the United States' outstanding safety record. One of the FAA's core functions, aircraft certification, has always relied on the exchange of information and technical data. The FAA certifies the design of aircraft and components that are used in civil aviation operations. Some version of our certification process has been in place and served us well for over 60 years. This does not mean the process has remained static. To the contrary, since 1964, the regulations covering certification processes have been under constant review. As a result, the general regulations have been modified over 90 times, and the rules applicable to large transport aircraft, like the Boeing 737 MAX, have been amended over 130 times. The regulations and our policies have evolved in order to adapt to an ever-changing industry that uses global partnerships to develop new, more efficient, and safer aviation products and technologies. What has not changed is that, for any new project, the FAA identifies all safety standards and makes all key decisions regarding certification of the aircraft.

The FAA focuses its efforts on areas that present the highest risk within the system. The FAA reviews the applicant's design descriptions and project plans, determines where FAA involvement will derive the most safety benefit, and coordinates its intentions with the applicant. When a particular decision or event is critical to the safety of the product or to the determination of compliance, the FAA is involved either directly or through the use of our designee system.

The use of designation, in some form, has been a vital part of our safety system since the 1920s. Congress has continually expanded the designee program since creation of the FAA in 1958, and it is critical to the success and effectiveness of the certification process. Under this program, the FAA may delegate a matter related to aircraft certification to a qualified private person. This is not self-certification; the FAA retains strict oversight authority. The program allows the FAA to leverage its resources and technical expertise while holding the applicant accountable for compliance. During the past few years, Congress has endorsed FAA's delegation authority, including in the FAA Reauthorization Act of 2018, which directed the FAA to delegate more certification tasks to the designees we oversee.

In aircraft certification, both individual and organizational designees support the FAA. The FAA determines the level of involvement of the designees and the level of FAA participation needed based on many variables. These variables include the designee's understanding of the compliance policy; consideration of any novel or unusual certification areas; or instances where adequate standards may not be in place.

The Organization Designation Authorization (ODA) program is the means by which the FAA may authorize an organization to act as a representative of the FAA under strict FAA oversight. Currently, there are 79 ODA holders. ODA certification processes allow FAA to leverage industry expertise in the conduct of the certification activities and focus on important safety matters. The FAA has a rigorous process for issuing an ODA and only grants this authorization to mature companies with a proven history of designing products that meet FAA safety standards. ODA holders must have demonstrated experience and expertise in FAA certification processes, a qualified staff, and an FAA-approved procedures manual before they are appointed. The FAA delegates authority on a project-by-project basis, and the manual defines the process and procedures to which the ODA must adhere when executing the delegated authority. The ODA holder is responsible to ensure that ODA staff are free to perform their authorized functions without conflicts of interest or undue pressure.

There are many issues that will always require direct FAA involvement, including equivalent level of safety determinations, and rulemakings required to approve special conditions. The FAA may choose to be involved in other project areas after considering factors such as our confidence in the applicant, the applicant's experience, the applicant's internal processes, and confidence in the designees.

Something that is not well understood about the certification process is that it is the applicant's responsibility to ensure that an aircraft complies with FAA safety regulations. It is the applicant who is required to develop aircraft design plans and specifications, and perform the appropriate inspections and tests necessary to establish that an aircraft design complies with the regulations. The FAA is responsible for determining that the applicant has shown that the overall design meets the safety standards. We do that by reviewing data and by conducting risk-based evaluations of the applicant's work.

The FAA is directly involved in the testing and certification of new and novel features and technologies. When a new design, or a change to an existing design, of

an aircraft is being proposed, the designer must apply to the FAA for a design approval. While an applicant usually works on its design before discussing it with the FAA, we encourage collaborative discussions well in advance of presenting a formal application. Once an applicant informs the FAA of the intent to develop and certify a product, a series of meetings are held both to familiarize the FAA with the proposed design, and to familiarize the applicant with the certification requirements. A number of formal and informal meetings are held on issues ranging from technical to procedural. Once the application is made, issue papers are developed to provide a structured way of documenting the resolution of technical, regulatory, and administrative issues that are identified during the process.

Once the certification basis is established for a proposed design, the FAA and the applicant develop and agree to a certification plan and initial schedule. In order to receive a type certificate, the applicant must conduct an extensive series of tests and reviews to show that the product is compliant with existing standards and any special conditions, including lab tests, flight tests, and conformity inspections. These analyses, tests, and inspections happen at a component-level and an airplane-level, all of which are subject to FAA oversight. If the FAA finds that a proposed new type of aircraft complies with safety standards, it issues a type certificate. Or, in the case of a change to an existing aircraft design, the FAA issues an amended type certificate.

FACTS CONCERNING THE BOEING 737 MAX

While the FAA is always striving to improve safety, the certification processes described above are extensive, well-established, and have consistently produced safe aircraft designs for decades. The Boeing Company has designed and built 14 variations of its original model 737 since the FAA issued the original type certificate in 1967. Following standard certification procedures, and based on the information Boeing provided, the FAA determined in February 2012 that the 737 MAX qualified as an amended type certificate project eligible for management by the Boeing ODA. The formal application was submitted in June 2012. Under such an arrangement, FAA subject matter experts are directly involved in safety related aspects of the project. For example, the FAA was directly involved in the System Safety Review of the Maneuvering Characteristics Augmentation System (MCAS).

The process from initial application to final certification took five years; the 737 MAX was certified in March 2017. The process included 297 certification flight tests, some of which encompassed tests of the MCAS functions. FAA engineers and flight test pilots were involved in the MCAS operational evaluation flight test. During the FAA's continued oversight of airworthiness standards, as we obtain pertinent information, identify potential risk, or learn of a system failure, we analyze it, mitigate the risk, update the certification requirements and require operators to implement the mitigation.

737 MAX ACCIDENTS AND THE DECISION TO GROUND THE FLEET

On October 29, 2018, a Boeing 737 MAX 8 operated by Lion Air as flight JT610 crashed after taking off from Soekarno-Hatta Airport in Jakarta, Indonesia. Flight JT610 departed from Jakarta with an intended destination of Pangkal Pinang, Indonesia. It departed Jakarta at 6:20 a.m. (local time), and crashed into the Java Sea approximately 13 minutes later. One hundred and eighty-four passengers and five crewmembers were on board. There were no survivors. An Indonesian-led investigation into the cause of this accident is ongoing, supported by the National Transportation Safety Board (NTSB), FAA, and Boeing. A preliminary report prepared by the Indonesian National Transportation Safety Committee was released in November 2018.

On November 7, 2018, based on all available and relevant information, including evidence from the Lion Air accident investigation and analysis performed by Boeing, the FAA issued an Emergency Airworthiness Directive. The airworthiness directive requires operators of the 737 MAX to revise their flight manuals to reinforce and emphasize to flight crews how to recognize and respond to uncommanded stabilizer trim movement and MCAS events. The FAA continued to evaluate the need for software and/or other design changes to the aircraft including operating procedures and training as additional information was received from the ongoing Lion Air accident investigation. On January 21, 2019, Boeing submitted a proposed plan for an MCAS software enhancement to the FAA for certification. To date, the FAA has tested a prototype of this enhancement to the 737 MAX flight control system in both the simulator and the aircraft. FAA flight test engineers and flight test pilots performed a preliminary evaluation of the prototype which included aerodynamic stall situations and recovery procedures.

On March 10, 2019, Ethiopian Airlines flight ET302, also a Boeing 737 MAX 8, crashed at 8:44 a.m. (local time), six minutes after takeoff. The flight departed from Bole International Airport in Addis Ababa, Ethiopia with an intended destination of Nairobi, Kenya. The accident site is near Bishoftu, Ethiopia. One hundred and forty-nine passengers and eight crewmembers were on board. None survived. An Ethiopian-led investigation into the cause of this accident is ongoing, supported by the NTSB, FAA, and Boeing. A preliminary report prepared by the Aircraft Accident Investigation Bureau of Ethiopia was released in April 2019.

Following the second accident, the FAA gathered all of the data it had regarding 737 MAX operations in the United States and continued to review information from the investigation as it became available. On March 11, 2019, the FAA issued a Continuous Airworthiness Notification to the International Community (CANIC) for 737 MAX operators. The CANIC included a list of all of the activities the FAA had completed in support of the continued operational safety of the 737 MAX fleet. These activities included the airworthiness directive issued on November 7, 2018, ongoing oversight of Boeing's flight control system enhancements, and updated training requirements and flight crew manuals.

After issuing the CANIC, the FAA continued to evaluate all available data and aggregate safety performance from operators and pilots of the 737 MAX, none of which provided any data to support grounding the aircraft. Also, at that time, other civil aviation authorities had not provided any data to the FAA that warranted action. The FAA's initial review of flight safety data for U.S. operators showed no systemic performance issues and provided no basis to order grounding the aircraft.

On March 13, 2019, however, the Ethiopian Airlines investigation developed new information from the wreckage concerning the aircraft's configuration just after takeoff that, taken together with newly refined data from satellite-based tracking of the aircraft's flight path, indicated some similarities between the Ethiopian Airlines and Lion Air accidents that warranted further investigation of the possibility of a shared cause that needed to be better understood and addressed. Accordingly, the FAA made the decision to ground all 737 MAX airplanes operated by U.S. airlines or in U.S. territory pending further investigation, including examination of information from the aircraft's flight data recorders and cockpit voice recorders.

POST-GROUNDING ACTIONS

On March 19, 2019, Secretary Chao asked the U.S. Department of Transportation's Inspector General to conduct an audit of the certification for the Boeing 737 MAX 8, with the goal specifically to compile an objective and detailed factual history of the activities that resulted in the certification of the Boeing 737 MAX 8 aircraft. That audit is ongoing, with the cooperation of the FAA.

On March 20, 2019, the FAA issued a second CANIC with updated information for operators of the 737 MAX. Specifically, the CANIC notified operators that Boeing had begun work on a Service Bulletin that would specify the installation of new flight control computer operational program software and had developed flightcrew training related to this software. Boeing is still to submit the final software package for certification. The FAA's ongoing review of this software installation and training is an agency priority, as will be the roll-out of any software, training, or other measures to operators of the 737 MAX.

On March 25, 2019, Secretary Chao announced the establishment of a Special Committee to review the FAA's procedures for the certification of new aircraft, including the Boeing 737 MAX. The Special Committee to Review FAA's Aircraft Certification Process is an independent body whose findings and recommendations will be presented directly to the Secretary and the FAA Administrator. The Special Committee is formed within the structure of the Safety Oversight and Certification Advisory Committee (SOCAC) created by section 202 of the FAA Reauthorization Act of 2018.

Further, on April 2, 2019, the FAA announced it was establishing a Joint Authorities Technical Review (JATR) to conduct a comprehensive review of the certification of the automated flight control system on the Boeing 737 MAX. The JATR is chaired by former NTSB Chairman Christopher Hart and comprises a team of experts from the FAA, National Aeronautics and Space Administration (NASA), and the aviation authorities of Australia, Brazil, Canada, China, the European Union, Indonesia, Japan, Singapore, and the United Arab Emirates. On April 29, the JATR initiated its review, with members tasked to provide the FAA with their findings regarding the adequacy of the certification process and any recommendations to improve the process. Completion of the JATR's work is not a prerequisite for returning the 737 MAX to service.

Additionally, on April 12, 2019, the FAA convened a meeting at the agency's Washington, D.C. headquarters with safety representatives of the three U.S.-based commercial airlines that have the Boeing 737 MAX in their fleets, as well as the pilot unions for those airlines. The meeting covered three major agenda items: a review of the publicly available preliminary findings of the investigations into the Lion Air and Ethiopian Airlines accidents; an overview of the anticipated software enhancements to the MCAS system; and, an overview of pilot training. Each presentation corresponding to the agenda, delivered by FAA subject matter experts, allowed for an open exchange between all participants. This meeting was an opportunity for the FAA to hear individual views from operators and pilots of the 737 MAX as the agency evaluates what needs to be done before the FAA makes a decision to return the aircraft to service in the United States.

The FAA recently solicited public comment on a draft report prepared by the FAA's Boeing 737 MAX Flight Standardization Board (FSB). The FSB is a panel that FAA utilizes to evaluate and determine the sufficiency of proposed training developed by Boeing and related to the proposed software enhancements for the 737 MAX aircraft. An FSB is generally comprised of qualified pilots from FAA's Certificate Management Offices, foreign authorities, and industry. The FSB report outlines the minimum guidelines for an air carrier training program. The comment period on the draft report has been extended multiple times to ensure ample opportunity for public input. The FAA will review this input before making a final assessment.

On May 6, 2019, the FAA initiated a multi-agency Technical Advisory Board (TAB) review of the MCAS software update and system safety assessment in order to determine sufficiency. The TAB consists of a team of experts from the U.S. Air Force, NASA, Volpe National Transportation Systems Center, and the FAA. None of the TAB experts have been involved in any aspect of the Boeing 737 MAX certification. The TAB is charged with evaluating Boeing and FAA efforts related to the software update and its integration into the flight control system. The TAB will identify issues where further investigation is required prior to approval of the design change. Although the JATR is broadly considering certification of the flight control systems, the TAB is evaluating the proposed technical solutions. The TAB's recommendations will directly inform the FAA's decision concerning the 737 MAX fleet's return to service.

On May 23, 2019, the FAA will host a meeting of Directors General of civil aviation authorities from around the world to discuss the FAA's activities toward ensuring the safe return of the 737 MAX to service. This meeting is part of the FAA's efforts to work with other civil aviation authorities to address specific concerns related to the 737 MAX, in keeping with the FAA's longstanding cooperation with its international partners. As recent events have reminded us, aviation does not have borders or boundaries. The FAA is focused on continuous safety improvement here at home and internationally through our ongoing engagement with other civil aviation authorities and industry stakeholders throughout the world. Aviation remains the safest mode of transportation in the United States and globally, and we advance this level of safety by sharing issues, trends, and lessons learned throughout the world. The United States is the gold standard in aviation safety. The FAA is resolute in its commitment to maintaining that standard. In our quest for continuous safety improvement, the FAA welcomes external review of our systems, processes, and recommendations. And the 737 MAX will return to service for U.S. carriers and in U.S. airspace only when the FAA's analysis of the facts and technical data indicate that it is safe to do so.

This concludes my prepared statement. I will be happy to answer your questions.

Mr. LARSEN. Thank you very much for your statements, both of you.

We are now going to move to Member questions. Each Member will be recognized for 5 minutes, and I will start by recognizing myself.

Administrator Elwell, this week the Wall Street Journal reported the FAA internal review tentatively determined senior agency officials did not participate in or monitor critical safety assessments of the 737 MAX flight control system.

It also noted the FAA deferred to Boeing's early safety classification and the subsequent analysis of potential hazards that were performed with limited oversight by the agency.

Is that report accurate? And, if accurate, what explanation does the FAA have for, I guess, falling down on the job?

Microphone.

Mr. ELWELL. Thank you for that question, Chairman Larsen. I think you are talking about the Wall Street Journal article of yesterday. And we take all those articles and those charges or reports seriously. But, frankly, there is nothing in that article that led me to anything that I am aware of. So we will certainly see what we can find out about it.

But—and I will ask my colleague, Earl, if he is aware of what the article——

Mr. LARSEN. Before you get to Mr. Lawrence, so the article reported that the FAA's own assessment determined tentatively that senior agency officials were not involved in this assessment.

Mr. ELWELL. I am not aware of an internal assessment——

Mr. LARSEN. Mr. Lawrence?

Mr. ELWELL [continuing]. That has reached that conclusion.

Mr. LAWRENCE. I am not aware of the internal assessment that the article refers to.

Mr. LARSEN. OK. Well, we have some homework, and you do, too. But I think it does relate to the next set of questions with regards to the ODA and the use of the ODA process.

Mr. Elwell, you previously stated—it was reported that you stated that a full reversion of certification activities to the FAA would require 10,000 additional FAA inspectors and $1.8 billion. I am not here to argue whether it is one more or one less than that, but has the FAA considered moving back to the previous designated—in June—representative system away from the AR system? And what would that cost be?

Mr. ELWELL. Chairman Larsen, I don't know what that cost would be. I know that there are a number of investigations and audits, as several opening statements have pointed out, that are designed to look at the process.

I also know that our risk-based, data-driven systems approach has, as Ranking Member Graves stated, led to the U.S. safest system in history, and in the world. I am very, very careful to make sure that the results of any inquiries, investigations, audits bring us actionable information.

I mean, as I said, we welcome those investigations. We welcome the audits. They make us better. But at this point, to say that we are willing to go back to something before we have gone through those investigations, I am not prepared to say that. I really want to see what these investigations and these audits have to say about our processes.

Mr. LARSEN. So the current system with authorized representatives, however, has ODA participants reporting, I understand, to managers, as opposed to engineers. And under the DER system the ODA designees were reporting to engineers.

Are you, through your assessment, looking at whether a change from reporting to engineers, who can monitor engineers, versus to managers, who are looking more at budgets—are you looking at whether that process needs to be changed? Is that going to be part of the—say, the blue ribbon commission's look?

Mr. ELWELL. Sir, I am not aware of any limit on what we are going to look at. We are going to look at everything.

I would say that the Organization Designation Authorization, ODA, as it exists today, is a process that has developed over decades. We have had ODA in one form or another since the beginning of the FAA. We have had delegation of authority since 1927. The concept isn't new, it is the administration of it.

In my mind, if we have robust oversight, and we have all the protections in place to guard against conflicts of interest or undue pressure, which I believe we currently have, it is a good system. But it can always be made better. I mean, that is what we are all about.

Mr. LARSEN. And I will just conclude on that point, though, that—I guess putting the faith in the evolution of the system to get to where we are today isn't necessarily a positive assessment of the system that we have. Just because it has evolved since 1927 doesn't mean it has evolved to the place where it needs to be or should be, and it perhaps has over-evolved in this case, if you will.

So with that I will yield 5 minutes to Ranking Member Graves of Louisiana.

Mr. GRAVES OF LOUISIANA. Thank you, Mr. Chairman.

Raise your hand if you have a pilot's license in this room.

Raise your hand if you have been flying a plane when the stick shaker has gone off.

So, wait, could you do that again? Hands up if the stick shaker has gone off. So three of you, four of you. And did any of you not turn the plane around, or come back and land when that happened? Raise your hand if you kept going. Thank you.

Mr. Chairman, I just want to make note that no one raised their hand in terms of continuing the flight. And the reason I ask that question is that in both accidents stick shakers went off and the planes didn't turn around. And I just—I find that interesting, that in this case the planes didn't turn round.

Mr. Elwell, there has been a lot of confusing information in the news media regarding what happened. And I have read a few times where there has been reference to "self-certification." Could you clarify that? Do companies self-certify their own aircraft?

Mr. ELWELL. Mr. Graves, no, sir, they don't. We don't have a program of self-certification.

ODA empowers private individuals at a company that has an ODA program to do certain tasks and make certain decisions. They are delegated with that authority that we then oversee. And this isn't something that we give lightly. To be granted an ODA is a privilege that a company earns. We have about 79 or 80 of them, I think.

And it is important to note that the vetting that is required of the individuals in an ODA program and the ODA program itself is very thorough and robust.

And to your point, Mr. Chairman, we are not resting on that. We don't ever stay static on anything in the FAA, safety-related. So we will continue to look at that.

And I have to my right Mr. Earl Lawrence, who is our resident expert on ODA and the process, if I can allow him to elaborate.

Mr. LAWRENCE. Thank you. I would like to build one point under Mr. Elwell's comments, and it goes back to Chairman Larsen's comment earlier.

In an ODA system we don't have engineers reporting to just managers. We have engineers reporting to engineers, and those engineers all have to be approved and vetted by the FAA. So the head of an ODA is an engineer who has all those skills and experiences that has to be approved by FAA engineers, as well.

Mr. GRAVES OF LOUISIANA. Thank you.

Mr. Elwell, another question. Again, a lot of interesting articles regarding the potential ungrounding of the MAX. Could you describe the steps that the plane would have to go through in order to be ungrounded, or to be able to fly again?

Mr. ELWELL. Yes, sir. So I think that—just to go back a little bit, it is important to lay the groundwork for it. We grounded the U.S. fleet when we had the data to establish a potential causal link between two accidents. That is the justification for a grounding. And it is important that you establish a link, because you then have what you need to mitigate—to unground, or to remove the prohibition order.

So what we will do is we will receive Boeing's application for a design modification to the MCAS system, and we will thoroughly evaluate that and their system safety analysis. We will evaluate the training required to certify that new software system. And once we have made our analysis, we have consulted with the TAB—which, by the way, is a third party, third set of eyes that I think this committee recommended a month or two ago that should be employed in this instance, and we agree, and we initiated the TAB. And once we are absolutely convinced of the safety, return to service, and we will do it.

Mr. GRAVES OF LOUISIANA. Chairman Sumwalt, very quick, yes or no. Do you believe that there are processes, programs, or procedures that domestic airlines follow that may have prevented these, based on your preliminary—prevented these accidents, based on your preliminary reports?

Mr. SUMWALT. Ranking Member Graves, I apologize. Maybe it is my ears, maybe it is the acoustics in the room. I am not having—I am having difficulty hearing the question.

Mr. LARSEN. We will have to come back to it. But we will, we will.

I recognize Chair DeFazio for 5 minutes.

Mr. DEFAZIO. Thank you, Mr. Chairman.

Administrator Elwell, we were both in the Air Force. You were a pilot, I wasn't. But my understanding is that the Air Force has a minimum of two angle-of-attack sensors on its planes, and sometimes as many as four. Does that sound right to you?

Mr. ELWELL. Sir, there are different numbers, depending on the size of the aircraft.

Mr. DEFAZIO. Right. But never one.

Mr. ELWELL. As far as I know, never one.

Mr. DEFAZIO. Right, OK.

Mr. ELWELL. The planes I flew in the Air Force had at least two.

Mr. DEFAZIO. OK. Then is the MCAS a safety critical system, in your opinion?

Mr. ELWELL. I didn't make that designation, but it seems to me that, yes, it is.

Mr. DEFAZIO. OK, then why would it trigger with a single point of failure? I mean isn't that kind of standard, that we never have a safety critical system trigger off a single point of failure?

Mr. ELWELL. Sir, a single point of failure means that if that component, or that part of the aircraft fails, it will lead to an accident.

Mr. DEFAZIO. Well, in this case it led to triggering the MCAS, which is safety critical.

Here, let me read you something. This—I got this from a very, very experienced 737 pilot. "If MCAS is not stopped by the pilots at the completion of two full MCAS cycles—10 seconds, pause, 5 seconds, 10 seconds—horizontal stabilizer is at or very close to the full nose-down limit of travel. At this point the pilots do not have enough elevator authority to overcome the horizontal stabilizer, and the nose of the aircraft will continue to fall. The aircraft is no longer controllable in pitch. The only possible recovery is to trim the aircraft nose up, so the horizontal stabilizer moves to a flyable position. This pilot would characterize an MCAS runaway as having high potential to result in a drastic abrupt maneuver." That sounds pretty radical.

I mean—now, why—in this case the argument is the pilots are supposed to correct the system. But until after Lion Air, the pilots didn't know the system was installed. Is that correct?

Mr. ELWELL. Yes, sir.

Mr. DEFAZIO. And the pilots also didn't know that the disagree light didn't work unless you bought the optional package of safety, which included more—another set—you had both the disagree light, and then you had, I guess, digital gauges that showed what the angle-of-attack sensors were—or seeing, or feeling, or doing.

So when did the FAA become aware that the disagree light wasn't working which had been on, I guess, all previous models of the 737?

Mr. ELWELL. Sir, if I could go back to the 737 pilot?

Mr. DEFAZIO. Yes.

Mr. ELWELL. So I wasn't a 737 pilot in my commercial days, but I had the opportunity to fly the MAX sim a month or so ago, and I would offer on the mechanics of it that at the moment that a pilot—and we are trained our entire careers—the moment you feel the airplane doing something you didn't command it to do, you instinctively trim in the other direction. And if that doesn't work, you do a memory procedure called runaway stab trim.

Mr. DEFAZIO. Right.

Mr. ELWELL. So the—I am not going to take issue with his comments about two bursts of the MCAS, what it might do, but I know——

Mr. DEFAZIO. That is an elapsed time period of 20 seconds.

Mr. ELWELL. Yes, I——

Mr. DEFAZIO. It is 20 seconds. I mean that is pretty quick. And if you are at a low altitude I think it is, you know, pretty—but let's go back to the issue of——

Mr. ELWELL. Disagree light?

Mr. DEFAZIO. When the FAA was informed by Boeing. Boeing knew at, I believe, about a year before they informed the FAA that the disagree light didn't work.

Mr. ELWELL. So, sir, our—we have looked at this, and software engineers discovered the anomaly. And the anomaly was tied to the MCAS software. Part of the change to the——

Mr. DEFAZIO. But the question—just no, I get that. I mean we can get into details. But the point is a year elapsed before Boeing told the FAA. What actions did the FAA take at that point in time? Did you consider that inappropriate behavior by Boeing?

Mr. ELWELL. Sir, I am concerned that it took a year, and we are looking into that, and we are going to fix that. Once we learned that the light was not operable, then we made the decision that it is not a safety critical display. It is not a safety critical display. It is advisory. There are no actions that the pilot takes to an AOA disagree light. And so it did not rise——

Mr. DEFAZIO. Well, it would alert them to that—that whatever the runaway problem is due to is due to, at that point, the angle-of-attack indicators.

Mr. ELWELL. Actually, the notice of that is tactile. One yoke is shaking, and the other isn't. That is, by definition, AOA disagree.

Mr. DEFAZIO. Yes.

Mr. ELWELL. So the light is advisory.

Mr. DEFAZIO. OK. Then why is it there at all?

Mr. ELWELL. It is good for maintenance. So if you get an AOA disagree light in flight, you know to tell maintenance on the ground, "Hey, check. One of these is not calibrated correctly, or is off."

Mr. DEFAZIO. OK. So then, really, you don't think it is significant that Boeing didn't tell people the system was in the plane, and didn't tell people that disagree light didn't work. None of that was problematic?

Mr. ELWELL. Oh, I actually think—I think that is an issue, sir, and we are going to look into it. It shouldn't take a year for us to find out that that discovery was made.

Mr. DEFAZIO. I appreciate that, and I really would want to know the answer.

And in fact, the Dallas News—and this is off of a tape recording, so I think it is accurate—this was pilots talking to—after they found out there was an MCAS system in the plane after Lion Air, talking to a Boeing engineer, and they said, "Why wouldn't you tell us about the system?"

"I don't know that understanding this system would have changed the outcome," he said. "In a million miles you are going to maybe fly this airplane, maybe you are once going to see this, ever. We try not to overload the crews with information that is unnecessary." I mean do we really think that—that was unnecessary, that it wasn't even in the manual, and they didn't know about it?

I mean there is a lot of stuff in that manual that you don't really need to know.

Mr. ELWELL. Yes. Well, Mr. Chairman, I can't comment on that conversation. And I think you were quoting Boeing.

Mr. DEFAZIO. Yes.

Mr. ELWELL. I, as a pilot, when I first heard about this, I thought that there should have been more text in the manual about MCAS, I agree.

Mr. DEFAZIO. And Mr. Lawrence, in response to the chairman you said that the engineer reports to an engineer. Can that engineer to which the report is rendered also be a manager at Boeing?

Mr. LAWRENCE. They would be a manager in the organizational delegation—organization itself——

Mr. DEFAZIO. Right. Could they be—have managerial status at Boeing and they are paid by Boeing? Is that correct?

Mr. LAWRENCE. They are paid by Boeing. That is correct.

Mr. DEFAZIO. OK, thank you. Just one other question.

Now we have had 14. If we could, put up on the screen the flight deck 67, flight deck 17. Well, I thought we were going to put it up. But anyway, I have it here. You can't see it, but you would be familiar with it. We are getting used to our new electronics.

[Slide]

Mr. DEFAZIO. But when you think of—there it is, now. Pretty different airplanes, you know, their computer screens, GPS, everything is digital. The other is analog, you know, very different planes. And this is 14 variations later.

And I think we have got to question the system where if you—I think, if you took the 737–100 and compared it to a MAX, you would say, wow, these are different types. But we sort of gradually got there, kept moving and moving and moving through 14 variations, and never determined that it would have to go through a more rigorous process as a new type, and including pilot retraining and those sorts of things.

I mean doesn't that raise some questions about how you kind of get this creep over 14 variations over however many years that is, 67—42 years?

Mr. ELWELL. Sir, I know that begs the question. I would remind, though, that the amended type certificate of the MAX was amending the NG. And if you had the NG and the MAX side by side, then you could see the similarities. They are so close as to be amended——

Mr. DEFAZIO. Wasn't the NG amended from the 900?

Mr. ELWELL. Correct.

Mr. DEFAZIO. Which was amended from the——

Mr. ELWELL. Yes, sir.

Mr. DEFAZIO. So, I mean, that is kind of a creep, that seems to me. I think there is a question there that we should look at.

Mr. ELWELL. Well, and as I said before, in the beginning of your questions, we welcome that examination. If there is something wrong with the extension of a family—and of course, that is something that the 737 has, multiple iterations. But again, we are certifying to the last one.

Mr. DEFAZIO. OK. All right. With that, thank you, Mr. Chairman.

Mr. LARSEN. Thank you. I know we have a 5-minute rule. I am going to indulge the chair. I have 8½ minutes and I wanted to afford that for the ranking member of the committee, as well. So I recognize Mr. Graves, the ranking member, for up to 8½ minutes.

Mr. GRAVES OF MISSOURI. Thank you, Mr. Chairman. Could we bring it back up the—on the screen?

[Slide]

Mr. GRAVES OF MISSOURI. Because we keep focusing on the angle-of-attack indicator. So if you see on the right the 737 MAX, that screen in front of both the pilot and the copilot, with the blue above and the brown below, that is your primary angle-of-attack indicator. That is your artificial horizon. Every aircraft out there has to have that to be certified.

The one on the left, the older version—that is digital, on the right. The one on the left is what we call analog. And if you see the circle in front of both the pilot and the copilot, and there is white above and black below, it is the same thing. That is your artificial horizon. That is your primary angle-of-attack indicator—in fact, all of my years of flying, I don't think I ever had an actual—what we are talking about—angle-of-attack indicator in any of the aircraft I have ever flown.

But what is interesting, too, is—and we failed to—and I go back to this—you got to know how to fly the plane, fly the plane. In the Ethiopian Airlines incident you can look outside. That is the critical angle-of-attack indication right there. Look outside the airplane when you are flying it. You can tell if you are at a critical angle of attack, because you are going to be pitched up. You are going to be getting close to a stall situation. Those are your two main angle-of-attack indicators. First of all, look outside when you are flying the plane. And second of all, look at your artificial horizon.

And I guess my first question is for Administrator Elwell. And at this point we know—and we always know there are so many other things to look at in these investigations. You know, not just FAA certification activities with the 737 MAX, but many, many other things. And what I want to get to is the preliminary report shows that there were a lot of misidentifications on what was occurring in the aircraft, and misapplication of safety procedures, and in training itself.

And as a pilot—and I want you to talk to us as a pilot—can you provide us some context as to what actions or inactions by the pilots or the airline, for that matter, also require some close examination in the course of this, in this investigation?

Mr. ELWELL. Yes, sir. Thank you for that question.

As a pilot—I mentioned a little bit earlier that in the U.S., training focuses on hand flying, manual flying. There are other parts of the world in other countries that focus on flight control management. But in the U.S., from the first training you do as a pilot—Air Force for me, but it is the same in civil—it is flying the aircraft.

And what was going on—it has already been pointed out that there was a false indication of a stall—immediately recognizable to the trained pilot as a false indication because one yoke was shaking, the other wasn't.

What concerns me about the data from the flight data recorder is the apparent lack of recognition of runaway stab trim. Runaway stab trim is taught at the earliest stages of aircraft that have stab trim motors, and it is so important—to Chairman DeFazio's point about time, elapsed time, it is so important that you don't pull out

a checklist, you don't open and look at what is next. It is memorized, and you are tested on it all the time, and you turn off those stab trim motors.

In the Lion Air accident it is significant that, even though the airplane was pitching against the pilot's commands—that is classic runaway stab trim—the stab trim motors in 13 minutes were never turned off. And I think you made the point, sir, in your remarks that, in the case of the Ethiopian Air flight, they did turn them off, although they didn't adhere to the emergency AD that we put out on November 8th. They did turn the stab trims off, but they never controlled their airspeed. And then, subsequently, about a minute before the end of the flight, they turned them back on. Both of those things are unfortunate, obviously.

And I have to point out in deference to my colleague here to my left, Chairman Sumwalt, these investigations are ongoing. And as you said, there are so many pieces to any accident. I have never looked at an accident where there weren't three, or four, or five links to the chain, any one of which, if it hadn't gone wrong, the plane would have survived. So we know that there is going to be and there are factors.

But as a pilot, as you asked me, that is what I saw, the lack of control and the speed on Ethiopian and the apparent not doing the stab trim cut-out switch procedure.

Mr. GRAVES OF MISSOURI. We come back to it, and we keep coming back to it, and forgetting that, you know, once they set those throttles to full power, they never retired them. And I have used that analogy—the analogy before, when you are in a car and you are speeding towards a brick wall, full speed, you are going to take your foot off the gas. That is what most people would do. But they accelerated right through their certified maximum speed of a—the MAX 8, and just kept on accelerating.

Throughout the entire process that aircraft kept accelerating. And when you get those kind of pressures against the control surfaces, it makes it very, very hard to do manually. And you know—and again, this comes back to so many times pilot training.

This is what worries me more than anything else. And I hate to disparage, you know, another country and what their pilot training is, but that is what scares me in all of this, is climbing on an aircraft or an airline, you know, that is outside U.S. jurisdiction. I know what we have in the U.S., and I know what we are capable of, and I know the quality of our pilots, and the—what they have to go through to get to that point.

And I just think it is—you know, it just bothers me that here we are, we just—we continue to tear down our system based on, you know, what has happened in another country—two other countries, and particularly given the qualifications and—you know, and what we are learning about the training standards.

But that last part was more editorial than anything else, Mr. Chairman. I will yield back.

Mr. LARSEN. Thank you, Ranking Member Graves. I now recognize Representative Norton for 5 minutes.

Ms. NORTON. Thank you, Mr. Chairman. No, we don't want to tear down our system, we want to restore confidence in our system,

Mr. Elwell. And I am sure that you are concerned that this impressive record may well be shattered.

I regard it as a purpose of this hearing, as your answers—to help us, if we can, restore confidence in a system—and, by the way—most Members, maybe except me, use every single week to go back and forth to the Congress.

So this loss of confidence, this—despite this wonderful 10-year record, seems to have been shattered. And so just let me ask you a question preliminarily, Mr. Elwell.

I think most members of the public, after one crash, would have said, "Oh, that is unusual." Well two crashes. Why did it take so long, compared to other countries that made the decision almost immediately after the Ethiopian Airlines accident? In fact, as I recall it, the President made the announcement. But, as is his want, he probably was perhaps preempting the FAA. But that is where the announcement came from.

If anything, it signals the importance that somebody should speak up. So I think the public—which will be interested in this hearing—wants to know why did it take you so long after the Ethiopian Airlines accident. Explain that to this committee.

Mr. ELWELL. Ms. Norton, thank you for that question. The FAA is a data-driven, risk-based systems approach to all things safety. When we take an action, and whether it is the grounding of an aircraft, or an airworthiness directive, or——

Ms. NORTON. Other countries weren't data driven? That is the difference between you and other countries?

Mr. ELWELL. I can't speak to the decisionmaking of other countries. I can tell you this. A number of countries that grounded their 737 MAX fleets called us immediately after and asked what data we had. Several countries asked, after grounding their fleets, "What are we going to need"——

Ms. NORTON. That means that they were looking at real-time, real-life evidence, even if it may have contradicted the data.

Are you still as reliant on data as you were then, compared to other countries? Today would you be reliant only on data?

Mr. ELWELL. Well ma'am, that is a great question. We made our decision to ground the aircraft when we had the data that linked the two flights, data to link the flights.

But we weren't just sitting, waiting for the cockpit voice recorder or the flight data recorder. We were examining, as the regulator of our 737 MAX fleet, what is going on with our fleet. And we drew data on 57,000 flights. And we were talking constantly with our neighbor to the north.

Ms. NORTON. That was after the first?

Mr. ELWELL. After—from the first accident, but up through Ethiopia, to find out are we—the fleet that I am responsible for regulating, are they experiencing any anomalies? And there were zero in 57,000 flights. So I had to——

Ms. NORTON. Can I ask you this, Mr. Elwell?

Mr. ELWELL. I am sorry, ma'am?

Ms. NORTON. Could I ask you this, then? OK. Again we see reliance—and I would say perhaps over-reliance—on data. Did the President make this call, or did the FAA make this call?

Mr. ELWELL. FAA is the safety regulator. FAA made the call to——

Ms. NORTON. And he only made the announcement, is that what you are saying? You were prepared to make that call yourself after the second accident?

Mr. ELWELL. Yes ma'am.

Ms. NORTON. OK. He preempted you, but you were prepared to do it. You wouldn't have waited for a third accident. The data told you after the second accident.

Mr. ELWELL. Yes, ma'am. Yes, ma'am.

Ms. NORTON. Could I ask you, Mr. Elwell, does the FAA mandate pilot training on all of its systems in which—this was news to me—in which the pilot is considered the redundancy for the system's failure? Most of us didn't know that the pilot was so considered.

Mr. LARSEN. Mr. Elwell, you have to take that question for the record.

Mr. ELWELL. I am sorry, sir?

Mr. LARSEN. You will have to take the question for the record.

Mr. ELWELL. OK.

Mr. LARSEN. And I recognize Mr. Mitchell, Representative Mitchell, for 5 minutes.

Mr. MITCHELL. Thank you, Mr. Chair. The effectiveness, the success of the aviation system in North America, has been based on safety, reliability, and transparency in decisionmaking, both in terms of certification of aircraft, pilot qualifications, and when there are incidents.

Mr. Elwell, you recall last week there was a briefing for members of the committee on the 737 MAX certification. I asked a question. I asked what the FAA had done in the process of reviewing and certifying the MCAS system. To be honest with you, sir, I got a whole description of what the system did and didn't do, but I didn't get an answer to my question. At no point did I. And then we are greeted by, as Mr. DeFazio notes, this Wall Street Journal article.

So I will ask the question again. I will ask it for the record. And I will ask you to submit in writing to the committee. What were the steps the FAA took in reviewing the MCAS system and the accompanying training? Because I have asked it now three times, and I have—to be blunt with you, sir, with all due respect, I haven't gotten a direct answer. And the committee deserves it.

Mr. ELWELL. We will get that answer for you, sir.

Mr. MITCHELL. That would be deeply appreciated. And I would like it straight up. What was the engagement in the system throughout the process in detail. Don't worry about boring me. I don't believe that the chair is going to be bored by reading this. I certainly am not. We need to understand that, because there is a critical component of this.

Mr. ELWELL. Yes, and I can assure you that the MCAS system was examined and certified, because it was a new system to the MAX.

Mr. MITCHELL. It was.

Mr. ELWELL. And we retained it, and we had the oversight of that, and we certified it.

Mr. MITCHELL. Well, as you may recall, I asked the question and didn't get an answer that was anywhere close to satisfactory. I would appreciate it.

Let's transition to a—as was noted, the 737 MAX has flown 57,000 flights in North America without an incident.

Part of the difference is the training of the aviators, the pilots. I mean I have done some instruction. I don't have a pilot's license, I didn't have enough time. But it was clearly made to me—first thing, you aviate, you fly the plane. Then you navigate, then you communicate. So, yes, I have seen a stick shaker, they made me do it. It is interesting.

I am concerned that—and I am trying to be respectful, because they are deceased—the pilot in command of the Ethiopian Air was 29 years old, and was reported to have 8,100-and-change hours of flight. Now, let me give you some examples. Close friends of mine who are commercial pilots flew for major corporations. He is 58, has 17,000 hours. Another gentleman is 63, also flew for major corporations and private flight. He is 63 years old, has 20,000 hours. The second—their first officer had 361 hours.

Have you—I mean, do we not have concerns with not only the training of pilots in other nations, but the reliability of their logs to try and claim 8,100 hours at age 29? How many pilots do you know that have over 8,000 hours at 29 years of age?

Mr. ELWELL. Mr. Mitchell, I don't know anybody at 29 years old that has 8,100 hours, but I am not going to say that that is not possible.

And the answer to your question is do we want to examine and take a very hard look at the training standards, globally? Yes, absolutely. We have been involved—the U.S. has led on pilot training for many years, and we do that at the International Civil Aviation Organization, the U.N. body that provides that guidance for standards around the world.

Mr. MITCHELL. I think it needs to be an issue that we address, and as we deal with this, because clearly the disparity is concerning to me.

One quick question. I guess I would also ask you to submit this for the record, because time is going to run short. In reference to my colleague's question, part of the reason for the delay, or the delayed response of the United States, is we got our data from Canada, did we not?

Mr. ELWELL. Indirectly. Yes, sir.

Mr. MITCHELL. We didn't have the data with the same level of specificity that Canada had, because we don't have access to that system that they use for air traffic control. Correct?

Mr. ELWELL. We do have access to it, sir. But Canada got it first because it came from a company that the air traffic services in Canada——

Mr. MITCHELL. Would you submit that whole process, that whole timeline, in writing to the committee, please?

Mr. ELWELL. Yes, sir. We will do——

Mr. MITCHELL. Thank you, sir. One last comment. I believe that we have got the most advanced aviation system in the world. We will find multiple factors that contribute to this terrible tragedy, one of which will be we didn't see things that could have come up.

It is hard to sometimes have a crystal ball. But when you do recertify this aircraft, I will be among the first to buy a ticket to fly the plane, because I have faith in our aviation system. I have faith in the FAA. And I have faith in Boeing and the aircraft they fly. I will buy one, I will fly it somewhere to make the point that we have to trust our aviation system.

Thank very much. I yield back.

Mr. ELWELL. Thank you, sir.

Mr. LARSEN. Thank you. And I now recognize Representative Lipinski for 5 minutes.

Mr. LIPINSKI. Thank you, Mr. Chairman. Sitting here in front of the family of a victim of one the crashes of a 737 MAX, and looking at the pictures of the victims, it is crystal clear what the responsibility of the FAA, the NTSB, and our committee is right now. We need to get to the bottom of what happened, so we can do whatever we can to ensure the safety of air passengers.

And from what we know so far, it seems to me, at least—although there—it sounds like there may be—have been other factors, but it seems that something went wrong with the FAA's safety certification of the 737 MAX, and 346 people died.

We need to figure out what went wrong. If it was the certification process itself, we need to fix it to avoid a repeat. If it was the problem with the lack of compliance with the process, then we have to hold accountable whoever it was that was not compliant, the FAA and/or Boeing.

In addition, further steps must be taken to ensure compliance. No, this is not a legal proceeding here, and I know that we are in the early stages of the investigation of the crashes and the certification of the MAX. But stories we have heard about the process of certification so far are troubling.

The guiding principle of the FAA and manufacturers must be safety, not getting a highly valued plane out more quickly.

A question was raised earlier by Chairman DeFazio about why the 737 MAX was not required to get its own type certificate. To me this is very troubling. It seems to me that because it didn't have to get its own type certificate it could move more quickly through the process. Now I am not a pilot, and I will defer to the pilots on this committee when it comes to issues of their experience as pilots.

But I am a mechanical engineer. I know that this plane—Boeing needed to compete with Airbus, they—in order to have more fuel efficient planes, they put new engines on the plane. The engines had to be put further forward on the wings. These changes in aerodynamics caused the need for the MCAS system. And it seems to me that the MCAS system fundamentally changes the way the Boeing 737 flies. How was this not a major change that required a new type certificate?

Mr. ELWELL. Thank you for that question, Mr. Lipinski, and I am glad you asked it, because—and I appreciate that you are an engineer. Actually, the MCAS was put into the 737 MAX for the opposite reason. It doesn't make it fly differently. The MCAS was put—designed into the airplane to make it fly and feel for the pilots exactly like the NG—

Mr. LIPINSKI. Yes, but it was a change. It was a fundamental change——

Mr. ELWELL. Yes, it was a change——

Mr. LIPINSKI [continuing]. To how it flies. I understand it was put in there to try to make it fly the same way. But the system itself was a change.

Mr. ELWELL. So the MCAS was added to a system that was on the—that is on the NG called the speed trim system. It is—and I am not an engineer, but it is a layer below, a software layer below the speed trim system. And, as you said, the MCAS was put in because the engines were—brought the CG a little bit forward on the airplane. The test flights demonstrated that in a high angle-of-attack regime the yoke didn't feel the same to the pilots as the NG. The MCAS pushed the nose over, so that controllability and the feel on the yoke would be the same.

And the flight test pilots deemed that it was identical, and then the flight standardization board pilots, which were actually line pilots that we enlisted to fly both planes, found—came to the same conclusion.

Mr. LIPINSKI. Well, I am hopeful that this was not a situation where the desire was just to get the plane out more quickly, that it wasn't a situation where safety was not the priority, because that must be the priority. As I said, for the FAA, for the manufacturer, safety must be the priority. I understand how important Boeing is as an American company, but safety must always come first.

Mr. ELWELL. Sir, I——

Mr. LIPINSKI. Thank you, I yield back.

Mr. ELWELL. I couldn't agree more. Thank you, sir.

Mr. LARSEN. Represent Spano for 5 minutes.

Mr. SPANO. Thank you, Mr. Chairman. And before I begin I too want to extend my sincere condolences and regrets to the members of the family who are here today. I can't imagine what you are going through. And thank you for being here. I am very grateful that you are here.

My first question is to Mr. Elwell. Can you help me understand? Describe in a little bit more detail the FAA's delegation authority. What are the things we delegate? What are the things that we don't delegate? Those things that we do delegate, how does the FAA oversee the actions of designees? Just generally, thank you.

Mr. ELWELL. Thank you, sir, for that question. The key word in your question—detail—begs that after I introduce that I am—I would like to hand off the detail of the ODA to Earl, who is our resident expert.

I will just start by saying the Organization Designation Authorization, as it has come to be known, ODA, is a longstanding principle in certification, and it is a way in which the FAA leverages the expertise within the manufacturing entity. It is very important we understand that, without leveraging their engineering expertise, it would be virtually impossible to have the system that we have today.

So as far as the details of how the ODA is administered, I—Earl?

Mr. SPANO. I appreciate that, and I appreciate it is a longstanding process, but I think the public would like to know——

Mr. ELWELL. Yes, sir.

Mr. SPANO [continuing]. So that they can have some level of confidence that the FAA is doing the job that we expect them to do. What is delegated, what is not, how do we oversee that?

Mr. ELWELL. Thank you.

Mr. LAWRENCE. So thank you for the question, because I think there is a lot of misunderstanding of our delegation process. I would like to simplify our, sir, process in four key areas.

And the first and foremost is setting the standards. What are the rules and requirements for any design to meet?

Next are another layer of test protocols and standards. So it is how you are going to show compliance.

The third level is the actual doing of the tests and the calculations.

And then the fourth is the overview of all those results, and the approval.

Only in that third level, the actual doing of a test, is where delegation is used. FAA is fully responsible for setting the standards that all tests must comply with, and setting the standards for the minimum safety for that aircraft, and then reviewing it all in the end. We never give up that authority.

We take advantage of the expertise of the people who are actually building and designing the aircraft to assist us in reviewing those tests and those procedures, particularly on things that have been done over and over and over again over many years.

I want to highlight that it took us 5 years and over 110,000 man hours to certify the 737 MAX. I don't think that was a quick process or just a cursory review. We apply the same rigorous standards on whether it is a derivative design or original design. And I am proud of my team for their abilities and their expertise in reviewing any certification project.

Mr. SPANO. Thank you. Thank you, Mr. Lawrence.

The next question for Chairman Sumwalt. If you would, just help us—help me understand. Over the last maybe two or three decades, you know, what is the state of commercial airline safety here in the United States? Give us a, if you would, a brief sketch in 1 minute and 12 seconds.

Mr. SUMWALT. Well, I think generally speaking, the state of the airline industry in the United States over the last few decades has increasingly gotten safer and safer. That—as it was pointed out earlier, we had one fatality in the past decade. One is too many. And, of course, we have the families of the Colgan 3407 crash here. There were 50 lives lost there. So it is good, but good is not good enough.

Mr. SPANO. And then one final question. It has been mentioned that we don't—we can't control, necessarily, some of the pilot training protocols abroad. Are there any mechanisms, if any, that we have at our disposal to ensure that other countries, you know, do require their pilots to have the training that we feel is appropriate? And if so, what are those mechanisms?

Mr. SUMWALT. Yes, ICAO, International Civil Aviation Organization, outlines the standards and recommended practices for member states to follow. There are 193 states that are subscribers to or signatories to ICAO. So——

Mr. LARSEN. And you can get further information on that, as well.

I also remind the subcommittee that we have asked, through a bipartisan letter to the DOTIG for the international pilot training standards, and some other information, as well. When we get that we will share it with the full committee.

I recognize Representative Cohen for 5 minutes.

Mr. COHEN. Thank you, sir. I express my sadness at the loss of the individuals and for the parents to be present here, and all the relatives.

Mr. Elwell, I believe it was every country grounded the MAX before we did. Every country. Is it because they were too quick to draw a conclusion from two airplanes going down in similar circumstances, and realizing the flying public should be protected in their countries? Or was it because we were just so much better at using data and not being concerned with the fact that there were two identical—or close to identical—crashes? How were we last?

Mr. ELWELL. Mr. Cohen, as I mentioned earlier, the FAA is data-driven, risk-based systems approach. We don't deviate from that, because it is critically important that that is how we operate.

You mentioned we were the last. As far as we know—and we have talked to these countries who grounded their fleets—we were the first country to ground because of a data that linked the two accidents, which is critically important—us and Canada. I must say Canada also waited until we had that data, and the data was not available until the radar tracks were refined to suggest—and evidence we found on the ground—that linked the two flights.

Mr. COHEN. So the opposite of data is common sense? The other countries acted on what looked like, with common sense, that there is a causal connection and a reason to think two airplanes fall out of the sky and they crash with similar problems with keeping the plane under control after takeoff and high speeds, and that is—because you don't have the data yet you are jeopardizing another airplane? It just seems like common sense should have taken control. Data is fine, but sometimes it is just right before your eyes.

There was a story or an article written that pilots of planes that didn't crash in the United States kept noticing the same basic pattern of behavior that is suspected to have been behind these two crashes. This was in the Dallas Morning News review of voluntary aircraft incident reports, the NASA database. Pilots all safely disabled the MCAS and kept their planes in the air. But one of the pilots reported to the database that it was "unconscionable that a manufacturer, the FAA, and the airlines would have pilots flying an airplane without adequately training or even providing available resources and sufficient documentation to understand the highly complex systems that differentiate this aircraft from prior models."

Mr. Elwell, how can it be that we didn't tell the pilots about MCAS, and implore them to be aware of it in the situation? This was the system that was put in to allow there to be—what was, arguably, a new airplane to compete with Airbus, and we didn't tell the pilots?

Mr. ELWELL. So, Mr. Cohen, the reports that you are referring to, they are called a ASRS. It is a—reporting a indemnified safety

reporting system. There were—in the 50,000 flights in the MAX we had 24 reports that mentioned—from pilots that mentioned some sort of anomaly on pitch. None of those reports were related to the MCAS, zero.

And so—and as I mentioned—we scanned and filtered every one of those flights for evidence that there was MCAS or AOA anomalies in the U.S. fleet. That is what FAA needs to do. It is what we did. There were no reports of MCAS anomalies reported on the MAX.

Mr. COHEN. Has the FAA considered requiring that pilots that fly the MAX get simulator training?

Mr. ELWELL. I am sorry, do you mean——

Mr. COHEN. In the future, that anybody that flies a 737 MAX, that there be a simulator, and that they be trained in that simulator?

Mr. ELWELL. Well, so we need to wait for the Boeing application of the fix. Once we have the official application of the fix, we will be able to determine if and exactly what sort of training will be required for MAX pilots.

Mr. COHEN. And one last question. Media reports indicated that Boeing underestimated the capability of MCAS by a magnitude of four times in its initial submission with the FAA, and the FAA only found out about it from Boeing's notice to airlines explaining MCAS after the Lion Air accident.

For the record, can you please confirm this account? And if that is not correct, please clarify the timeline.

Mr. ELWELL. I will get an answer for you on that question, sir. I am not familiar with——

Mr. COHEN. OK, we will put in our written questions.

Mr. LARSEN. Take it for the record.

Mr. COHEN. I yield back the balance of my time.

Mr. LARSEN. The Chair recognizes Representative Balderson for 5 minutes.

Mr. BALDERSON. Thank you, Mr. Chairman. I also would like to express my condolences to the families that are here, and my thoughts and prayers are with you.

Administrator Elwell, thank you for being here today in this important hearing. There are currently 79 aircraft certification service ODAs. Are you aware of any International Civil Aviation Organization standards or recommended practices that directly conflict with the FAA's use of the Organization Designation Authorization program?

Mr. ELWELL. Sir, I am not aware of any. I will tell you that ODA is a practice shared by all countries who do certification. And in some countries they use it much more than we do. But please, if you would let me defer to my colleague, Earl, on the specificity of your question.

Mr. LAWRENCE. So delegation is used in—universally throughout the certification process, and in all countries. And I guess I would highlight that the 737 MAX was a dual certification in this case, with EASA, the European safety organization, and the FAA. And so all the decisions and review of the delegation and those activities was conducted by both agencies at the same time. So I think

that shows the reinforcement and the comfortableness of another authority in how we use delegation to assist us.

Mr. BALDERSON. Thank you very much. Administrator Elwell, you state that any party the FAA regulates remains responsible for compliance with the FAA's regulatory standards, and the FAA does not hesitate to take enforcement action when it is warranted.

Can you provide examples of when FAA enforcement action was taken as a result of noncompliance, and how the FAA was able to discover violations of your regulatory standards?

Mr. ELWELL. So there are examples of when we have had to take enforcement action. In particular, there have been several actions taken with ODA. I think—and Earl will correct me, if I am wrong—I believe that we have denied ODA authority—a certificate for ODA—on at least one occasion. And then within the ODA organizations, our oversight will occasionally discover somebody not following.

You have to understand that the organization itself is run by a manual that is written specifically for the activities that the ODA is allowed to do. And when that manual is not followed, then, you know, the oversight catch that—it will step in.

But Earl, is there amplification on that?

Mr. LAWRENCE. Just to build a little bit on Mr. Elwell's comments there, we have removed one ODA, but there are multiple findings, as we say. We audit every single one of these entities on an annual basis.

And per the direction of this committee in our reauthorization bill, you have asked us to stand up a new ODA oversight office. And Mr. Elwell signed off on setting that office up in April. And that will change us to not just waiting for an annual basis. That will transition us to a constant overview of data flow, so we will be constantly monitoring, and not just relying on annual audits. So it will reinforce that to an even greater extent, our oversight.

Mr. BALDERSON. All right. Thank you both very much.

I yield back my remaining time, Mr. Chairman.

Mr. LARSEN. Thank you, Representative Balderson. The Chair recognizes Representative Titus for 5 minutes.

Ms. TITUS. Thank you, Mr. Chairman. I represent Las Vegas, and about half of the 42 million people come by plane. And so having high safety standards is very important.

When this first happened, though—I fly back and forth on Southwest every weekend—first thing I did was call to see if the flight I had scheduled was one of these that was in question. Then I realized, if I am scared to fly on that, I don't want my family, my friends, my constituents, or my visitors to fly on that plane, too. So it is very important that we get to the bottom of this. So I thank the chairman for having this hearing.

We have heard a lot of defense from you this morning about ODAs and the emphasis on data being the reason you grounded the plane. And that all sounds fine, but the public perception was that it took so long for us to do it. We were the last ones to do it is because the FAA was just too cozy with Boeing, that you were in bed with those that you were supposed to be regulating, and that is why it took so long. So that is the impression the public has, and what we need to deal with.

Now the emphasis shifts from not the grounding, but the ungrounding. So I would ask you what process you are going to use to unground this plane. I know you have created some new organizations within the agency. I think on the 2nd, Mr. Elwell, you announced the formation of the Joint Authorities Technical Review team to—you know, that includes a number of representatives from other countries to—including Ethiopia and Indonesia to investigate your certification process. Last week you announced a multi-agency Technical Advisory Board to review the proposed software fix.

These don't have regulatory authority, but I wonder, are you going to use their decisions before you move to ungrounded? Are you going to have their consensus? What is it going to look like to the public if you ignore them and they just become window dressing? Would you address now the next step?

Mr. ELWELL. Thank you, ma'am. Thank you for that question, because it is very important. We have established the safety record that we have by doing just what you alluded to: listening, getting feedback, getting suggestions.

We have been incredibly transparent throughout the process, and that is what we are with all of the countries we deal with, with the stakeholders in the aviation industry. The TAB that you mentioned and described perfectly in the JATR—the TAB, by the way, as I mentioned earlier, Chairman DeFazio recommended that over a month ago and we agreed wholeheartedly. And we will listen. And, in fact, they are in—they are reviewing right now. We have already received, I believe, a couple of suggestions.

We are also—as I mentioned in my opening remarks, we are going on May 23rd to meet with—we invited 57 countries that grounded the MAX, and invited their civil aviation authority directors to come and talk to us—and us to them, more importantly—explaining to them exactly the process, our safety analysis.

We will not allow the 737 MAX to fly in the U.S. until it is absolutely safe to do so, and we will use every tool, every data gathering capability we have, to ensure that is the case. You have that as a personal commitment and as a commitment of 45,000 passionate aviation professionals in the FAA.

Ms. TITUS. And what role will Boeing play in this process?

Mr. ELWELL. So Boeing will submit their application for the update to the MCAS software. The formal and final submission we expect—I don't know, Earl, the next week or so? And at that point we will do test flights, we will do analysis. We will present it to the TAB. The TAB will look it over. We will do a thorough and robust safety analysis. We will determine, based on—the software fix they give us will determine what level of training will be required of 737 MAX pilots.

And then, once we have established all of that, and internally the FAA review says that the 737 MAX is safe to fly, then the prohibition order will be lifted, and we will present whatever mandates are tied to this new software.

Ms. TITUS. And do you believe you have the resources and the expertise without depending on the ODAs to provide that final oversight and make that guarantee that it is safe to fly again?

Mr. ELWELL. Yes ma'am. I do.

Ms. TITUS. And how do you reassure us of that?

Mr. ELWELL. I point to an organization, the FAA's diligence in safety that has produced a record that—it is, in many ways, remarkable in the U.S.

I also point, as I just said, the FAA—I have never seen, outside of Chairman Sumwalt's organization, a more dedicated organization of safety professionals. I am awed every day I come to work. They are amazing.

And I will tell you they are—I am a little bit worried about morale right now, to be honest with you, across the FAA. It is critically important to me that we—and, of course, to the world and to the U.S.—that we get this right. But it is important for public confidence, as you said. And it is important for the morale of the great professionals that are doing the work to get this airplane safely back in the air. And we are not going to do it till it is safe.

Ms. TITUS. Thank you. Thank you, Mr. Chairman.

Mr. LARSEN. Thank you, Representative Titus. I recognize Representative Massie for 5 minutes.

Mr. MASSIE. Thank you, Mr. Chairman. I would like to widen our focus here a little bit and talk about the types of data we collect, flight data; how we collect it; and what we do with it after it is collected, not just in these particular incidents, but other incidents. Because I find it odd that 2 weeks, 30 days after the incident there is still speculation and guessing about what the pilots did, how did they react, and we don't know.

Probably just about everybody in this room has a camera in their pocket. And earlier in this hearing we saw a picture of a 1967 flight deck of a 737 versus a 2017 flight deck of a 737 MAX. And I understand why in 1967 there weren't cameras in the cockpit. Can you speak to why we don't have cameras in the cockpit, cameras that are cheap and would answer so many of these questions we are still speculating about, it seems? Mr. Sumwalt, please.

Mr. SUMWALT. Thank you very much for that question. The NTSB has, in fact, recommended that——

Mr. MASSIE. I am talking about for commercial flights, of course.

Mr. SUMWALT. That is right. Cockpit image recorders should be required for commercial flights. We have—for airline flights. We have made that recommendation, and it has not been acted upon.

Mr. MASSIE. Why hasn't it been acted upon?

Mr. SUMWALT. Well, that is a great question, and it is a question that the regulators should answer.

Mr. MASSIE. Can I ask you, Mr. Elwell? You have a thought on that?

Mr. ELWELL. So the FAA works with our colleagues at the NTSB very closely. And we take every recommendation the NTSB makes, and we examine it, and we evaluate it for safety of flight. And that is our first and foremost consideration. And Chairman Sumwalt and I have not always disagreed on all the recommendations, but I think we would both say that the—this semi-symbiotic relationship that we have has been part and parcel of where we are today and the safety record we have today.

Mr. MASSIE. Let me ask about the way we collect the data. Can you explain to my constituents why, for $10, they can get internet on a flight for the whole flight, yet we are still chasing down a physical black box to find out what happened in the cockpit? Why

do we have to go to the crash site to recover the data in this day and age? And why is all the data lost if we can't find the black box?

Mr. Sumwalt or Ms. Schulze, if you would like to answer.

Ms. SCHULZE. Sure, thank you for that question.

Mr. MASSIE. I am not advocating getting rid of the black box. I am saying why can't we augment it with some streaming.

Ms. SCHULZE. Sure. And I think the industry has been looking at this, from a technical standpoint, to understand what is technically feasible. But I think that is something that would be an important backup to the equipment on the aircraft, which is still a valuable tool. And in these accidents, extremely valuable for us to understand what was going on in the—on the aircraft and in the cockpit.

Mr. MASSIE. It is hard for me to explain to my constituents who get on the plane and get internet why it is not technically feasible. Now, I know why it wouldn't work in every situation, but—and why you need the black box.

But let me go to my third question, which is what do we do with the data after we retrieve it. Mr. Sumwalt, why doesn't the NTSB publish all data from the black box immediately upon retrieval?

Mr. SUMWALT. Well, thank you very much. We do eventually publish that. And let me point out that the NTSB uses a party system. So when we have the data, the manufacturer has it, it is shared with the manufacturer, with the FAA, with anybody who needs it to be able to understand the circumstances of that crash so that they can make immediate safe——

Mr. MASSIE. Let me just—I appreciate your answer, but I said "immediately," and you said "eventually."

Mr. SUMWALT. OK. If we are talking about public release of the information, yes, that does become available when we open the public docket.

Mr. MASSIE. Why not make it immediate? What benefit is conveyed upon society by withholding that data from the manufacturer, the person who actually made the equipment? Why aren't they allowed to have it immediately? And why is the NTSB allowed to withhold or block them from getting that data when—and I wanted—I am talking about the difference between immediately and eventually, because lives could be lost eventually.

Mr. SUMWALT. All right, let me make an important clarification. The manufacturer and the FAA has access to that information immediately when we have it. They are part of our process. They are in the room reviewing the data immediately with us.

Mr. MASSIE. OK, I am glad to have your assurance on that. I have some manufacturers that have experienced different results.

Thank you, Mr. Chairman.

Mr. LARSEN. Thank you. I recognize Representative Stanton for 5 minutes.

Mr. STANTON. Thank you very much, Mr. Chairman. We are here today because of the unspeakable loss of 346 lives in the tragic crash of Lion Air's flight 610 and Ethiopian Airlines flight 302. Our aviation system is the safest in the world, but these accidents have shaken the public's confidence and trust. We owe it to the people whose lives were lost and their families to get to the bottom of what happened and address any issues within the FAA's certifi-

cation process to ensure the safety of not only this aircraft, but the system as a whole.

The MAX should not be returned to service until the safety of the aircraft is assured by FAA, Boeing, and its operators. Back-to-back crashes demand the reviews of Boeing and FAA responses that are underway.

We need to get to the bottom of why a single point of failure was permitted in the MAX. Commercial aviation, especially in the United States, is so safe, in large part, because of safety redundancies. Based on preliminary reports, a single point of failure appears to have played a significant role in these tragedies.

Now there have been reports of certain optional safety features of the MAX were sold as extras. And my question is for Mr. Elwell. Is it common to have safety features offered as optional and not mandatory?

Mr. ELWELL. Mr. Stanton, any safety-critical component to the certification of an aircraft is not optional. It is part of the certification of the aircraft.

Mr. STANTON. Would those features, which were not in either the Lion Air or Ethiopian planes, have made a difference in aiding the pilots to more quickly identify the MCAS system was triggering?

Mr. ELWELL. In my opinion, no. And I think you are referring to the AOA disagree light.

Mr. STANTON. Yes.

Mr. ELWELL. Yes, sir.

Mr. STANTON. Should these be required features?

Mr. ELWELL. I actually would like to defer to Mr. Lawrence.

Mr. STANTON. Please.

Mr. LAWRENCE. So AOA disagree indicator was not on the original 737. It was first introduced on the NG model. It is a maintenance alert, so we do not consider it part of our critical items. And I am, you know, not aware of which other aircraft may or may not have it installed.

Mr. STANTON. As far as you know, what are Boeing's plans to incorporate these features on all Boeing aircraft?

Mr. LAWRENCE. Are they looking to incorporate the AOA indicator on all Boeing aircraft?

Mr. STANTON. Yes.

Mr. LAWRENCE. My understanding is it is not on other Boeing aircraft. It was just the NG—in the manner that it was displayed.

Mr. STANTON. I understand that the software modifications for the MCAS system are in process. Can you describe the status of the modifications you would expect for the MAX?

And then how confident are you that these will reduce another incident involving a runway stabilizer trim event?

Mr. ELWELL. So——

Mr. STANTON. Please.

Mr. ELWELL. I will let Earl modify or get into more detail in my answer.

Mr. STANTON. Please.

Mr. ELWELL. But we are expecting the formal application of the MCAS update, software update, soon. We do know the basic parameters of—there are three pieces to that fix that would, in—once established and once put on airplanes, would render the scenarios

that were perpetuated in the Lion Air and the Ethiopian accidents—they wouldn't happen the way they happened there.

But I will let Earl elaborate any further on that.

Mr. STANTON. Mr. Lawrence?

Mr. LAWRENCE. I—yes, thank you. The software—I would call it the beta version for this audience here—has been submitted to us. And the reason why they submitted it to us is so we can stick it in the simulator, so we can test it, so we can also look at their system safety analysis, and see whether it will appropriately address it.

The key thing the new software does is look at both angle-of-attack indicators to assure that a single failure will not cause the system to initiate, and future changes.

Mr. STANTON. All right, one more question for Mr. Elwell. You are a U.S. Air Force Academy graduate, combat pilot during Operation Desert Storm, commercial pilot for 16 years, with more than 6,000 hours combined civilian and military flight time. It is very impressive experience. Do you think the FAA should have mandated training for the MCAS system for pilots, knowing what we know now?

Mr. ELWELL. Sir, thank you for that question. The investigations and the audits and the reviews currently underway are going to make their recommendations. I am going to answer you the way you asked the question, as a pilot, as somebody who has——

Mr. STANTON. Please.

Mr. ELWELL [continuing]. Devoted my entire life to flying and safety.

I—at the beginning, when I first heard of this, thought that the MCAS should have been more adequately explained in the ops manual and the flight manual, absolutely. We, in our emergency airworthiness directive that we issued on November 8th after Lion Air, we added explanation of MCAS, and we also reminded our own operators and the world via a document we call a CANIC. We reminded pilots when to engage runaway pitch trim procedures, and we added a note to those instructions.

When we complete our overview, when we complete our safety analysis, I expect that we will have amplified MCAS description, in addition to anything else that we think and we find is needed to make pilots more aware and respond better to an anomaly.

Mr. STANTON. Thank you, thank you.

Mr. LARSEN. Thank you. We are going to proceed on our side of the aisle with questions. And then, if there's a Member of the Republican Party that shows up that hasn't asked questions, then they will get in line at the appropriate time.

So we will go with—next is Representative Craig. You are recognized for 5 minutes.

Mrs. CRAIG. Thank you, Mr. Chairman. I too want to express my sincere condolences to the family members who are here today for the lives that were lost.

Mr. Elwell, as you may know, before I came to Congress I worked in a similarly highly regulated space, the medical device industry, where one malfunctioning defibrillator or a pacemaker could result in an innocent life lost. We heeded strict compliance and reporting requirements to disclose aftermarket malfunctions to

the Government through the FDA's Adverse Event Reporting System. This aftermarket reporting was and continues to be justified.

With that in mind, I would like to learn more about the manufacturer aftermarket reporting requirements that allow the FAA to be notified about certain failures, malfunctions, or defects. Because, according to media reports, Boeing first discovered that the angle-of-attack sensor disagree light software was malfunctioning a few months after delivery of the MAX in May of 2017. At that time they learned the disagree light wouldn't work unless airlines also had the optional AOA indicators. Therefore, 80 percent of pilots flying Boeing's MAX believed an indicator light would show when, in fact, it would not.

But it wasn't until Lion Air, in October of 2018, over a year later, that Boeing finally notified FAA that most planes were flying with software malfunctions. Furthermore, the New York Times reported yesterday that pilots from American Airlines pressed Boeing executives to work urgently on a fix. In a closed-door meeting they even argued that Boeing should push authorities to take an emergency measure that would likely result in the grounding of the MAX.

So with that, I have three yes-or-no questions, and then I have a fourth.

Did Boeing have an obligation to report this aftermarket software malfunction to the FAA?

Mr. ELWELL. Boeing software engineers did write a PR—what is the—performance report? Problem report.

Mrs. CRAIG. OK.

Mr. ELWELL. They followed their procedures. Because it is not—the AOA disagree light was not a critical safety display—it is advisory only for maintenance recording—it languished. And I am not happy with a 13-month gap between finding that anomaly and us finding out about it. And we are going to look into that, we are looking into that, and we will make sure that software anomalies are reported more quickly.

Mrs. CRAIG. So that was a yes.

Did Boeing have an obligation to report this aftermarket software malfunction to existing airline customers for them to be aware of and submit a service difficulty report if necessary? Did Boeing have that responsibility, yes or no?

Mr. ELWELL. I am sorry, can you repeat the question? I didn't get the beginning——

Mrs. CRAIG. Yes. Did they have an obligation to report this aftermarket software malfunction to existing airline customers? Is there an obligation on their part to report this malfunction to consumers, as well?

Mr. ELWELL. So the Boeing ODA and the Boeing software engineers respond to their procedures. I am going to defer to Earl on whether or not they—that the standards and the ODA manual requires that.

Mr. LAWRENCE. The obligation is to evaluate the anomaly to the internationally approved standards, and procedures for looking at that. If those procedures indicate that it is an item that meets a certain level, then yes, it would have to be reported to the other airlines and to the FAA.

In this particular case, the approved procedures designated the risk of this item not being in a working condition did not require immediate action. It did require action, and that is what we are talking about, we would like to see quicker reaction than 13 months in the future.

Mrs. CRAIG. And can you confirm, Mr. Elwell, that Boeing continued to deliver planes with a nonfunctioning disagree light, even after the discovery that it was only operational with add-ons, and even after the Lion Air accident?

Mr. ELWELL. I believe that the 737 MAX was delivered after the software engineers discovered that anomaly, yes.

Mrs. CRAIG. Thank you. And finally, do you believe our current aftermarket reporting requirements are adequate to protect airline passengers?

Mr. ELWELL. Mrs. Craig, we have an IG report. We have the blue ribbon panel, or the special committee. We have the JATR that we formed. This committee's investigation has been initiated, and we are gathering reams and reams of data. All of these reviews are going to look at the process, top to bottom, and come back with recommendations. I fully expect that, when this is all done, we are going to have recommendations that will make us better. In addition, we are going to continue to scrutinize our process. We are going to make sure that it doesn't take 13 months to find out that there is a software anomaly.

But I just want to remind everyone here let's not make the AOA disagree light the issue. The AOA disagree light is an advisory. And the AOA disagree light would not have changed in either accident. I want to make sure everybody understands. Don't make something that isn't a critical safety item a critical safety item, because there are enough critical safety items for us to focus on.

Mrs. CRAIG. Thank you. I yield back.

Mr. LARSEN. The Chair recognizes Representative Davids, the vice chair of the subcommittee, for 5 minutes.

Ms. DAVIDS. Thank you, Mr. Chairman. And I too would like to extend my condolences to the family members who have lost loved ones and are here today.

And I think it is really important for us to recognize that the relationship that exists between this committee and the FAA and the NTSB is one that is clearly geared toward making sure that we are operating the safest airline industry, aerospace industry, and our airways here in this country.

And I have been very happy to hear the desire for just an evaluation of where are the things that we can actually address to make sure that, no matter what, these types of tragedies don't occur in the future.

And you know, as a member of this committee, I take our constitutional duty of oversight very seriously. And I know that you take the FAA's duty to safety very seriously, as well. And because of that, I want to take a step back and ask how often—and you mentioned in your testimony that the regulations and safety certification procedures are constantly reevaluated. Can you talk a little bit about how often the process is reevaluated to make sure that when new technologies are coming along, and we have got new

standards that might be developing, how often are we evaluating the actual process of the certifications?

Mr. ELWELL. Thank you for that question.The FAA, as an organization, is constantly collecting data, evaluating data, taking action, and reviewing. It is the safety management system approach to everything we do. It is never static.

Having said that, we don't change just to change.

We pull data, we review, we analyze data. We do this both internally and we do it externally. We have what is called—and I don't know how far you want me to go into this, but we have an organization called the Commercial Aviation Safety Team that was formed in 1997. The goal there was to gather data from all stakeholders in the commercial aviation ecosystem, and to collect all that data voluntarily, and analyze that data, come up with safety enhancements.

Since 1997 we have generated over 100 voluntary safety enhancements the entire industry uses, and they use them to this day. And we have reduced the commercial aviation fatality rate by 95 percent since 1997. And that is exactly from what you just asked, from analyzing our processes, gathering data, coming up with solutions, implementing those solutions, and then evaluating the results of that implementation.

Ms. DAVIDS. And then can—I would actually like to hear about the exchange of information between the NTSB and FAA.

Earlier you mentioned that when the NTSB has gone through and looked at some of the—probably some of the previous accidents, that—at least on one occasion, a recommendation to include video recordings in the cockpit has been made. How often are the—who is making the decision about which recommendations by the NTSB are being adopted into the safety protocols?

And can you talk a little bit about what that process looks like?

Mr. ELWELL. Is that——

Ms. DAVIDS. Maybe a little bit about how are the recommendations made, and then how do you decide whether or not you are going to accept those recommendations?

Mr. SUMWALT. Right. I will make it quick. The NTSB investigates transportation accidents. And when we find areas that could enhance safety as a result of that accident or crash, we issue safety recommendations. We issue them to the appropriate recipient. We issue for aviation accidents—more than likely they would go to the regulator, who, of course, is the FAA in this case.

Mr. ELWELL. And we receive the NTSB recommendations, and then we have to go through a process to evaluate those recommendations against the whole system.

Chairman Sumwalt, we have had this conversation. They have sometimes the enviable luxury of looking at a single event, or a single issue. We take every recommendation in its totality for the whole system. And that is why we continue to collaborate, and we continue to evaluate all the recommendations to determine whether or not they can be implemented.

But the unifying thing between NTSB and FAA is an unshakable desire to improve this system, and make the system safer.

Mr. LARSEN. The Chair recognizes Representative Brownley for 5 minutes.

Ms. BROWNLEY. Thank you, Mr. Chairman. I too want to express my condolences to the family who is here today. My daughter lives in Africa, and has lived and worked in Africa for the last 5 years. She has lived in a couple of different places. She lived in Nairobi. And my daughter has taken this flight from Addis Ababa many, many times. So this particular crash really hit me hard in my gut. But my condolences to you.

I also wanted to follow up on that camera in the cockpit suggestion. So you make the suggestion to the regulator, but none of those suggestions are made public. That doesn't come to Congress.

Mr. SUMWALT. Thank you for that question. We do not issue recommendations directly to Congress. However, when Congress asks for our input, we do in fact provide a list of all open recommendations. And thankfully, oftentimes those recommendations end up getting folded into legislation.

Ms. BROWNLEY. And then, when the FAA doesn't agree with recommendations, does that report come to Congress?

Mr. ELWELL. Ma'am, I don't think so. I don't think so. But I will check. I will check and make sure.

[The information from the Federal Aviation Administration follows:]

Post-hearing response from the Federal Aviation Administration to request for information from Hon. Brownley

All NTSB accident investigation reports, the recommendations stemming from the investigations, and the FAA response to those recommendations, along with the NTSB's status of those recommendations, are available to Congress and the public through the NTSB's web page.

Ms. BROWNLEY. Thank you.

Mr. Elwell, in your testimony, you stated that any party that the FAA regulates remains responsible for compliance with the FAA's regulatory standards, and the FAA does not hesitate to take enforcement action when it is warranted. So was there ever a time through the 737 MAX certification that enforcement was warranted?

Mr. ELWELL. The 737 MAX certification began in January 2012 and ended in March 2017, so——

Ms. BROWNLEY. Was there ever——

Mr. ELWELL [continuing]. Five years——

Ms. BROWNLEY [continuing]. Was it ever warranted to——

Mr. ELWELL. I will defer to Earl if we took enforcement action specifically on anything with regard to the MAX.

Mr. LAWRENCE. I do not believe we took any enforcement action regarding the MAX during that 5 years.

What would have happened, because it was a certification activity, is any time we would have gotten any concerns from any of the engineers that were working it we would have evaluated those and addressed them right then and there, before the final certification.

Ms. BROWNLEY. OK. But there—in terms of some of this self-certification process that is part of the certification process, there was never a need to take any enforcement action?

Mr. LAWRENCE. Not——

Ms. BROWNLEY. Yes or no. I have got a lot of questions.

Mr. LAWRENCE. Not for these particular items——

Ms. BROWNLEY. OK, OK, very good.

Also, Mr. Elwell, in your testimony you say the FAA identifies all safety standards, identifies all safety standards, and makes all key decisions regarding certification of the aircraft.

So, from your perspective, does that ultimately mean that the buck stops with you?

Mr. ELWELL. Yes, ma'am, it does.

Ms. BROWNLEY. Thank you.

Also, in your testimony you talked about the process for certification included 297 certification flight tests. And you say then some of which encompassed tests of the MCAS functions. Can you tell me how many times that that was tested? You gave the number for the overall process, but not for the MCAS.

Mr. ELWELL. Yes, 297 flights, 133 we flew and the others we contributed in some way or another.

I don't know the number of test flights where the MCAS was evaluated——

Ms. BROWNLEY. Do you have that in a record somewhere?

Mr. ELWELL. We certainly would have that, and get that back to you. Yes, ma'am.

[The information from the Federal Aviation Administration follows:]

Post-hearing response from the Federal Aviation Administration to request for information from Hon. Brownley

During the certification of the 737 MAX, the MCAS function, which is part of the primary flight control system, was tested by the FAA, including in engineering simulator familiarization/evaluations and airplane flight tests. This was done in conjunction with stalls and maneuvering characteristics testing and included steep turns and upset recovery maneuvers.

Airplane handling qualities were evaluated during stalls, steep turns, and upset recovery scenarios with MCAS failure modes (MCAS off). The certification testing of the flight control system had four areas: stall speed performance; maneuvering characteristics; stall characteristics; and control system malfunctions.

The FAA flew 24 of the 30 flight tests on the flight control system. MCAS was active during these flights, except during testing of the failure mode with MCAS disabled. The flight test breakdown is as follows:

- For stall speed performance, there were seven flight tests—the FAA flew all seven.
- For maneuvering characteristics, there were seven flight tests—the FAA flew three of the seven.
- For stall characteristics, there were seven flight tests, three with planned MCAS involvement—the FAA flew six of the seven.
- For control system malfunctions, there were nine flight tests—the FAA flew eight of the nine.

Ms. BROWNLEY. OK, very good. You also went on in your testimony to talk about Secretary Chao and the U.S. Department's inspector general report. Do you have any idea when that report will be available to the public?

Mr. ELWELL. I think you are referring to the IG report——

Ms. BROWNLEY. Yes.

Mr. ELWELL [continuing]. She directed on certification. I can't—I don't want to set a date for the IG, but I—generally, those investigations take 9 to 18 months.

Ms. BROWNLEY. Thank you. Secretary Chao also announced the establishment of a special committee to review the FAA's procedures for certification. You stated that that will be presented directly to the Secretary and the FAA Administrator. What about to the public and to Congress?

Mr. ELWELL. Ma'am, typically this—the special committee that will be formed under the SOCAC, it is, for lack of a better term, a blue ribbon panel. And in my experience over my career, blue ribbon panel results are often made public. But I won't speak for the Secretary as to how those results will be disseminated. But I can, again, get that answer for you, absolutely.

[The information from the Federal Aviation Administration follows:]

Post-hearing response from the Federal Aviation Administration to request for information from Hon. Brownley

The Department of Transportation will keep Congress apprised of the Special Committee report.

Ms. BROWNLEY. Thank you. I have more questions, but my time is up and I yield back.

Mr. LARSEN. The Chair recognizes Representative Allred for 5 minutes.

Mr. ALLRED. Thank you, Mr. Chairman. And thanks to our panels for being here. I represent Dallas, which is home to Southwest Airlines and American Airlines, two of our best airlines here in the country, who have also invested heavily in the 737 MAX. We also have Boeing in our area, and I recognize the investment that they have made in this, and the price that it is costing our airlines, the grounding of the MAX. And I also, of course, recognize what this is doing to Boeing.

But I think that our role on this committee—and your role, obviously, as I know you agree—that the FAA is—our motivation for being here is that we want to make sure that our airspace is the safest in the world, that we continue to be the gold standard. I have been asked a lot about the MAX in Dallas, and then I always say that, you know, we still are the gold standard for safety, and that we will remain that.

And so my questioning in these next couple minutes is getting at making sure we maintain that. Because when we spoke back in March, when you briefed us in a private briefing, I mentioned to you reports from pilots with concerns being raised about the MAX, and you kind of downplayed some of those. And then, as the Dallas Morning News recently reported, and as some of my colleagues have mentioned, a recording between the American Airlines pilot union and Boeing on November 27, 2013, the pilots expressed a number of concerns to the Boeing executives.

And my question to you is was the FAA made aware by Boeing or by anyone else about that meeting, or about any of the pilots' concerns?

Mr. ELWELL. Well, thank you for that question, Mr. Allred. My first indication of that meeting was when I read about it in the article. And I can't—obviously, I can't speak to a private meeting.

I will tell you this, though. My understanding is that meeting happened not long after the Lion Air accident. And I will tell you, as a lifelong pilot, that when an accident happens anywhere, and it is—and it includes an airplane you fly, it becomes visceral. It is an emotional response, pilots who fly an airplane, when they see one go down. And I would imagine that there was heightened emotions in that meeting.

I will tell you that when I was briefed and they explained the Lion Air and what we—the data we gathered, and told me about the MCAS, and I learned that it wasn't explained in the manual, my pilot juices started flowing, and I said, "Well, we—let's look—we need to look into that."

So I don't discount what was reported in that meeting, and I understand it, but I can't comment on it, what was said in the meeting.

Mr. ALLRED. OK. Do you know if there were any ODA designees present at that meeting for Boeing?

Mr. ELWELL. I have no idea.

Mr. ALLRED. OK. If not, should there be a requirement placed on manufacturers like Boeing to disclose the concerns of pilots when they are presented in a fashion like that? Should the FAA have been made aware of that?

Mr. ELWELL. My—sir, my initial reaction to that question would be any time a manufacturer that the FAA has regulatory oversight over becomes aware of a critical safety item, it should be made known to the FAA.

And I will defer to Earl if that is actually part of a regulatory——

Mr. LAWRENCE. It is actually a regulatory requirement, that if they become aware of anything that is critical to safety, they need to disclose that to us.

Mr. ALLRED. So after one crash, when a major pilot union is expressing their concerns, that should have been raised to FAA?

Mr. ELWELL. Again, if it is a critical safety of flight item, either procedural——

Mr. ALLRED. I would say, just—you know, I am not a pilot. I would say, though, if we have had a crash, and our professional pilots here, domestically, are expressing their concerns, that that is something that the FAA should know about. And so I think that that is something we need to look at here, in Congress, to make sure that you have that information as quickly as possible.

Mr. ELWELL. If I could add, Mr. Allred, at the same—at around that same time, since Lion Air accident and forward to today, my communications—I happen to have been an Allied Pilots Association member for 16 years. I had regular conversations with the leadership of the Southwest Airline Pilots Association, the Allied Pilots Association and the Air Line Pilots Association on a regular basis, because we thrive on transparency, we thrive on communication.

And I had regular conversations with them, including an April 12th meeting where we brought in the unions of all three of our U.S. operators of the MAX and their flight departments, and we had a give-and-take for about 2½ hours.

Mr. ALLRED. Well, thank you. And just, Mr. Chairman, for the record, if we could, I would like to have an answer on the MCAS not being in the manual, and how the decision was reached by the FAA not to require that.

If you could submit that for the record, I would appreciate that.

Mr. ELWELL. Yes, sir.

Mr. LARSEN. For the record.

So we will proceed with the second round of questioning, and I will recognize myself for 5 minutes and go to Mr. Sumwalt and Ms. Schulze with regards to the ET302 report as an example of how we work in a supporting manner, as opposed to a lead.

Are there things in the ET302 report that you would characterize differently if you were writing it?

Mr. SUMWALT. Well, I will take a stab at that, and then let Dana mention it.

The Ethiopian Government has not had the number of investigations that we have had. And I say that not in a bragging manner, but we have been in business for a long time. They have not had many major accidents in Ethiopia, so they don't have the level of experience that we do. Again, I am not bragging, nor making a condescending statement. It is just a fact.

As a result of that, they are moving very cautiously and very deliberately. And so, as far as the rest of that, I will defer to Dana.

Ms. SCHULZE. Thank you for the question, Chairman Larsen. And in fact, we are very pleased that the Ethiopian Government did release a report publicly. That information was critically important, of course, to the FAA and Boeing, but it was also critically important to other airlines flying the aircraft and, frankly, other regulators worldwide, to understand all the factors.

With that said, as with—we see in many preliminary reports issued by different countries they areμperhaps not exactly as the NTSB would format the information, or produce it, but I would say that the preliminary report is just that, it is the information that was available at the time. And so I would caution that that is not everything, by any stretch. And some of that information will need to be expanded further. And we are, of course, working very closely with the Ethiopian Government to make sure that we contribute and participate in that work.

Mr. LARSEN. Does ICAO provide a rubric, or a standard format for developing and for actually reporting the results of the investigation?

Mr. SUMWALT. Yes. The short answer to that is yes. ICAO Annex 13 outlines the standards and the recommended practices.

Mr. LARSEN. And to your satisfaction, in the case of ET302, the Ethiopian Government is following those standards and practices?

Mr. SUMWALT. They are. But Dana was just in Ethiopia last week, and I think she could further elaborate.

Ms. SCHULZE. Yes, they are following the Annex 13 practice. And we, as a state, or state of manufacture, have our accredited representative as part of the investigation, along with our advisors.

And so I was in Addis to meet with the investigative agency to reinforce the U.S. support, and our participation in the follow-on investigation at this point that will go forward. So yes, they are fol-

lowing the process, and we are going to continue to work closely with them on that in all areas.

Mr. LARSEN. So in the case of the Lion Air and Ethiopia—well, I guess when we apply our standard of timelines we tend to think it takes a year to get a final report out from NTSB, about, give or take. Do you anticipate it will be a year for the Lion Air report, and a year from the crash for the ET302 report?

Mr. SUMWALT. Yes. In the case of Lion Air they have said that they would—they are planning to get the report out by the 12-month anniversary.

As far as Ethiopian?

Ms. SCHULZE. It is very early in the stage for Ethiopia, and I—we couldn't say. But the Indonesian Government is planning to have a report released in the—towards the fall.

Mr. LARSEN. All right, thanks.

Administrator Elwell, regarding next week's meeting in—was it next week in Dallas—with the directors general, what is the FAA's goal in this meeting?

Mr. ELWELL. Thank you for that question, sir. The goal is to offer all of these countries who have grounded or prohibited flight in their airspace, 737 MAX, the benefit of all the information and all the thinking we, as the state of design, have to offer them.

It has been mentioned several times in this hearing that there is the perception, at least, of a crisis in confidence, particularly with regard to the airplane, and maybe larger. It is my hope that we get to, in a way, sort of fix a process that didn't, in my opinion, go in a way that we are used to internationally on the initial—at the accident.

Internationally, we are collaborative 99 percent of the time. When the Ethiopian accident happened, it was not a collaborative process from Sunday night to Wednesday morning, despite our best efforts and attempts to have conversations. I know countries act, and they act for various reasons.

This—on the ungrounding, I think it is just critically important that, as a global aviation community, we do what we do best. We collaborate. We exhibit transparency. We answer the questions that I am sure these countries are going to have of us. And then, at the end of the day—it will be, literally, a day-long agenda and regimen with them—my hope is that they have the confidence in our work and our analysis to make their ungrounding decisions, if that is where the discussion is, as close to our decision as possible, because I think that is important for the world, to have some level of confidence.

Mr. LARSEN. Thank you. I did notice two Members came in after we started the second round. In fairness, though, I did promise the ranking side a set of questions, unless they want to be kind enough to let us go to the Members who came in for a first round. I am just trying to figure out what the rules are.

All right, I would recognize Mr. DeFazio.

Mr. DEFAZIO. Thank you, Mr. Chairman. Just in answer to an earlier question, I did change the law a number of years ago, and I think the—Mr. Sumwalt is aware of this. You do have to respond when they submit things to you. You can say yea or nay, but you do have to meaningfully respond. It used to be that you would send

things over, and they would never respond and ignore them. So you should be getting yeas or nays out of the FAA when you send things over.

Mr. ELWELL. Mr. Chairman, you are right. And I didn't realize that was the question. But absolutely, we are required to tell them that we are doing it, or not doing it, or why.

Mr. DEFAZIO. It used to be that they went into the ether. Now they have to at least tell you that they don't agree. In any case, just to clarify that.

And so, to Mr. Lawrence, my understanding is originally the Europeans and the Brazilians said retraining of pilots was required. Later, for whatever reason, the Europeans decided it wasn't. Is that correct?

Mr. LAWRENCE. That is not my understanding of it.

Mr. DEFAZIO. OK. What about the Brazilians?

Mr. LAWRENCE. Again, there was——

Mr. DEFAZIO. So that new——

Mr. LAWRENCE [continuing]. Lots of discussions. And my understanding is——

Mr. DEFAZIO. So that list of 40 or 60 things—can't remember the exact number—that the Brazilians had about the plane that they thought were significant differences doesn't exist?

Mr. LAWRENCE. I actually have a email here, sir, from the Brazilians that recalled that, and said that was a mistake.

Mr. DEFAZIO. It was a mistake to say all those things that would require retraining, and so then they just withdrew it?

Mr. LAWRENCE. I think the context of all of these things is these are discussions when we evaluate aircraft.

Mr. DEFAZIO. Right, OK.

Mr. LAWRENCE. And they meant everything in that discussion——

Mr. DEFAZIO. OK, so—all right. So—all right, fine. But that is something that we are going to be looking into, and I have asked for both the Brazilians and the Europeans to respond, because there is questions on why they changed their mind, or when they changed their mind, or how they changed their mind in this process.

Now to the Administrator, so it is an amended type certificate, because there is an artificial system, the MCAS, which makes it fly like the earlier versions, the NG and others. Now, if we have essentially neutered the MCAS—all you have to do is pull on the yoke—does it now fly the same as all the earlier planes? And so it is still an amended type, or is it now a new type?

Mr. ELWELL. So, Mr. Chairman, actually, in the MAX pulling back the yoke doesn't——

Mr. DEFAZIO. It will in the future, my understanding, the fix.

Mr. ELWELL. No, the fix won't include the yoke pull back cut-out.

Mr. DEFAZIO. OK, all right. That was reported——

Mr. ELWELL. Because that disables——

Mr. DEFAZIO [continuing]. And the staff was under that impression. OK. So but—all right. So MCAS is going to be modified to work off both sensors. That is the only major change?

Mr. ELWELL. So——

Mr. DEFAZIO. Except it will only trigger once.

Mr. ELWELL. Correct, and there is one more. And I can't—and the engineers can't—imagine a scenario where this would happen, but in the Lion Air and Ethiopian incidents, the MCAS kept re-engaging because it still was receiving the signal that it needed to engage, until it reached a point with the motion of the stabilizer—this is the stabilizer, the back of the airplane that—pilots always have to do that—but it reached a point where they did not have yoke authority to reverse the——

Mr. DEFAZIO. Right.

Mr. ELWELL. The third part of the fix is, no matter if it re-engages more than once—and it would have to completely reset and go back to this—to the proper—it will always give the pilots 1½ Gs of authority. It will always give—it will never go to full deflection. So even in the chance that it powers several times, the pilots will have yoke authority.

Mr. DEFAZIO. OK. Just also for an earlier point you made about us leading the world and ICAO on training standards, I would point out that Congress had to mandate that change after Colgan Air, because I had been trying for many years and we hadn't gotten there. And so that was something that wasn't initiated—and this was before your time—by FAA, it was something that was mandated by the Congress.

Thank you, Mr. Chairman.

Mr. LARSEN. All right, thank you. After consulting the committee rules, Members get a first round. And so we will start with Mr. Carbajal from California.

Mr. CARBAJAL. Thank you, Mr. Chair. Administrator Elwell, in the last several years FAA has moved to utilization of ODA authority to speed up the certification process. How does the agency determine whether or not it has enough inspectors or engineers to provide adequate oversight?

Mr. ELWELL. Thank you for that question, sir. I would make a slight correction. The Organization Designation Authorization, ODA, that you referenced actually wasn't put in place to speed up certification. It was put in place so that a robust certification process could happen with collaboration between the FAA and the manufacture of design. And the detail about that is really in the wheelhouse of Mr. Lawrence, as the head of certification.

Mr. LAWRENCE. So I believe your question was about our oversight, and how do we maintain that and the ratio.

There are multiple programs, depending on the type of oversight, whether it is manufacturing, whether it is oversight of an air carrier, or whether it is over the design. And we evaluate that on an annual basis to make sure that we have sufficient resources to oversee those particular items, and they are done individually, and they are influenced by other factors such as a company's financial status, whether there are pilots on strike—and, you know, we take all the external items, not just their performance, in consideration about what resources we have on their oversight.

Mr. CARBAJAL. That sounds very vague to me. There are no standards that dictate the number of engineers or inspectors that you need to have on site?

Mr. LAWRENCE. The standards don't articulate a ratio when it comes to an ODA of a specific number of our resources to a specific

number of their resources. What the standards dictate is that we have the individuals necessary to do the oversight. The reason why it is not a single one-size-fits-all is because of the different types of ODAs and the way they are structured.

When it comes to Boeing it is such a big one, and it is so critical to us, we established a specific Boeing oversight office that—that is their sole job, to provide that day in and day out, so that their attention is not split in between oversight of another ODA or another manufacturer. They are focused solely on making sure that the ODA and Boeing's performance meet our expectations.

Mr. CARBAJAL. Thank you. In October 2015 the Department of Transportation Office of Inspector General recommended that FAA adopt a new oversight approach for ODA holders by developing new evaluation criteria and risk-based tools. The inspector general recently testified that this report recommendation is still open. What is the status of this effort, and why has it taken so long to do so?

Mr. ELWELL. Sir, thanks for that question. We, the FAA, welcome the evaluation, the audit, the review that the IG offers, that this committee offers. Every time somebody does—an entity within the FAA or externally, we learn something new and we get better. It is how we have reached the level of safety we have today.

And the recommendation you referred to, the 2015 recommendation about ODA oversight, I am going to let Earl answer the specifics of that. But what it has taken us is from a sort of a strict adherence to an annual review to something that is more akin to the way we do our oversight and the way we do our regulation in the system today, which is much more data-driven, risk-based, performance-based, so that we have the freedom to go and inspect an ODA five times in a year if we need to, if the data suggests.

But I will let Earl explain the specifics.

Mr. LAWRENCE. Well, I will just add, in the interest of time, that we accepted every single one of those recommendations. We have implemented them all, except for one. And it is not because we don't accept it, it is just it takes a period of time to implement fully all those recommendations. So we accept them all, and we are grateful for those, and they are guiding us going forward.

Mr. CARBAJAL. So how much longer is it going to take to implement this one?

Mr. LAWRENCE. So the last one is tied into implementation of direction from this committee, as well, to change the way we provide oversight, to have a dedicated organizational delegation office. That was designated by Mr. Elwell in April. And so that has started, and it will take us at least the summer to restructure and get everything in place to implement that.

So I am hoping by the end of this calendar year we will have completed that final recommendation, as well.

Mr. CARBAJAL. Thank you very much. Mr. Chairman, I yield back.

Mr. LARSEN. Thank you. The Chair recognizes Representative García for 5 minutes.

Mr. GARCÍA. Thank you, Mr. Chairman. First I ask unanimous consent to enter into the record a statement written by the parents of Samya Rose Stumo, who was just 24 years old when she was killed in the March 10th crash of a Boeing MAX 8 airplane while

on a mission to help others with healthcare in low- and middle-income countries. Her parents, as all of you know, Nadia Milleron, and her father, Michael Stumo, are tirelessly advocating for greater airline safety. And of course they have joined us during the duration of the hearing today.

Mr. LARSEN. Without objection, so ordered.

[The information follows:]

Statement of Nadia Milleron and Michael Stumo, Submitted for the Record by Hon. García

Our names are Nadia Milleron and Michael Stumo. We are the parents of Samya Stumo who lost her life on March 10, 2019, in the crash of Ethiopian Airlines Flight 302 aboard a Boeing 737 Max 8 airliner. Words cannot capture the grief we still feel and that will fill our lives forever.

We make this statement today to try to express to this important congressional Committee about the impact that a plane crash has on the lives of so many. It was not just our family that needlessly suffered the loss of our beloved 24-year-old daughter who had so much to give the world. There were 157 people on that plane that crashed into a field, making it their burial ground. Although we immediately rushed to Ethiopia to recover what we thought would be her body, we began to realize that there were no bodies. In fact, the remains, what little might have been left of Samya and of everyone else on that plane, were such small body fragments that they could not be recovered. We were forced to leave Ethiopia without her body.

We wake up every morning thinking of our Samya, and we go to bed each night hoping that she did not suffer too much in the last moments of her life. It was a wonderful life she had and one where only dreams lay ahead. She was traveling to make life better for others, helping to set up ThinkWell offices in countries that could benefit from better health care delivery. She was such a giving person. We are so proud of all that she accomplished and the mark that she left on so many in her short life. As we talk to other families who lost loved ones, these stories of love, of pride, of accomplishment, of loss are repeated over and over again.

But now we turn to you, as congressional leaders, to make sure that other families do not suffer from preventable airplane crashes in the future. Families of the victims have not been included in the process, we need to be included at all levels from here on out.

The Boeing 737 Max 8 airplane needs to remain grounded until all independent investigations are complete. Investigations are ongoing by this Committee, the Joint Authorities Technical Review, the Department of Transportation Inspector General, The DOT Blue Ribbon Panel, the FBI and the FAA Technical Advisory Board. The purpose of these investigations is to discover everything necessary to identify and correct problems.

A stunning array of news stories are consistently revealing more potential problems with design, safety procedures, software, hardware, manufacturing and certification. Flyers and governments across the world, including our family, have had our trust in Boeing and in the Federal Aviation Administration shaken. The Boeing culture of engineering safety may have been destroyed in favor of a Boeing management culture of profit extraction.

A third crash would kill more people and destroy the credibility of Boeing and the FAA.

The Federal Aviation Administration has a clear path forward to re-establish credibility and protect flyer safety. It can wait until all investigations are complete to determine all problems including the relationship among hardware, software, manufacturing, design, certification and pilot operation. Doing so would convince us, victims' families and the world that the FAA and Boeing are serious in putting flyers first.

Starting the ungrounding process before all investigations, including criminal investigations, are complete, would not.

Mr. GARCÍA. Thank you, Mr. Chairman. I will waive my statement to ask questions, as the hour is late as it pertains to this hearing.

Mr. Elwell, would you please confirm that proper operation of MCAS was considered a critical or essential safety feature in your certification of Boeing 737 MAX aircraft?

Mr. ELWELL. Yes, sir. The MCAS was certified as a critical safety product in the total certification of the aircraft.

Mr. GARCÍA. Would the plane have been certified without it?

Mr. ELWELL. That is too subjective for me to answer. I can't give you an answer for the record on that.

Mr. GARCÍA. Mr. Lawrence, sir?

Mr. LAWRENCE. I can maybe add a little context to it. The MCAS system was installed to make sure that it was in compliance with a specific regulation or handling characteristics. So that was the method Boeing chose to meet that requirement. They would have to meet that requirement. If they didn't do it through MCAS they would have had to meet that requirement through some other means, which could have been a structural change.

Mr. GARCÍA. What review functions were delegated to Boeing's engineers and Boeing engineer managers serving as outside evaluators?

Mr. Elwell, or either one of you?

Mr. ELWELL. Sir, could you repeat the beginning of that question?

Mr. GARCÍA. What review functions were delegated to Boeing engineers and Boeing engineer/managers serving as outside evaluators?

Mr. ELWELL. Sir, I am going to defer to Earl on the specifics of that question.

Mr. LAWRENCE. So I believe, sir, you are referring to the organizational delegation members who are employees of Boeing, and their oversight.

Mr. GARCÍA. That is correct.

Mr. LAWRENCE. And I make the distinction, because Boeing—the company, not the ODA—is responsible for compliance, and must show all the compliance finding. The members of the ODA and that structure, which—all members are approved and vetted by the FAA—are the reviewers of whatever Boeing the company does first, before we have our third set of eyes on the work that they do.

Am I answering your question, sir?

Mr. GARCÍA. I think so. Let me change gears, as the clock is ticking.

In light of the apparent malfunctions of the MCAS in these crashes, have you considered the adequacy of your review of the MCAS and any other essential critical safety equipment on the 737 MAX or other airplanes?

Mr. ELWELL. Mr. García, thank you for that question, sir. That is exactly what we are doing. It is what the IG is going to look at, as directed by the Secretary, the processes by which we certify aircraft. The Joint Authorities Technical Review is going to look at the flight control computer system and the certification thereof. And of course, the special committee, or the blue ribbon panel that has been—also commissioned by the Secretary—is going to look at the process that we used for certifying the MCAS, 737 MAX, and our certification processes, writ large.

Again, these are reviews and audits and investigations that, because they have been helpful in making us better, we welcome them. And we will participate to the extent that we are able, and look forward to the recommendations.

Mr. GARCÍA. Thank you. And to Chairman Sumwalt, do you think that the outcome of the investigations that are ongoing will result in greater training of pilots from other countries?

Mr. SUMWALT. Congressman García, that is hard to say. We need to figure out everything involved in each of these actions to actually make that determination. Of course, as you know, ultimately the determination on training will be up to the regulator.

Mr. GARCÍA. Thank you. I yield back, Mr. Chair.

Mr. LARSEN. Thank you. The Chair recognizes Representative Brown for 5 minutes.

Mr. BROWN. Thank you, Mr. Chairman. Earlier in the hearing Chairman DeFazio was asking about engineers reporting to managers. The point was made that often these managers are engineers. For me, what that raises is really just the fundamental question of the independence of the engineers who are making these decisions, these assessments, evaluations about compliance, whether it is design, or build-out of these components or an aircraft.

The investigation around the *Challenger* shuttle explosion in 1986 found instances where engineers and employees raised concerns about the shuttle that were not efficiently taken into consideration by management. And I know, you know, obviously, NASA and FAA are different, and the processes are different. But my concern is that this could be another example of a management failure, and not necessarily or exclusively an engineering failure. Sometimes managers are influenced by factors other than safety and quality, and that is the nature of large organizations. Maybe it is profit. Maybe it is public pressure to deliver something.

So I would like to ask about the mechanisms that are in place at the management level to ensure that engineering software and labor concerns are adequately taken into account when evaluating new and old products. The FAA is responsible for ensuring that its products are brought to market, all reasonable efforts have been made to properly characterize risk and ensure public safety is fully protected. At the core of this function is the independence of engineers who are conducting the evaluation.

So, Mr. Elwell, what processes does the FAA have in place to maintain the independence of its engineering assessments for certifying flight worthiness, and ensuring that there is an environment that engineers understand that their professional engineering opinion will be valued and supported?

Mr. ELWELL. Thank you for that question, Mr. Brown. That is exactly what we have endeavored to instill in the ODA process from its inception. And that is a freedom of the ODA members to come to the FAA with any and all—in fact, it is trained, every ODA member is vetted by the FAA before that member is approved. Things such as integrity, professionalism, experience in certification, all of those things are weighed.

I would point out not only has ODA been a refined process for decades, it has also been endorsed by Congress in a number of FAA

reauthorizations that have actually expanded in statute our responsibilities to increase ODA. And I say that only to point out that ODA, when done right, is indispensable to the safety of this system and to the health and growth of our aviation ecosystem.

Having said that, the investigations that have been initiated as a result of these accidents we are going to follow with great interest, and we are going to take the recommendations and the findings to make the systems——

Mr. BROWN. Let me ask this followup, and I appreciate that.

In the course of evaluating the safety of the 737 MAX during the certification, were there any dissenting opinions raised during the evaluation of its flight worthiness? And is the process set up where an engineer may disagree with another, and raise that independently to the FAA?

Mr. ELWELL. Is your question did that happen, or is that something——

Mr. BROWN. Yes, did it happen, did it happen, and does that happen.

Mr. ELWELL. I don't know if we have record of that, and Earl could address that. But I would——

Mr. BROWN. Well, let's—Earl, can you address that?

Mr. LAWRENCE. We do not have a specific record of a—for example, a written complaint from one of the Boeing engineers, or a concern. But I want to reinforce that there is dialogue in between FAA engineers and Boeing engineers along the whole process. And they do express concerns, they do have technical debates, and that is a normal part of the process.

And I want to highlight that the FAA sets the standards, and the FAA is the final decisionmaker. And we do that to protect the engineers, as you are articulating, that they can't change the standards. It will be—they evaluate whether they are meeting those standards. And when they see undue pressure, there is—we actually require the Boeing ODA to have a whole reporting system, which—they have a process to evaluate any of those concerns and report it back up.

Mr. BROWN. Thank you. Thank you, Mr. Chairman.

Mr. LARSEN. Thank you. Continuing with the first-round questions, Mr. Lynch, Representative Lynch, is recognized for 5 minutes.

Mr. LYNCH. Thank you very much. Thank you, Mr. Chairman, for holding this hearing. And I want to thank the witnesses for your help.

Mr. Lawrence, the issue around the sensors and the fact that—at least it is alleged in some of the press reports that the purchasing airlines were not aware that certain sensors were inactive. Have you dealt with that in terms of your own investigation and your own review of what has happened in both of these airline accidents?

Mr. LAWRENCE. So, sir, I believe you are referring to the angle-of-attack enunciator or indicator in the cockpit?

Mr. LYNCH. Right.

Mr. LAWRENCE. That was discovered by Boeing. It was not reported to the airlines upon their discovery. It was evaluated as an item under our software standards that did not have to be re-

ported, because there wasn't an associated pilot action with that indicator.

So, since there was not an associated pilot action to take based on that—it was really there for a maintenance alert—then they were required to update it and bring it back into working condition, but they were not required to report it at that time.

Mr. LYNCH. So going back to the bifurcation between the FAA's responsibility versus the responsibilities that we designate back to the manufacturer, is that something that, if it were a core FAA function, would have been made aware—would have been—that information would have been made aware to the airlines themselves? Or is that something that would have gone undiscovered, regardless?

Mr. ELWELL. Sir, if there had been—if it—to your question, if it had been a critical safety of flight item it would have been immediately reported, and would have been required to be immediately reported. That—it took too long. We don't need the IG investigation, the JATR, or the special committee to tell us that 13 months was too long for us to find out that there was a software anomaly. And you have our commitment that we are going to look into that and fix that.

Mr. LYNCH. OK. The—as I read the Organization Designation Authorization—this is the program where FAA hands off responsibilities to Boeing—there is definitely, in my mind, an asymmetry in technological ability that Boeing has here, and I am worried about regulatory capture, if you will.

Under the ODA it says that only noncritical matters will be shifted to Boeing. And when I hear the full committee chairman say that this is a single point of failure—in retrospect, do you agree that that, you know, the designation to Boeing for this responsibility should have been kept with the FAA?

Mr. ELWELL. Thanks for that question, Mr. Lynch. We are going to wait for the investigations on process for an analysis of—there are three different studies right now engaged on the 737 MAX certification.

In general, in ODAs we delegate to the manufacturer noncritical items so that we can focus on the safety-critical, or new and novel aspects of the certification of the aircraft.

Mr. LYNCH. OK, I——

Mr. ELWELL. The MCAS——

Mr. LYNCH. Let me reclaim my time. And I understand that, and I fully respect that.

Let me just go back. And I know other Members have said this already, but this is a devastating pair of accidents here, and my heart and my prayers go out to all the victims and their families.

You also realize that this cannot happen again, right? This cannot happen again. If this—if we lose another aircraft, and I am in a—I am in the city of Boston. And so planes taking off from Logan under these circumstances, 40 seconds out, 1 minute and 40 seconds out, would land in very densely settled neighborhoods, and would be totally devastating. So we have to get this right, and I trust you will do that. Thank you.

Mr. LARSEN. Thank you, Representative Lynch. We will go to—continue second rounds now, and start with Representative Balderson.

Mr. BALDERSON. Thank you very much, Mr. Chairman. My first question is to both witnesses, and it is on behalf of Ranking Member Graves.

His question was how do U.S. airline operations and safety programs differ from non-U.S. airlines?

Mr. ELWELL. Sir, the—each state is responsible for its own safety programs. We have a set of standards set—guidance, really, but adhered to, internationally. We have—as Chairman Sumwalt said earlier, we have—193 nations participate in the International Civil Aviation Organization, a U.N. body, who adhere to those standards, aviation standards, across all aspects of the aviation ecosystem.

Those minimums must be met or exceeded for any country to fly to our country, or to have a cochair relationship with one of our carriers to fly to our country. But it is up to each country to determine whether or not they are going to adhere to the minimums or raise them. And in the U.S., clearly, our standards for—in almost every category far exceed ICAO standards. That is not to say that the ICAO standards in any area are necessarily too low. But we wouldn't have the safety record that we have in our country if we hadn't raised the bar.

And the important thing here, sir, is that we don't just raise the bar in our own little silo here in the U.S. aviation. We have been proactive internationally for decades. And, as Chairman DeFazio mentioned, one of the things that this committee—that he championed, which is upset training and stall training that was added to the training for our pilots, in large part as a result of the Colgan incident—we went to ICAO and we made the case, and it was accepted at ICAO, that that additional training should be an international standard. And we are now in the process of ensuring that that is implemented globally.

Mr. SUMWALT. Congressman, the NTSB has nothing to add to what Acting Administrator Elwell said.

Mr. BALDERSON. Thank you very much. My next question is to Mr. Elwell.

There have been numerous reports in the media that the certification of the MAX was rushed. How long did the certification of the MAX take?

Mr. ELWELL. Sir, the certification of the MAX began with the application in January 2012, and it ended and was certificated by former FAA Administrator Michael Huerta in March of 2017. The whole process took 5 years, just around 5 years. The average for an amended type certificate is somewhere between 3 and 5.

So I certainly wouldn't characterize it as rushed. We adhere to the principle that a certification is done when all of the standards and the regulations are complied with, not a day before or day after. And that is the criteria we used for the MAX.

Mr. BALDERSON. OK, thank you. One followup. Do you know the typical amount of time a European Union Aviation Safety Agency certification takes?

Mr. ELWELL. Sir, I personally don't. But Earl, are you—do they have an average?

Mr. LAWRENCE. I don't know what their average is, but on average projects that we have been involved on with some of theirs has been 3 years.

Mr. BALDERSON. OK, thank you. Mr. Chairman, I yield back my remaining time.

Mr. LARSEN. All right. The Chair recognizes the vice chair of the subcommittee, Representative Davids from Kansas, for 5 minutes.

Ms. DAVIDS. Thank you, Mr. Chairman. So I wanted to get into a little bit more about the distinction between the light the sensor will set off, the—I don't remember the differentiating——

Mr. ELWELL. The AOA disagree light?

Ms. DAVIDS. Disagree light. So the disagree light is something separate and apart from the MCAS system, or the augmentation system actually engaging, right?

So the light is—has been the focus of the—and maybe it is the canary in the coal mine, I don't know, but I think the bigger issue is if the system engages and pilots have to respond to it, or are forced to respond to it, the training and the notice that that might be the case is—seems there is a little bit of a disconnect, or a concern of many members on the committee.

So what prompted the emergency airworthiness directive that was issued in November 2018? I know the Lion Air tragedy happened, and then after that the emergency airworthiness directive was issued. And it specifically called for operators of the 737 MAX to revise their flight manuals to reinforce and emphasize to flightcrews how to recognize and respond to uncommanded stabilizer trim movement and MCAS events. What prompted that directive?

Mr. ELWELL. So thank you for that question. Soon after the accident it was apparent—the Lion Air accident—it was apparent that it was an MCAS event. And it is important to note that the MCAS is designed so that if it engages when it is supposed to—in other words, in certain angles of attack, which means nose high to the airstream—and under certain conditions, if it were to function, it is designed such that the pilots would not even know that it is operating.

So, by definition, if it operates when it is not supposed to, which is what happened in both of these cases, pilots would immediately know that something, maybe not the MCAS—and this is why it is very important—an analogy, I think, that makes sense in this regard is if someone in a restaurant is choking you don't find out what they are choking on before you administer the Heimlich. It is exactly the same in runaway pitch trim.

When a pilot feels the nose going over in his hands he will feel it in the yoke. He is trained from the beginning—at least U.S. pilots, and it is not to say that international are not—that is runaway pitch trim. And when the MCAS kicked in when it wasn't supposed to, it drove the nose over in the pilot's hands. They could feel it.

So what—when we looked at that data, and realized by—the flight data recorder showed that the runaway pitch trim procedure was not done with Lion Air in the entirety of the flight—we knew that this needs to be emphasized. And that is what the emergency AD did. It said, "Remember, if you get a pitch over activity in an

airplane and you didn't tell the airplane to do it, that is runaway pitch trim. Run the runaway pitch trim procedure." That is why we put it in an emergency AD.

We also added—and this was important—that before you run that procedure, before you physically turn off those stab trim motors, you still are able to use the trim switch on the yoke, trim the pressure off the yoke so that, instead of feeling it pushing you over and pulling it back, and fighting it, trim off that pressure so the yoke is in a neutral state. Very important to do that before turning off those motors. That was also in those instructions, and that became critically important with the Ethiopian accident.

Ms. DAVIDS. So what is the process to follow up on an emergency airworthiness directive to ensure that—the flight manuals and the reinforcement of the process that is supposed to be followed—how do you make sure that once you have sent out the directive, that it is actually being adhered to?

Mr. ELWELL. I am going to ask Earl to watch me on this answer. But when we, the FAA, issue an emergency AD and it applies to an aircraft that has worldwide use, it is married up with a manufacturer's directive—which, in this case, Boeing put out. And it is also—we do what is called a Continuous Airworthiness Notification to the International Community. A CANIC is also distributed globally, pointing to the emergency AD.

Once we do that, then it is incumbent upon every civil aviation authority that is a state of registry for that aircraft, that oversees their airlines, their training, to make sure that that manufacturer's bulletin and the FAA AD are adhered to.

Ms. DAVIDS. Thank you, Mr. Chairman.

Mr. LARSEN. Thank you. I have a few questions for wrap-up.

First for Chair Sumwalt. How would you characterize the ongoing communications now between the NTSB and the Indonesian investigators and Ethiopian investigators?

Mr. SUMWALT. Very good. And, of course, Dana was in Ethiopia last week to ensure that we maintain those good relationships.

Mr. LARSEN. Same with Indonesia?

Mr. SUMWALT. Indonesia is very good, as well.

Mr. LARSEN. All right, great.

Mr. Elwell, we talked about the TAB, the Technical Advisory Board. Is it your intent that the FAA would not make a decision to unground the 737 MAX unless TAB recommendations were implemented?

Mr. ELWELL. Mr. Chairman, I—it is my intent to have any TAB recommendation dealt with and adjudicated. Ultimately, the decision to unground rests on me, rests on the FAA. I have sole responsibility for it. So I am not going to sit here today and put some responsibility on the TAB that I shouldn't. But the whole reason that we created the TAB, and that they are working with us and looking at the process right now, is so that we can benefit from their expertise.

Mr. LARSEN. OK. So before we wrap I want to give both of the witnesses a chance to add anything that they would like, and I will start with Chair Sumwalt.

Mr. SUMWALT. Well, thank you. I think we have heard questions about pilot training. And maybe that there may be different stand-

ards throughout the world. And I think it is important to point out that if an aircraft manufacturer is going to sell airplanes all across the globe, then it is important that pilots who are operating those airplanes in those parts of the globe know how to operate them. And I think that is important.

Just to say that the U.S. standards are very good—and this might be a problem with other parts of the globe—I don't think that is part of the answer. And I don't mean this—I hate to use this term, but the airplane has to be trained to the lowest common denominator. Thank you.

Mr. LARSEN. Administrator Elwell?

Mr. ELWELL. Mr. Chairman, first I want to say again how sincerely aggrieved we all are, the loss of lives in both of these accidents. It is the reason why we do what we do, is to prevent that. So when it happens it is horrific, and it drives us.

And if I could leave this committee and the American public with anything, it is that the 45,000 professionals at the FAA and Secretary Chao and this committee, we are all united in the goal to make sure that we look at everything possible. And that is why all of these investigations, these audits, these reviews are so critically important, because we are going to learn from them, and we are going to honor the people who passed in these accidents, and we are going to make it better.

Mr. LARSEN. Thank you. No further questions from the subcommittee?

Seeing none, I want to thank each of our witnesses today for your testimony. Your contribution to today's discussion has been informative and very helpful.

I would ask unanimous consent the record of today's hearing remain open until such time as our witnesses have provided answers to any questions that will be submitted to them in writing, and unanimous consent that the record remain open for 15 days for any additional comments and information submitted by Members or witnesses to be included in the record of today's hearing.

Without objection, that is so ordered.

And if no other Members have anything to add, this subcommittee stands adjourned.

[Whereupon, at 1 p.m., the subcommittee was adjourned.]

SUBMISSIONS FOR THE RECORD

Prepared Statement of Hon. Pramila Jayapal, a Representative in Congress from the State of Washington

Mr. Chairman, thank you for the opportunity to submit this statement for the record for today's Transportation and Infrastructure Aviation Subcommittee hearing on the "Status of the Boeing 737 MAX."

On March 13, 2019, the Federal Aviation Administration (FAA) grounded the Boeing 737-MAX series planes after two similar accidents in Indonesia and Ethiopia led to the death of 346 people. I am on record supporting this decision and have called for an urgent investigation into any safety issues around the 737-MAX.[1] I commend the House Committee on Transportation and Infrastructure's decision to launch an investigation into the FAA certification process and oversight of the Boeing 737-MAX planes.[2]

As the representative of Washington's Seventh District—which encompasses most of Seattle and surrounding areas including Shoreline, Vashon Island, Lake Forest Park, Edmonds and parts of Burien and Normandy Park—I recognize and deeply appreciate the contributions of generations of Boeing workers to our district. We have a skilled, deeply rooted aerospace workforce in our region that is committed to building the best planes possible. These jobs—and the success of Boeing—fuel our district's economy.

Unfortunately, reports have emerged that many of these workers' concerns about safety issues went ignored or were quieted in the lead up to the recent tragic crashes of Boeing aircraft. For example, according to an investigative report from the Seattle Times published May 5, 2019, senior engineers employed by Boeing whose job it was to act on behalf of the FAA faced heavy pressure from Boeing leadership to "limit safety analysis and testing so the company could meet its schedule and keep down costs."[3] In fact, one of these engineers working on the MAX program was removed from the program after raising concerns about the aircraft's fire-suppression system around its engines.

I am also concerned about preliminary investigations revealing that neither the Lion Air nor Ethiopian Airlines aircraft that crashed included "optional" safety instruments that Boeing sold to carriers for an extra cost and the FAA did not require to be added to 737-MAX jets. These two instruments were designed to alert pilots to possible malfunctions of an automated anti-stall system called MCAS, which in both of these crashes may have been triggered by faulty data from an angle-of-attack sensor. The malfunction of this system in both cases pushed the planes' noses down, with the pilots struggling to gain control of their plane.[4]

My deepest concern is the growing evidence that Congress has allowed the FAA to delegate increasingly more authority to Boeing to certify the safety of its own airplanes—which is directly jeopardizing the lives of air travelers.[5] Congress must seriously and quickly review whether the agency is retaining sufficient oversight of safety certification processes, and if it is not, we must increase the resources of the FAA to conduct this oversight and ensure the safety of these planes. I am particularly concerned that the FAA's reliance since 2004 on Organization Designation Authorization (ODA) to certify the safety of aircraft represents a conflict of interest. Under this system, the Authorized Representatives who work on safety issues on

[1] https://twitter.com/RepJayapal/status/1105903235540418560

[2] http://dearcolleague.us/2019/04/co-sign-letter-to-faa-on-certification-and-oversight-of-boeing-737-max-series-planes/

[3] https://www.seattletimes.com/business/boeing-aerospace/engineers-say-boeing-pushed-to-limit-safety-testing-in-race-to-certify-planes-including-737-max/

[4] https://www.washingtonpost.com/transportation/2019/04/11/markey-introduces-bill-bar-aircraft-manufacturers-charging-additional-fees-safety-features-boeing-did/?utm_term=.4a56a1619623

[5] https://www.politico.com/story/2019/03/21/congress-faa-boeing-oversight-1287902

behalf of the FAA actually report to Boeing managers, as opposed to FAA technical managers as safety certification officers did prior to 2004.[6]

Federal oversight authorities have repeatedly raised concerns about the ODA system and the FAA's delegation of authority to Boeing. In 2012 and then in 2015 again, the Department of Transportation inspector general raised concerns about weak FAA oversight of Boeing. The 2015 audit raised concerns that FAA's office overseeing safety inspections for Boeing was understaffed.[7] The 2012 report found that FAA managers who review safety features on new and modified aircraft designs had faced retaliation for speaking up about their concerns, which pre-dated the 737 Max development.[8]

I welcome the stated commitment from the inspector general of the Department of Transportation that FAA will revamp its ODA oversight process by the end of July 2019[9] and I am grateful for the focus by the Transportation and Infrastructure Committee on this issue.

I also urge the FAA to fully and fairly investigate 737-MAX safety issues and specifically reports that Boeing managers ignored or silenced concerns raised by senior engineers during safety inspections, and then make available the report and underlying evidence from the investigation to the public in a timely manner.

Finally, I support the call from Aviation Subcommittee Vice Chair Sharice Davids urging the FAA to ensure that any upgrades to the 737-MAX series planes made by Boeing in response to these accidents maintain aviation safety as a first priority. These upgrades should not be "optional" items for planes with added costs. I also support Vice Chair Davids' request that these upgrades are transparent to, and include proper training for, pilots, mechanics and the many other skilled workers using and servicing these planes as well as the flying public.[10]

In conclusion, I look forward to working with Aviation Subcommittee Chairman Larsen on this issue moving forward. I express my deep gratitude to him for his commitment to the safety of the flying public and to the generations of Boeing workers in our region. I thank the Chairman for submitting this statement on my behalf for this hearing today.

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[6] https://www.seattletimes.com/business/boeing-aerospace/engineers-say-boeing-pushed-to-limit-safety-testing-in-race-to-certify-planes-including-737-max/

[7] https://www.oig.dot.gov/sites/default/files/FAA%20Oversight%20of%20ODA%20Final%20Report%5E10-15-15.pdf

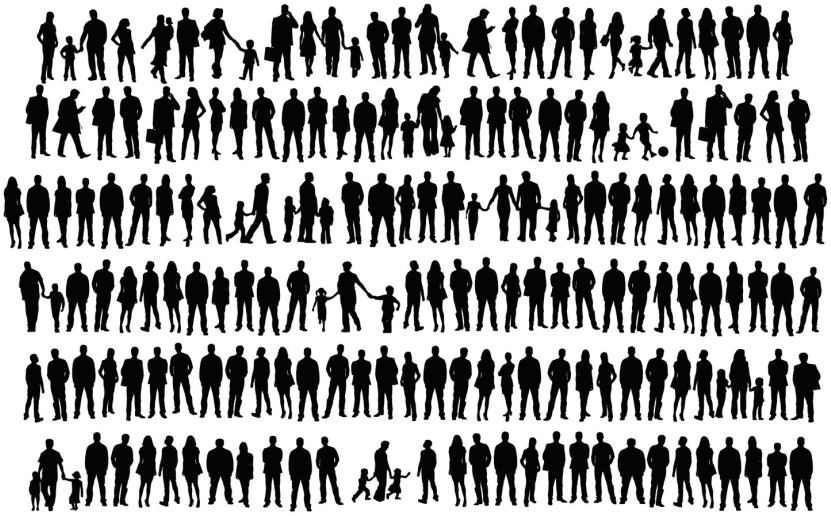
[8] https://www.bloomberg.com/news/articles/2019-03-18/boeing-had-too-much-sway-checking-own-planes-faa-workers-warned

[9] https://www.rollcall.com/news/congress/faa-administrator-defends-decisions-boeing-737-max

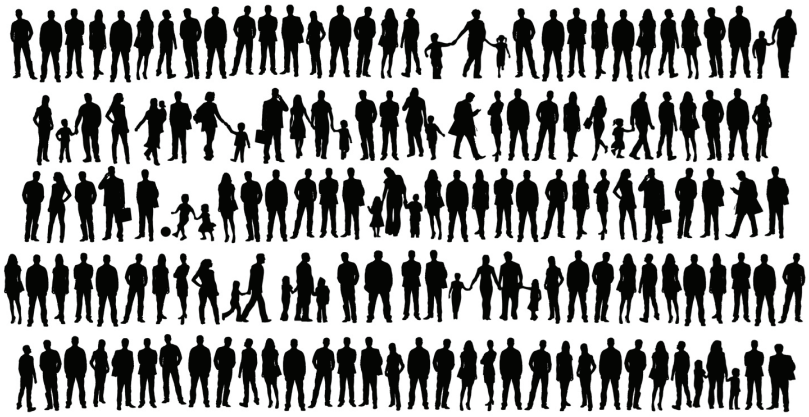
[10] http://dearcolleague.us/2019/04/co-sign-letter-to-faa-on-certification-and-oversight-of-boeing-737-max-series-planes/

Photos Submitted for the Record by Hon. Larsen

JT610 BOEING 737 MAX 8



ET302 BOEING 737 MAX 8



Silhouettes of Victims

Stella Konarska and son Adam; Poland and Kenya

Adam Konarski; Poland

Micah Messent; Canada

Danielle Moore; Toronto, Canada

Melvin Riffel; Redding, California

Bennett Riffel; Redding, California

Samya Rose Stumo; Sheffield, Massachusetts

Marcelino Rassul Tayob; Mozambique

Christine Alalo; Uganda

George Kabau; Kenya

Bernard Musembi Mutua; Kenya

Two Letters from Sara Nelson, International President, Association of Flight Attendants—CWA, AFL–CIO, Submitted for the Record by Hon. DeFazio

MARCH 11, 2019.

DAN ELWELL
Acting Administrator
Federal Aviation Administration, 800 Independence Ave., SW., Washington, DC 20591

DEAR ADMINISTRATOR ELWELL,

The Association of Flight Attendants-CWA is incredibly grateful to you for your constant efforts to maintain the safest transportation system in the world. Your leadership has been extraordinary in some of the most challenging times and we are so thankful.

We write today to advise you that crew and passengers are expressing concerns about the 737 MAX 8 after the March 10, 2019 crash of Ethiopian Airlines Flight 302, relatively closely following the tragedy of Lion Air Flight 610 on October 29, 2018. We fully support the investigative process and caution the public to avoid drawing conclusions prior to uncovering the facts of the incident. However, the second accident in less than five months involving the same model airplane gives rise to concerns and a quick jump to conclusions that undermine full confidence in the aircraft type. We encourage the relevant authorities to take steps immediately to address concerns and ensure the safety of the 737 MAX fleet.

We support and encourage the Federal Aviation Administration (FAA) to work closely with Boeing and its suppliers, the National Transportation Safety Board (NTSB), the U.S. airlines that operate this airplane model, maintenance and training providers, and affected employee groups, to review all potential issues that could contribute to these two catastrophic outcomes. This review should be comprehensive, considering at minimum the certification basis, maintenance practices, operational procedures, and crew training aspects of the 737 MAX program, and it should be open and transparent, to ensure the public's confidence in its conclusions and recommendations.

It may be helpful to communicate the steps that U.S. airlines have taken to implement the requirements outlined by the FAA in the December 6, 2018 737 MAX Flight Control Airworthiness Directive.

Thank you for all your work to keep U.S. commercial aviation safe.

Sincerely,

SARA NELSON
International President

MAY 14, 2019.

Hon. PETER A. DEFAZIO
Chairman
Committee on Transportation and Infrastructure, U.S. House of Representatives, Washington, DC 20515

CHAIRMAN DEFAZIO,

The Federal Aviation Administration (FAA) must address the flying public's concerns about the relationship between the FAA, the airlines, and the manufacturers that it regulates. For decades, the U.S. aviation system has been the aviation safety model for the world. However, that position must be earned and continually strengthened.

In order to accomplish this, the FAA should ensure that federal regulations and statutes governing aviation safety are implemented and unquestionably enforced. To accomplish this, the FAA may well need to increase its inspector and certification workforce, as well as their compensation in order to make these positions more competitive with the private sector. This will require an FAA Administrator with a proven record of leadership, demonstrated efforts to improve aviation safety, and the ability to work with all stakeholders, including aviation labor.

Congress voted to strike "promotion" of air commerce from the FAA's mandate with the passage of the FAA Reauthorization Act of 1996, following that year's loss of 110 passengers and crew on ValuJet Flight 592. However, the conference report stated that "The managers do not intend for enactment of this provision to require any changes in the FAA's current organization or functions. Instead, the provision is intended to address any public perception that might exist that the promotion of air commerce by the FAA could create a conflict with its safety regulatory mandate." [1]

The FAA's performance of its aviation safety mandate is again in question after two fatal 737 MAX crashes. This time, real changes are needed in how the FAA ensures the safety of the airplanes and operations that it regulates.

AFA believes that Boeing's credibility directly relates to the credibility of U.S. aviation. It's important to Flight Attendants that the credibility and the leadership of U.S. aviation is maintained around the world.

Lives must come first always. But a brand is at stake as well. And that brand is not just Boeing. It's America and what it means in international aviation and by extension in the larger world more generally—that U.S. aviation sets the standard for safety, competence, and honesty in governance of aviation.

Sincerely,

SARA NELSON
International President

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[1] See https://www.pbs.org/wgbh/pages/frontline/flyingcheap/safety/cosy.html, 2-9-2010

APPENDIX

QUESTIONS FROM HON. HENRY C. "HANK" JOHNSON, JR. FOR HON. ROBERT L. SUMWALT III, CHAIRMAN, NATIONAL TRANSPORTATION SAFETY BOARD

Question 1. What safety measures does NTSB want to see implemented before the plane returns to service?

Question 1a. Do you believe there were adequate protections in place prior to the Lion Air and Ethiopian Air crashes?

ANSWER. The National Transportation Safety Board's (NTSB's) participation in the ongoing Lion Air and Ethiopian Airlines investigations is for the purpose of assisting the lead agencies, in their respective countries, in determining how the airplane, human(s), and operating environment might have played a role in the accidents. As part of that work, the investigators are collecting and evaluating available evidence to assess protections applicable to each of those areas. That work is ongoing, and the NTSB is working closely with the respective lead agencies to assist in identifying deficiencies. In particular, as the lead representative for the state of design and manufacture of the aircraft, the NTSB is examining the original certification process used to approve the Maneuvering Characteristics Augmentation System (MCAS) function on the Boeing 737 MAX. The certification process is the mechanism by which the manufacturer and the Federal Aviation Administration (FAA) determine the safety protections needed to ensure an acceptable level of safety risk in service. This investigative work is ongoing, and where deficiencies are identified, the NTSB will make safety recommendations, as appropriate.

Question 1b. Why didn't the NTSB reevaluate safety precautions in the 737 MAX after the Lion Air flight?

ANSWER. As part of supporting the Komite Nasional Keselamatan Transportasi (KNKT) of Indonesia's investigation of the Lion Air crash, NTSB experts supported the development and analysis of recorder data, wreckage, and other investigative facts with the participation of the FAA and Boeing as technical advisors. Based on the available facts in the Lion Air accident investigation, Boeing issued a flight Operations Manual Bulletin to provide enhanced safety precautions in pilot procedures related to a runaway stabilizer failure condition and began updating the Boeing 737 MAX MCAS software for implementation, once certified. As part of their continued operational safety role, the FAA immediately mandated use of the new Boeing procedure through an Emergency Airworthiness Directive that was also provided to foreign regulatory agencies of countries operating the Boeing 737 MAX and began work with Boeing on certification planning for the updated MCAS software.

In addition to applying its expertise to this early evidence collection and analysis process, NTSB investigators also assisted KNKT in the examination of maintenance and design certification factors directed by the available evidence in the Lion Air accident. The NTSB's examination of design certification factors related to the approval of the MCAS function on the Boeing 737 MAX is ongoing as is the NTSB's support of the Ethiopian Aircraft Accident Investigation Bureau's investigation into the broader aircraft, human(s), and operating environment factors that contributed to the Ethiopian Airlines accident.

Question 1c. During investigation into the 737 MAX sensor defect, has NTSB encountered additional safety concerns that will further prolong the grounding of the 737 MAX?

ANSWER. In addition to this fact-gathering and our support of the foreign agencies, as noted above, the NTSB has been examining the design and certification of the MCAS since our investigators initially responded to the Lion Air accident. This work entails careful examination of the certification artifacts with respect to applicable regulations, standards and guidance, technical methods, and communications that were part of the aircraft certification process. This examination is ongoing, and

where deficiencies or areas for improvement are found, the NTSB will make safety recommendations.

Regarding the pending new design, the FAA is the regulatory agency charged with making decisions regarding an airplane's certification as well as continued operational safety (COS). Questions related to the recertification effort and/or the FAA's COS actions, such as the return to service of the Boeing 737 MAX, are best referred to them.

Question 2. As technical advisor to the ongoing investigations of the Lion Air and Ethiopian Airlines flights, has Boeing been cooperative with NTSB's assessments and input?

Question 2a. Do you believe Boeing will remain cooperative although they initially opposed the grounding of the 737 MAX?

Question 2b. Has there been any disagreement between Boeing and NTSB on the safety assessments?

Question 2c. Has Boeing been allowed to have its own mechanics assist in the safety assessments?

Question 2d. Would you say that it's ever appropriate for interested companies to be allowed to assess their own safety on behalf of the government?

ANSWER. Boeing has, and continues to be, cooperative and fully supportive of the NTSB as well as the Indonesian and Ethiopian investigations. In accordance with the International Civil Aviation Organization (ICAO) Annex 13, Boeing, FAA, and GE Aviation are technical advisors to the U.S. Accredited Representative, appointed by the NTSB. Accredited representatives provide the engineering and technical information necessary for the foreign authorities to conduct the investigations. This framework is an essential part of the Annex 13 process to ensure that investigators have the technical information needed to address safety concerns. We believe the productive working relationship between the NTSB and all our technical advisors will continue throughout the entirety of these investigations.

QUESTIONS FROM HON. PETER A. DEFAZIO FOR DANIEL K. ELWELL, ACTING ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION

Question 1. Mr. Elwell, when I asked you at the hearing if the Maneuvering Characteristics Augmentation System or MCAS was a safety critical system, you acknowledged that in your opinion you thought MCAS should be classified as a safety critical system. Will MCAS be recertified by the FAA as a safety critical system before the 737 MAX flies again, and if not why not?

ANSWER. MCAS is not a standalone system. It is part of the 737 MAX primary flight control system. Whether a system is safety critical or not is based on the outcome of the system safety assessment. We will apply the same methodology and policies in evaluating and certifying the modified MCAS design. However, we will also take into consideration the preliminary report information from the two accidents.

Question 1a. Assuming MCAS is reclassified as a safety critical system, which it was not during the Amended Type Certification review when the 737 MAX entered service in 2017, what additional steps will be taken by both Boeing and the FAA to reclassify MCAS as a safety critical system?

ANSWER. MCAS is not a standalone system. It is part of the 737 MAX primary flight control system, which was classified as a safety critical system. During the certification program, MCAS was a necessary part of the flight control system in order for it to meet FAA safety regulations. We do not expect that to change when the MCAS software change is FAA-approved and incorporated.

Question 2. Acting Administrator Elwell, at the hearing you acknowledged that Boeing developed MCAS so that the 737 MAX would feel the same to pilots used to flying the 737 NG. In fact, there are significant structural design changes to the 737 MAX from the previous 737 NG model, most notably the larger engines that were placed further forward on the wings. This changed the aerodynamics of the aircraft in flight, and MCAS was intended to make the 737 MAX appear to pilots as though it was the same airplane as the 737 NG, even though it was not. Reports have indicated that Boeing sought to avoid a new type certificate for the MAX and instead pursued an amended type certificate. It seems clear this was intended so that Boeing could avoid going through a new type certificate process with the 737 MAX and instead pursue the amended type certificate program primarily because of the way MCAS impacted the flying characteristics of the aircraft. Boeing has now proposed significant revisions to how MCAS works on the 737 MAX. I am concerned that MCAS has been expected to transform significant structural design changes to the 737 MAX into something it is not, the 737 NG aircraft.

*Question 2a.*Please provide a written explanation of all of the post-Lion Air and Ethiopian Airlines proposed changes to MCAS by Boeing.

ANSWER. The FAA is working with Boeing on the software changes being made to the MCAS function as part of the primary flight control system. Boeing's proposed changes include:

1) To correct potential erroneous signals from the angle-of-attack (AOA) sensors, the two signals (left and right) will be compared and averaged. The average will be used to determine whether MCAS is activated.
2) When the left and right AOA sensors disagree by more than 5.5 degrees, MCAS functionality will be inhibited.
3) There will be one MCAS input for each situation that activates MCAS, rather than multiple inputs.
4) If MCAS is activated, the input will be limited to ensure the pilot can maintain control of the stabilizer.

In addition to approving the Boeing software change described above, the FAA will require incorporation of the change and any associated training we identify for 737 MAX pilots before the agency approves the airplanes for return to service.

Question 2b. Please also provide an assessment of whether these changes to MCAS will satisfy the requirements necessary for the 737 MAX to remain an amended type certificated airplane. In other words, does the modified version of the MCAS system offset the structural design changes on the 737 MAX compared to the 737 NG—or should the 737 MAX go through a new type certificate process before flying again?

ANSWER. The 737 MAX is a design derivative of the 737-800NG. The determination to classify the 737 MAX as an amended type design, which is approved with an Amended Type Certificate (ATC), was consistent with FAA regulations and current guidance.

The primary changes in the MAX were: a 4-5 percent weight increase; new engines with a minimal increase in thrust; a longer nose gear; a slightly higher tailcone; fly-by-wire spoilers; and new winglets.

Some examples of significant design changes that might require a new TC are: a change in the number of engines from 2 to 4, or 4 to 2; a change in the placement of engines, from underwing to body-mounted; a change in wing placement, high-wing to low-wing; thrust changes that change airplane speeds from subsonic to supersonic; change in materials from metal to composite; and a change in the type of airplane tail, T-tail to V-tail or cruciform.

The software change to modify the MCAS will not result in a significant design change such that the 737 MAX would require a recertification or a new type certificate.

Question 3. A recent FAA Organization Designation Authorization (ODA) Scorecard examined the authorities of qualifying companies to move forward with certain projects without a Project Notification Letter (PNL) from FAA. The Scorecard shows that prior to 2015, 14% of the 36 companies surveyed had authority to proceed with certain projects without a PNL. However, by 2018, 89% of the 36 companies surveyed had such authority.

Question 3a. How is the FAA ensuring that this increase in ODA authority is not degrading safety or appropriate FAA oversight?

ANSWER. Organizational Designation Authority (ODA) has long been a key part of the FAA's use of delegation. The FAA grants ODA authority based on the needs of the agency. The FAA may issue an ODA once it determines that a company or organization meets stringent eligibility requirements, including professional integrity, technical competency, and a history of compliance assurance. When application is made for type certification, the FAA reviews the program and determines what can be delegated, the level of involvement the agency will have, and what the FAA intends to retain. This determination is based on the ODA holder's demonstrated safety record and performance.

The FAA has a robust delegation oversight program, which the agency conducts through supervision and inspection. In addition to our review of audits and an annual assessment, the FAA conducts an on-site detailed inspection every two years. The inspection is a means for the FAA to assess whether the ODA holder's procedures are adequate, the ODA unit has complied with the procedures, and the ODA unit makes technical decisions that are acceptable. Poor performance by the ODA holder, Boeing in this case, can result in more FAA involvement, suspension, or termination of the ODA privilege.

In accordance with the FAA Reauthorization Act of 2018 (P.L. 115-254), on March 5, 2019, Acting Administrator Dan Elwell approved the formation of the Aviation Safety ODA Office. Among other functions, this office will facilitate system-level

oversight for standardized application of policy, proficiency of ODA and field office staff in executing oversight processes and monitoring of risk and performance issues.

Question 3b. What impact has this growth in authority for qualifying companies to proceed with qualifying projects without a PNL had on the safety of commercial aviation?

ANSWER. Submission of a Project Notification Letter (PNL) is a step in the certification process as project details are discussed, including what will be delegated and what level of involvement the FAA will have in the project. FAA ODA policy allows ODAs to omit the PNL step for certain Supplemental Type Certificate (STC) projects, when there are sufficient procedures in their FAA-approved ODA manual to complete the project.

PNL projects must meet all appropriate and applicable standards. This process of omitting the PNL step is only for companies that have proven capability and have a successful history of producing compliant, safe products. We are simply streamlining the process for those companies.

QUESTIONS FROM HON. ELEANOR HOLMES NORTON FOR DANIEL K. ELWELL, ACTING ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION

Question 4. Mr. Elwell, media reports indicate that the FAA may not necessarily require training for new systems in which the pilot is considered the redundancy in case of a system failure. Can you explain the FAA's policy on training for new systems on an existing type certificate (like the MAX), and explain the training differences in terms of (1) systems that treat the pilot as the redundancy; and (2) systems that have a technological redundancy built in?

ANSWER. Required training for systems differences or maneuvers is based on FAA regulations. 14 CFR Part 61—Certification: Pilots, Flight Instructors, and Ground Instructors, Part 121—Operating Requirements: Domestic, Flag and Supplemental Operations, and Pilot Practical Test Standards for an added type rating drive the requirements for training, regardless of redundancy.

QUESTIONS FROM HON. STEVE COHEN FOR DANIEL K. ELWELL, ACTING ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION

Question 5. Mr. Elwell, media reports indicate that in its initial submission to the FAA, Boeing underestimated the capability of MCAS to move the stabilizer trim wheel by a magnitude of four times (from .6 to 2.5 degrees nose-down position), and the FAA only found out about the increased capability from Boeing's notice to airlines explaining MCAS after the Lion Air accident. Can you please confirm this account? And if this is not correct, please clarify the timeline.

ANSWER. The MCAS function, which is part of the primary flight control system, has a range of pitch motion with which to change the nose-high attitude of the airplane. Nose-high attitude is the position of the airplane's nose above that of level flight. The MCAS function bases the necessary amount of stabilizer input on the speed of the airplane. At high airspeeds, less stabilizer input is necessary to correct a nose-high attitude, so 0.6 is sufficient. At low airspeeds, since the stabilizer is less effective and needs more input to correct a nose-high attitude, 2.5 is required.

The actual stabilizer input is scalable, with the minimum being 0.6 and the maximum being 2.5. This is how flight control systems are designed and it is to be expected that Boeing would use this tried-and-true control methodology in the design of the 737 MAX. It is correct that changes to MCAS allowing 2.5 degrees of movement during some low airspeed scenarios were implemented by Boeing after the initial system safety assessment (SSA) was provided to the FAA. This change was processed by the ODA and was not required to be separately communicated to the FAA when it was made, as the most serious scenario had already been addressed in the SSA.

The FAA ensures that the worst-case scenarios or most critical conditions of airplane operation are tested. In this case, it was the high-speed condition. Even little changes in airplane attitude can be critical at high speeds, as everything happens faster and pilots have less time to react. In the low-speed condition, the pilot has more time to react and unexpected pitch attitudes can be more easily corrected.

Question 5a. Follow-up: If correct, because the FAA only initially reviewed the .6 movement, would another review have been warranted? What is the threshold for revisiting the analysis with new information? And along those lines, what is Boeing's obligation to report the change to FAA?

ANSWER. Another review would not have been necessary. Small control surface (the stabilizer, in this case) movements are needed at high speeds. At low speeds,

inputs must be larger to effect the necessary response in airplane attitude. The most critical condition is the high-speed condition, and the FAA tested this condition both in the simulator and during flight test. If Boeing had presented another similar or equally critical condition, that would have warranted another FAA review. With respect to Boeing's reporting obligations, they are required to follow their FAA-approved ODA procedures manual. Typically, changes in design, function, and configuration, if deemed significant, are expected to be reported to the FAA.

Question 6. Mr. Elwell, at the hearing I asked you about reports in the Dallas Morning News that appeared to describe nose down situations in 737 MAX aircraft in the U.S. that seemed similar to the MCAS malfunctions on the Lion Air and Ethiopian Airlines planes before they crashed. You responded that out of 50,000 737 MAX flights in the U.S. there were 24 reports from pilots that had a pitch anomaly with the nose pointed down and that none of those reports were related to the Maneuvering Characteristics Augmentation System or MCAS. I am interested in learning more about how the FAA determined that none of these reports were related to MCAS. Please provide the Committee with a more detailed written response regarding how the FAA determined none of those pilot reports were related to MCAS. Please also include all reports, studies, analysis or memorandums that were completed by the FAA regarding the 24 reported incidents you mentioned.

ANSWER. Please find attached a short summary table of the 24 Aviation Safety Reporting System (ASRS) reports, along with the full report, dated March 14, 2019. The 24 incidents date from October 2017 through December 2018, with no reports after December through the report's publication date. Please note that these reports are voluntarily submitted, confidential, and non-punitive. These incidents are not corroborated by NASA, the FAA, or NTSB. The existence or number of reports on a specific topic cannot be used to infer prevalence of that problem in the National Airspace System.

[The summary table follows; the report dated March 14, 2019, is on pages 87–122.]

Quick Reference Table of 737 MAX Aviation Safety Reporting System (ASRS) Reports

	ASRS Reports/Date	Synopsis	FAA disposition
1	ACN: 1604159 12/2018	Pilot reported failure to descend on approach.	Flight Management Computer programming error. Not related to MCAS.
2	ACN: 1603503 12/2018	Pilot reported departing with an equipment list paperwork discrepancy.	Nothing to do with flight control system or MCAS.
3 †	ACN: 1597380 11/2018	Pilot reported an autopilot anomaly, which led to an undesired, brief nose down situation.	This occurred with the autopilot engaged and MCAS functionality can only occur with the autopilot off and flaps fully retracted. Not an MCAS event.
4 †	ACN: 1597286 11/2018	Co-pilot reported that the airplane pitched nose down after engaging the autopilot on departure.	Not an MCAS incident as it occurred after the autopilot was engaged. MCAS functions are not available with auto pilot engaged.
5	ACN: 1593701 11/2018	Copilot reported an altitude deviation due to a premature level off by the autopilot.	Not an MCAS incident, as autopilot was engaged.
6	ACN: 1593699 11/2018	Pilot reported a slot in the cockpit center pedestal that allowed paper to slip through and possibly collect on wire bundles.	Maintenance issue. Nothing to do with MCAS.
7	ACN: 1593021 11/2018	Captain reported confusion regarding switch function and display annunciations related to ''poor training and even poorer documentation.''	No flight path anomalies reported. MCAS cannot be switched on and off nor does it have a display annunciation. Nothing to do with MCAS.
8	ACN: 1593017 11/2018	Pilot expressed concern that some systems such as the MCAS are not fully described in the airplane flight manual.	This comment is about MCAS, but not an MCAS incident. MCAS is not a system, rather it is part of the flight control system.

Quick Reference Table of 737 MAX Aviation Safety Reporting System (ASRS) Reports—Continued

	ASRS Reports/Date	Synopsis	FAA disposition
9	ACN: 1590012 10/2018	Pilot reported auto-throttles did not move to the commanded position during takeoff and climb.	This is an auto-throttle issue. Nothing to do with MCAS.
10	ACN: 1587343 10/2018	Off duty flight attendant reported not being able to see the cabin safety demonstration due to passenger seats being too high.	Nothing to do with airplane operation.
11	ACN: 1583127 10/2018	Pilot reported an unstabilized approach due to human factors and airplane familiarization.	Nothing to do with flight control system or MCAS.
12	ACN: 1583028 09/2018	Pilot reported that the engine fuel consumption was higher than expected.	Nothing to do with flight control system or MCAS.
13	ACN: 1572630 08/2018	Crew reported failure to follow engine start procedures resulting in an aborted start.	Plane is on the ground. Nothing to do with MCAS.
14	ACN: 1568887 08/2018	Pilot reported making a sudden stop while taxiing to avoid collision with ground vehicle.	Plane is on the ground. Nothing to do with MCAS.
15	ACN: 1565207 08/2018	Pilot reported the airplane Wi-Fi was not working at cruise.	Nothing to do with the flight control system of MCAS.
16	ACN: 1560763 07/2018	Co-pilot reported airplane unable to meet altitude requirements on the published departure procedure.	No flight control anomalies. Nothing to do with MCAS.
17	ACN: 1555013 06/2018	Copilot reported feeling unprepared for first flight in the 737 MAX, citing inadequate training.	This is an issue for the airline to address. There was no mention of a particular system for which he felt inadequately trained.
18	ACN: 1550073 06/2018	Maintenance personnel reported not receiving maintenance data from a particular 737 MAX.	This is a post-flight activity, conducted on the ground. Nothing to do with MCAS.
19	ACN: 1538699 04/2018	Aircrew reported deviations on approach, due to confusion with the new instrument displays.	Possible training/familiarization issue. Nothing to do with MCAS.
20	ACN: 1517486 02/2018	Pilot reported ground crew did not follow procedures as the airplane was pushed away from the gate.	Plane is on ground. Nothing to do with MCAS.
21	ACN: 1501507 11/2017	Co-pilot reported flight information is not displayed after the airplane landed.	Plane landed safely. Nothing to do with MCAS.
22	ACN: 1495437 11/2017	Pilot reported potential for a wingtip to strike the ground, during takeoffs and landings in high cross-winds.	Nothing to do with flight controls. Nothing to do with MCAS.
23	ACN: 1488017 10/2017	Pilot reported procedural issues with the flight management system, specifically regarding descent capabilities.	This was a procedural issue of aircrew interaction with the flight management (not flight control) system. Nothing to do with MCAS.
24	ACN: 1486024 10/2017	Aircrew reported automatic engine shutdown after starting the engine, most likely due to engine start checklist items being performed too quickly.	Plane is on the ground. Nothing to do with MCAS.

† Reports 3 and 4 are from the same airplane and event. Report 3 is the pilot's report and report 4 is from the co-pilot.

QUESTIONS FROM HON. COLIN Z. ALLRED FOR DANIEL K. ELWELL, ACTING ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION

Question 7. Mr. Elwell, can you please explain why MCAS was not in the initial manual (and Flight Standardization Board report)? What was the rationale for that decision? Is the FAA revisiting that decision?

ANSWER. While Boeing 737 MAX training requirements do not specifically address MCAS, existing pilot procedures do include the knowledge to deal with an MCAS event, which manifests itself as runaway stabilizer. The responsive actions for runaway stabilizer trim are identical in both the 737NG and 737 MAX airplanes.

It is important to note that MCAS is not a "system" that can be independently operated by the pilots. It is software code that operates in the background as part of the larger automated flight control system. The autonomous nature of the system did not interface with any normal, non-normal, or emergency checklists. Due to the autonomous nature of the system, it did not impact pilot knowledge, skills, or abilities, and therefore did not necessitate differences training.

QUESTIONS FROM HON. HENRY C. "HANK" JOHNSON, JR. FOR DANIEL K. ELWELL, ACTING ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION BOARD

Question 8. The Organization Designation Authorization (ODA) program is intended to give the FAA more room to address high-risk issues and nuanced technologies by allowing some regulatory delegation to technical experts, like Boeing. If the intent is for the FAA to streamline its effectiveness, why do you believe that knowledge of some of the 737 MAX's safety nuances slipped through the cracks?

ANSWER. FAA does not consider any safety aspect of a certification project a nuance. To be granted an Organization Designation Authorization (ODA), a company must have a positive safety record, a history of compliance to FAA regulations, and a proven level of technical capability. Leveraging ODAs to work on the low-risk portions of a certification program allows the FAA to focus resources on the higher-risk areas and new and novel technologies and applications.

The FAA focused significant resources on certification of the 737 MAX—over 110,000 hours of FAA staff time were devoted to this effort. Boeing showed compliance with all of the applicable design regulations in an acceptable manner and the FAA concurred on the system safety assessment Boeing presented.

Nevertheless, the FAA is always looking to improve established certification processes. Both Secretary Chao and Acting Administrator Elwell have gone on record as welcoming scrutiny and input on areas of improvement. In support of this, several reviews related to the certification process have been initiated which will provide:

- potential process improvements;
- information on the manner in which the certification process was applied to the 737 MAX flight control system;
- input on how the FAA certifies new technologies, in general;
- a complete program review of the 737 MAX certification program; and
- a technical assessment of the proposed software change to the MCAS portion of the flight control system.

Question 8a. Does the FAA entrust similar regulatory practices to their other manufacturing partners?

ANSWER. The FAA grants ODA authority based on the needs of the agency. There are 70 ODAs that hold design approval authority, with some ODA companies specializing in after-market modifications known as supplemental type certificates and some producing replacement parts under a Parts Manufacturing Approval. The larger companies that have ODAs may have several types of ODA authority. The FAA assesses all ODA applicants using the same rigorous criteria, including safety record, history of compliance, and technical capability. Each ODA is then delegated authority on a project-by-project basis according to those criteria.

Question 8b. Have there been lapses in safety information from those partners as well?

ANSWER. The FAA has a rigorous ODA oversight program. Each ODA must have a proven record of compliance assurance and is responsible for ensuring that its compliance assurance process is robust. ODAs are also charged with finding noncompliances and fixing their system as necessary to ensure no recurrence of noncompliances.

Annually, the FAA and the ODA company review performance using the ODA Scorecard process, implemented in 2016. The Scorecard captures any disconnects between the company and the FAA. To date, FAA review of Scorecards has not indicated any lapses in safety information. The FAA is always working to improve ODA processes, with the goal of certifying safe products.

Question 8c. Do you think the designee program may need to be revisited as a pitfall for coverup or error?

ANSWER. Delegation has been a key part of the FAA's authority for decades, and allows the FAA to leverage expertise and focus resources on the most safety-critical

issues. As evidence of the agency's strong commitment to continuous improvement, however, the FAA is constantly reviewing established processes in search of ways to improve effectiveness, and ensure allocated resources continue to target areas with the most significant safety implications.

Question 9. It is undeniable that concerns about the FAA/Boeing partnership have eroded public trust. What steps are your entities taking to mitigate these concerns as you set your sights on flying the planes?

ANSWER. The word "partnership" mischaracterizes how the FAA and a company work together. The FAA regulates companies to ensure their designs are compliant and safe. During certification, both the FAA and the company have defined roles and responsibilities. The FAA has similar relationships with all of the companies and ODA holders that we regulate.

The FAA has been meeting regularly with foreign civil aviation authorities (CAAs), industry groups, and airlines to provide updates on all activities. The FAA will continue this outreach to these entities as the airplane are returned to service. The following are examples of the many activities the FAA has led to provide information to these entities and address concerns raised.

The FAA, as the State-of-Design agent, has had ongoing engagement with countries that own and operate the 737 MAX. To keep technical experts around the globe apprised of 737 MAX-related efforts, the FAA conducted a series of 10 webinars in April and May to share information and provide technical assistance to many authorities in a number of areas.

On May 23, Acting Administrator Elwell hosted a meeting for Directors General from countries with 737 MAX airplanes. Fifty-nine representatives from 31 countries, along with representatives from the European Aviation Safety Agency and the International Civil Aviation Organization (ICAO), attended and participated in an open dialogue about the status of the 737 MAX fleet and the steps FAA intends to take to return the fleet to service in the United States. The FAA will continue this outreach to support these countries as they work through their own programs and processes to return their own 737 MAX fleets to service.

Acting Administrator Elwell also hosted a meeting with safety representatives of U.S. commercial airlines that fly the 737 MAX and pilots of those airlines. The interactive discussion addressed the 737 MAX flight control system, questions about pilot training, and the return to service process.

Once the design change is approved, there are several activities the FAA plans to conduct, including:

- Issuing a Continued Airworthiness Notification (CANIC);
- Issuing an Airworthiness Directive (AD);
- Amending or cancelling the grounding order;
- Issuing a public statement about the return to service; and
- Publishing the Flight Standardization Board report.

In addition, the FAA's Office of Communications will broadcast information worldwide through contact with media and news organizations, website postings, and updates to FAA's social media platforms. The FAA will continue to provide updates through these channels as they occur.

Question 9a. Would you agree that greater transparency in this process has the potential to optimize safety for pilots and passengers?

ANSWER. The FAA has made a strong effort to be transparent in executing its State-of-Design responsibilities. The FAA has shared actions, the timeline of what the agency knew and when, and the FAA process to certify a design change for the 737 MAX and ensure it is safe to fly. Both Secretary Chao and Acting Administrator Elwell have publicly stated that the FAA welcomes scrutiny of the established certification process, in general, and the certification of the 737 MAX and new technologies, specifically.

To these ends, the FAA is supporting, and in some cases leading, a number of reviews and audits currently underway. The Department of Transportation Office of the Inspector General has already begun its audit, and the work of the Joint Authorities Technical Review panel, the Technical Advisory Board, and Secretary Chao's Special Committee is ongoing.

Continuous improvement is part of the FAA's safety culture, and demands that the agency never stop looking for ways to strengthen its processes and improve safety. The findings and recommendations from these audits and panels will provide important input as the FAA continues to pursue improvements in established regulations, processes, and policies.

REPORT SUBMITTED BY FAA IN RESPONSE TO QUESTION 6 FROM HON. STEVE COHEN

Search Request No. 7284

B737 MAX Aircraft Safety Reports

March 14, 2019

Aviation Safety Reporting System
P.O. Box 189 | Moffett Field, CA | 94035-0189

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, CA 94035-1000

TH: 262-7

MEMORANDUM FOR: Recipients of Aviation Safety Reporting System Data

SUBJECT: Data Derived from ASRS Reports

The attached material is furnished pursuant to a request for data from the NASA Aviation Safety Reporting System (ASRS). Recipients of this material are reminded when evaluating these data of the following points.

ASRS reports are submitted voluntarily. Such incidents are independently submitted and are not corroborated by NASA, the FAA or NTSB. The existence in the ASRS database of reports concerning a specific topic cannot, therefore, be used to infer the prevalence of that problem within the National Airspace System.

Information contained in reports submitted to ASRS may be clarified by further contact with the individual who submitted them, but the information provided by the reporter is not investigated further. Such information represents the perspective of the specific individual who is describing their experience and perception of a safety related event.

After preliminary processing, all ASRS reports are de-identified and the identity of the individual who submitted the report is permanently eliminated. All ASRS report processing systems are designed to protect identifying information submitted by reporters; including names, company affiliations, and specific times of incident occurrence. After a report has been de-identified, any verification of information submitted to ASRS would be limited.

The National Aeronautics and Space Administration and its ASRS current contractor, Booz Allen Hamilton, specifically disclaim any responsibility for any interpretation which may be made by others of any material or data furnished by NASA in response to queries of the ASRS database and related materials.

BECKY L. HOOEY, DIRECTOR
NASA AVIATION SAFETY REPORTING SYSTEM

CAVEAT REGARDING USE OF ASRS DATA

Certain caveats apply to the use of ASRS data. All ASRS reports are voluntarily submitted, and thus cannot be considered a measured random sample of the full population of like events. For example, we receive several thousand altitude deviation reports each year. This number may comprise over half of all the altitude deviations that occur, or it may be just a small fraction of total occurrences.

Moreover, not all pilots, controllers, mechanics, flight attendants, dispatchers or other participants in the aviation system are equally aware of the ASRS or may be equally willing to report. Thus, the data can reflect **reporting biases**. These biases, which are not fully known or measurable, may influence ASRS information. A safety problem such as near midair collisions (NMACs) may appear to be more highly concentrated in area "A" than area "B" simply because the airmen who operate in area "A" are more aware of the ASRS program and more inclined to report should an NMAC occur. Any type of subjective, voluntary reporting will have these limitations related to quantitative statistical analysis.

One thing that can be known from ASRS data is that the number of reports received concerning specific event types represents the **lower measure** of the true number of such events that are occurring. For example, if ASRS receives 881 reports of track deviations in 2010 (this number is purely hypothetical), then it can be known with some certainty that at least 881 such events have occurred in 2010. With these statistical limitations in mind, we believe that the **real power** of ASRS data is the **qualitative information** contained in **report narratives**. The pilots, controllers, and others who report tell us about aviation safety incidents and situations in detail—explaining what happened, and more importantly, why it happened. Using report narratives effectively requires an extra measure of study, but the knowledge derived is well worth the added effort.

REPORT SYNOPSES

ACN: 1604159 (1 of 24)

Synopsis

B737 MAX8 Captain reported failure to descend as charted while flying the RNAV (RNP) Z approach to Runway 17R at DEN due to an FMC programming error.

ACN: 1603503 (2 of 24)

Synopsis

B737 MAX Captain reported departing with deferred maintenance and complex MEL, but noticed MEL sticker was not properly applied.

ACN: 1597380 (3 of 24) Reports 1597380 and 1597286 refer to the same event.

Synopsis

B737MAX Captain reported an autopilot anomaly in which led to an undesired brief nose down situation.

ACN: 1597286 (4 of 24) Reports 1597380 and 1597286 refer to the same event.

Synopsis

B737 MAX First Officer reported that the aircraft pitched nose down after engaging autopilot on departure. Autopilot was disconnected and flight continued to destination.

ACN: 1593701 (5 of 24)

Synopsis

B737 MAX8 First Officer reported an altitude deviation due to an intermediate level off by the aircraft automation.

ACN: 1593699 (6 of 24)

Synopsis

737MAX8 Captain reported a slot in the cockpit center pedestal allowed flight documents to slip through and collect on aircraft wire bundles.

ACN: 1593021 (7 of 24)

Synopsis

B737MAX Captain reported confusion regarding switch function and display annunciations related to "poor training and even poorer documentation".

ACN: 1593017 (8 of 24)

Synopsis

B737MAX Captain expressed concern that some systems such as the MCAS are not fully described in the aircraft Flight Manual.

ACN: 1590012 (9 of 24)

Synopsis

B737-MAX8 Captain reported the autothrottles failed to move to the commanded position during takeoff and climb.

ACN: 1587343 (10 of 24)

Synopsis

Off duty Flight Attendant reported being unable to see the B737 Max cabin safety demonstration because the passenger seats are too high.

ACN: 1583127 (11 of 24)

Synopsis

B737 MAX Captain reported an unstabilized approach into DEN due to human factors and aircraft familiarization.

ACN: 1583028 (12 of 24)

Synopsis

B737 MAX-8 Captain reported the engine fuel burn was higher than expected.

ACN: 1572630 (13 of 24)

Synopsis

B737 MAX-8 crew reported failing to follow the engine start procedure resulting in an aborted engine start.

ACN: 1568887 (14 of 24)

Synopsis

B737-800 Captain reported making a sudden stop to avoid a collision with a fuel truck on the ramp.

ACN: 1565207 (15 of 24)

Synopsis

B737NG Captain reported the aircraft Wi-Fi was not working in cruise, which affected the ability to access the flight plan on the iPad.

ACN: 1560763 (16 of 24)

Synopsis

B737-800 First Officer reported that departing out of BWI, the aircraft is unable to make the 17000ft. restriction at FOXHL on TERPZ 6 departure.

ACN: 1555013 (17 of 24)

Synopsis

B737 MAX First Officer reported feeling unprepared for first flight in the MAX, citing inadequate training.

ACN: 1550073 (18 of 24)

Synopsis

Maintenance personnel reported that on Boeing 737MAX, Maintenance Control is not receiving ACARS or Electronic Logbook write-ups the flight crew sends.

ACN: 1538699 (19 of 24)

Synopsis

B737 MAX pilots reported flying through the final approach course and descending below published altitudes due to confusion with the new style instrument displays.

ACN: 1517486 (20 of 24)

Synopsis

A pilot reported a tug driver and ramp crew did not follow proper procedures during pushback.

ACN: 1501507 (21 of 24)

Synopsis

B737 Max First Officer reported that the flight number disappears from the digital display after the aircraft has landed making it difficult to communicate with ATC from landing to the gate.

ACN: 1495437 (22 of 24)

Synopsis

B737-MAX Captain reported an unresolved threat of a wingtip strike during crosswind landing and takeoff operations.

ACN: 1488017 (23 of 24)

Synopsis

Captain reported procedural issues with the FMS on the 737-MAX in reference to descent capabilities.

ACN: 1486024 (24 of 24)

Synopsis

B737 Max flight crew reported that an Auto Shutdown of the Number Two engine on engine start was probably due to the First Officer activating the Isolation switch and the Pack switch during the start.

Report Narratives

ACN: 1604159

Time / Day

Date : 201812
Local Time Of Day : 0601-1200

Place

Locale Reference.Airport : DEN.Airport
State Reference : CO
Altitude.MSL.Single Value : 10500

Environment

Light : Daylight

Aircraft

Reference : X
ATC / Advisory.TRACON : D01
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Flight Phase : Initial Approach
Airspace.Class B : DEN

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 501
Experience.Flight Crew.Type : 11195
ASRS Report Number.Accession Number : 1604159
Human Factors : Human-Machine Interface
Human Factors : Situational Awareness

Events

Anomaly.Deviation—Altitude : Undershoot
Anomaly.Deviation—Altitude : Excursion From Assigned Altitude
Anomaly.Deviation—Procedural : Clearance
Detector.Person : Flight Crew
Detector.Person : Air Traffic Control
When Detected : In-flight
Result.Flight Crew : Returned To Clearance
Result.Flight Crew : Became Reoriented
Result.Air Traffic Control : Issued Advisory / Alert

Assessments

Contributing Factors / Situations : Human Factors

Primary Problem : Human Factors

Narrative: 1

We planned for the Visual to Runway 16L and talked about the possible assignment to 17R. When checking in with Approach we were advised to expect 17R. We briefed and programmed the RNP Z 17R. AS we approached the IAF I was preparing for what to do (i.e. what fix to use based on location of active waypoint) and/or the state of the IAF (i.e. active waypoint or not). To the best of my recollection, the IAF was on LSK L2, then I placed it IAF under IAF, although a review after the fact stated we "could" place in on top of it. We both complied with VVMI prior to execution. The aircraft continued on downwind with no descent. Almost simultaneously, as we noticed the wrong picture on the MAP display, the Controller asked us if we were descending. By this time I had disconnected automation and was following the purple line while both of us were monitoring altitude restrictions based on our clearance. The Pilot Monitoring reprogrammed the approach and the rest of the flight was uneventful. No further calls from ATC, altitude, or course deviations occurred. Consider calling the field in sight and requesting visual approach. We do believe that the IAF (since we were close to it) might have auto-sequenced from L2 to L1 (active), and as we know the programming in this case would have been different. Therefore, maybe a closer look at the distance remaining to the active waypoint might have helped prevent this situation.

Synopsis

B737 MAX8 Captain reported failure to descend as charted while flying the RNAV (RNP) Z approach to Runway 17R at DEN due to an FMC programming error.

ACN: 1603503

Time / Day

Date : 201812

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Weather Elements / Visibility : Rain
Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Parked

Component

Aircraft Component : Aerofoil Ice System
Aircraft Reference : X
Problem : Malfunctioning

Person

Reference : 1
Location Of Person : Company
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 357
ASRS Report Number.Accession Number : 1603503
Human Factors : Time Pressure
Human Factors : Confusion

Human Factors : Distraction

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation—Procedural : Published Material / Policy
Anomaly.Deviation—Procedural : MEL
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Became Reoriented

Assessments

Contributing Factors / Situations : Chart Or Publication
Contributing Factors / Situations : Equipment / Tooling
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Weather
Contributing Factors / Situations : MEL
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

ZZZ had terrible weather. We were already hours late when our aircraft arrived. The previous crew wrote up wing anti- ice not working. Outstation Maintenance arrived, and Dispatch and I determined that we could depart with a MEL (Minimum Equipment List) that allows us to fly in icing conditions. MEL was VERY complex and confusing. It required us to start a [B737] Max 8 with an air cart and start the number 2 engine first. I was concerned about the Safety of doing that in the dark and in heavy rain, so I made sure the ground crew and I were completely confident in our procedures.

A new release with MEL arrived, logbook was completed by Outstation Maintenance, and we began the process of starting the number 2 engine. During that time, we also were dealing with three different runway changes at ZZZ (XXL then XYL then XZL) which also meant three different SIDS (Standard instrument Departure) and complete re-briefing of takeoff, departure and engine out procedures. Also had to coordinate a crossbleed start. Then, our release expired and we had to get with Dispatch to reload the flight.

Amid all these distractions, we didn't realize that Maintenance never placed a sticker in the flight deck or logbook. I reviewed the logbook after Maintenance was done, but totally forgot about the stickers. I guess the major distraction was how the MEL and the MAX 8 AOM (Aircraft Operations Manual) differed with each other on this procedure, and lack of clear directions on working with this MEL. Flight was completed in ZZZ1 and we went to the hotel. I think a clearer AOM or MEL is needed on this problem.

Synopsis

B737 MAX Captain reported departing with deferred maintenance and complex MEL, but noticed MEL sticker was not properly applied.

ACN: 1597380 Reports 1597380 and 1597286 refer to the same event.

Time / Day

Date : 201811

Place

Locale Reference.ATC Facility : ZZZ.TRACON
State Reference : US
Altitude.MSL.Single Value : 2000

Environment

Weather Elements / Visibility : Snow
Weather Elements / Visibility : Rain

Aircraft

Reference : X
ATC / Advisory.TRACON : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121

Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Flight Phase : Climb
Airspace.Class B : ZZZ

Component

Aircraft Component : Autoflight System
Aircraft Reference : X
Problem : Malfunctioning

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 626
ASRS Report Number.Accession Number : 1597380
Human Factors : Human-Machine Interface
Human Factors : Confusion

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Detector.Automation : Aircraft Other Automation
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : FLC Overrode Automation
Result.Flight Crew : Overcame Equipment Problem
Result.Aircraft : Equipment Problem Dissipated

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Primary Problem : Aircraft

Narrative: 1

It was day three of six for me and day three with very good FO (First Officer). Well rested, great rapport and above average Crew coordination. Knew we had a MAX. It was my leg, normal Ops Brief, plus I briefed our concerns with the MAX issues, bulletin, MCAS, stab trim cutout response etc. I mentioned I would engage autopilot sooner than usual (I generally hand fly to at least above 10,000 ft.) to remove the possible MCAS threat.

Weather was about 1000 OVC drizzle, temperature dropping and an occasional snow flake. I double checked with an additional personal walkaround just prior to push; a few drops of water on the aircraft but clean aircraft, no deice required. Strong crosswind and I asked Tug Driver to push a little more tail east so as not to have slow/hung start gusts 30+.

Wind and mechanical turbulence was noted. Careful engine warm times, normal flaps 5 takeoff in strong (appeared almost direct) crosswind. Departure was normal. Takeoff and climb in light to moderate turbulence. After flaps 1 to "up" and above clean "MASI up speed" with LNAV engaged I looked at and engaged A Autopilot. As I was returning to my PFD (Primary Flight Display) PM (Pilot Monitoring) called "DESCENDING" followed by almost an immediate: "DONT SINK DONT SINK!"

I immediately disconnected AP (Autopilot) (it WAS engaged as we got full horn etc.) and resumed climb. Now, I would generally assume it was my automation error, i.e., aircraft was trying to acquire a miss-commanded speed/no autothrottles, crossing restriction etc., but frankly neither of us could find an inappropriate setup error (not to say there wasn't one).

With the concerns with the MAX 8 nose down stuff, we both thought it appropriate to bring it to your attention. We discussed issue at length over the course of the return to ZZZ. Best guess from me is airspeed fluctuation due to mechanical shear/frontal passage that overwhelmed automation temporarily or something incorrectly setup in MCP (Mode Control Panel). PM's callout on "descending" was par-

ticularly quick and welcome as I was just coming back to my display after looking away. System and procedures coupled with CRM (Resource Management) trapped and mitigated issue.

Synopsis

B737MAX Captain reported an autopilot anomaly in which led to an undesired brief nose down situation.

ACN: 1597286 Reports 1597380 and 1597286 refer to the same event.

Time / Day

Date : 201811

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.MSL.Single Value : 2000

Aircraft

Reference : X
ATC / Advisory.Tower : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Flight Phase : Takeoff
Airspace.Class C : ZZZ

Component

Aircraft Component : Autopilot
Aircraft Reference : X
Problem : Malfunctioning

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : First Officer
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 511
ASRS Report Number.Accession Number : 1597286
Analyst Callback : Attempted

Events

Anomaly.Aircraft Equipment Problem : Critical
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Regained Aircraft Control

Assessments

Contributing Factors / Situations : Aircraft
Primary Problem : Aircraft

Narrative: 1

Day 3 of 3 departing in a MAX 8 after a long overnight. I was well rested and had discussed the recent MAX 8 MCAS guidance with the Captain. On departure, we had strong crosswinds (gusts > 30 knots) directly off the right wing, however, no LLWS or Micro-burst activity was reported at the field. After verifying LNAV, selecting gear and flaps up, I set "UP" speed. The aircraft accelerated normally and the Captain engaged the "A" autopilot after reaching set speed. Within two to three seconds the aircraft pitched nose down bringing the VSI to approximately 1,200 to

1,500 FPM. I called "descending" just prior to the GPWS sounding "don't sink, don't sink." The Captain immediately disconnected the autopilot and pitched into a climb. The remainder of the flight was uneventful. We discussed the departure at length and I reviewed in my mind our automation setup and flight profile but can't think of any reason the aircraft would pitch nose down so aggressively.

Synopsis

B737 MAX First Officer reported that the aircraft pitched nose down after engaging autopilot on departure. Autopilot was disconnected and flight continued to destination.

ACN: 1593701

Time / Day

Date : 201811
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.MSL.Single Value : 33000

Environment

Light : Daylight

Aircraft

Reference : X
ATC / Advisory.Center : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Flight Phase : Climb
Airspace.Class A : ZZZ

Component

Aircraft Component : FMS/FMC
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 454
Experience.Flight Crew.Type : 454
ASRS Report Number.Accession Number : 1593701
Human Factors : Distraction
Human Factors : Training / Qualification

Events

Anomaly.Deviation—Altitude : Undershoot
Anomaly.Deviation—Procedural : Clearance
Result.Flight Crew : Returned To Clearance

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

We were climbing from FL 330 given a clearance to FL 360. Aircraft briefly leveled at initial cruise altitude FL 340 before Aircrew intervention. [Center] queried if we received the clearance to FL 360. As a result of the brief delay [Center] issued brief off course vectors to both us and converging traffic. Causal factors were equipment: not much experience in MAX-800, as a result, still have to search for everything. Automation: Upon receipt of FL 360 clearance and after the Captain dialed the MCP Altitude 36,000 FT, I should have, but failed to, ensured the cruise altitude reflected FL 360. Engaging the ALT INTV button would have facilitated the process. The solution is to Verify/Verbalize/Monitor. Verifying the CDU cruise altitude (NAV 2/3) would have prevented the temporary level off. Monitoring would have mitigated the delay at FL 340 but could have been timelier. As a relatively new First Officer, I had not seen this issue. However, I could have done a better job with VVM (Verbalize, Verify, Monitor) to back up the Captain with his duties while flying. Had I seen the momentary level off, I might have been able to alert ATC of it, avoiding any confusion or deviation of what the expectations were.

Synopsis

B737 MAX8 First Officer reported an altitude deviation due to an intermediate level off by the aircraft automation.

ACN: 1593699

Time / Day

Date : 201811
Local Time Of Day : 0601-1200

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Daylight

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Parked

Component

Aircraft Component : Cockpit Furnishing
Manufacturer : Boeing
Aircraft Reference : X
Problem : Design

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 428
ASRS Report Number.Accession Number : 1593699

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Flight Deck / Cabin / Aircraft Event : Other / Unknown
Were Passengers Involved In Event : N

When Detected : Pre-flight

Assessments

Contributing Factors / Situations : Equipment / Tooling
Primary Problem : Equipment / Tooling

Narrative: 1

ATIS sheet fell through the slot forward of the center pedestal and the blank off plate. We had Maintenance come out to remove it. We discovered 20 other ATIS sheets mixed into the wiring. The aircraft is only six months old. Severe potential fire hazard!

Synopsis

737MAX8 Captain reported a slot in the cockpit center pedestal allowed flight documents to slip through and collect on aircraft wire bundles.

ACN: 1593021

Time / Day

Date : 201811

Place

Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Next Generation Undifferentiated
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Flight Phase : Parked

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Total : 21200
Experience.Flight Crew.Last 90 Days : 178
Experience.Flight Crew.Type : 3342
ASRS Report Number.Accession Number : 1593021
Human Factors : Training / Qualification
Human Factors : Confusion

Events

Anomaly.Deviation—Procedural : Published Material / Policy
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Manuals
Contributing Factors / Situations : Procedure
Primary Problem : Manuals

Narrative: 1

This was the first flight on a Max for both pilots. Unfamiliarity with flight deck displays led to confusion about display annunciations and switch function. The Flight Manual does not address at least one annunciation, or the controls for the display—or if it does, neither pilot could find the explanation. I have spent literally

days looking for an explanation, could not find one, and that is why I wrote this report. It shouldn't be this hard to figure out what I'm looking at.

On the First Officer side ND, on the ground only, there is a MAINT annunciation. We both saw it, couldn't find any immediate explanation for it on the ground, and didn't address it until airborne. I researched the FM (Flight Manual) for an explanation, accomplishing a word search of the term MAINT. There are only two references I could find: the overhead MAINT light (a no go item) and the CDS MAINT light (a QRH item). There is no explanation of the ND MAINT annunciation.

We spent the entire hour flight trying to find the meaning of this annunciation and came up empty handed. We determined to check it out once we landed (if the light came on again). Sure enough, after parking, the MAINT annunciation came back on the ND display. We called Maintenance to check out the light. We waited to make an ELB entry, unsure if one was required. Turned out, an ELB entry was not required.

The mechanic explained the light was part of a menu for maintenance use only on the ground.

In addition, there are two selector knobs that are under-explained (i.e., not explained) in the manual, and we were uncertain what their purpose was. One is under the Fuel Flow switch and the other under the MFD/ENG TFR display switch. These knobs don't seem to work in flight. The First Officer offered to hit the SEL function in flight, to test it out, but I thought something irreversible or undesirable might happen (not knowing what we were actually selecting), so we did not try it out in flight. The mechanic later explained SEL on the First Officer side was used on the ground by maintenance to toggle between the maintenance functions. I forgot to ask what my side did, and still don't know.

Finally, in the Captain's preflight procedure in the bulletin, it says, "Selector . . . C". What selector is this referring to? Is this the same selector under the Fuel Flow switch, (which is shown in the MAX panels on the L position, as if that is the normal position?) This is very poorly explained. I have no idea what switch the preflight is talking about, nor do I understand even now what this switch does.

I think this entire setup needs to be thoroughly explained to pilots. How can a Captain not know what switch is meant during a preflight setup? Poor training and even poorer documentation, that is how.

It is not reassuring when a light cannot be explained or understood by the pilots, even after referencing their flight manuals. It is especially concerning when every other MAINT annunciation means something bad. I envision some delayed departures as conscientious pilots try to resolve the meaning of the MAINT annunciation and which switches are referred to in the setup.

Synopsis

B737MAX Captain reported confusion regarding switch function and display annunciations related to "poor training and even poorer documentation".

ACN: 1593017

Time / Day

Date : 201811

Place

Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Next Generation Undifferentiated
Flight Phase.Other

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 1593017
Human Factors : Confusion
Human Factors : Training / Qualification

Events

Anomaly.Deviation—Procedural : Published Material / Policy
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Manuals
Primary Problem : Manuals

Narrative: 1

The recently released 737 MAX8 Emergency Airworthiness Directive directs pilots how to deal with a known issue, but it does nothing to address the systems issues with the AOA system.

MCAS (Maneuvering Characteristics Augmentation System) is implemented on the 737 MAX to enhance pitch characteristics with flaps UP and at elevated angles of attack. The MCAS function commands nose down stabilizer to enhance pitch characteristics during steep turns with elevated load factors and during flaps up flight at airspeeds approaching stall. MCAS is activated without pilot input and only operates in manual, flaps up flight. The system is designed to allow the flight crew to use column trim switch or stabilizer aisle stand cutout switches to override MCAS input. The function is commanded by the Flight Control computer using input data from sensors and other airplane systems.

The MCAS function becomes active when the airplane Angle of Attack exceeds a threshold based on airspeed and altitude. Stabilizer incremental commands are limited to 2.5 degrees and are provided at a rate of 0.27 degrees per second. The magnitude of the stabilizer input is lower at high Mach number and greater at low Mach numbers. The function is reset once angle of attack falls below the Angle of Attack threshold or if manual stabilizer commands are provided by the flight crew. If the original elevated AOA condition persists, the MCAS function commands another incremental stabilizer nose down command according to current aircraft Mach number at actuation.

This description is not currently in the 737 Flight Manual Part 2, nor the Boeing FCOM, though it will be added to them soon. This communication highlights that an entire system is not described in our Flight Manual. This system is now the subject of an AD.

I think it is unconscionable that a manufacturer, the FAA, and the airlines would have pilots flying an airplane without adequately training, or even providing available resources and sufficient documentation to understand the highly complex systems that differentiate this aircraft from prior models. The fact that this airplane requires such jury rigging to fly is a red flag. Now we know the systems employed are error prone—even if the pilots aren't sure what those systems are, what redundancies are in place, and failure modes.

I am left to wonder: what else don't I know? The Flight Manual is inadequate and almost criminally insufficient. All airlines that operate the MAX must insist that Boeing incorporate ALL systems in their manuals.

Synopsis

B737MAX Captain expressed concern that some systems such as the MCAS are not fully described in the aircraft Flight Manual.

ACN: 1590012

Time / Day

Date : 201810
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 1000

Environment

Light : Daylight

Aircraft

Reference : X
ATC / Advisory.Tower : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Takeoff
Airspace.Class C : ZZZ

Component

Aircraft Component : Autothrottle/Speed Control
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Qualification.Flight Crew : Instrument
Experience.Flight Crew.Last 90 Days : 419
ASRS Report Number.Accession Number : 1590012
Human Factors : Confusion

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation—Speed : All Types
Anomaly.Deviation—Procedural : Published Material / Policy
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Overcame Equipment Problem

Assessments

Contributing Factors / Situations : Aircraft
Primary Problem : Aircraft

Narrative: 1

After 1000 feet I noticed a decrease in aircraft performance. I picked up that the autothrottles were not moving to commanded position even though they were engaged. I'm sure they were set properly for takeoff but not sure when the discrepancy took place. My scan wasn't as well developed since I've only flown the MAX once before. I manually positioned the thrust levers ASAP. This resolved the threat, we were able to increase speed to clean up and continue the climb to 3000 feet.

Shortly afterwards I heard about the (other carrier) accident and am wondering if any other crews have experienced similar incidents with the autothrottle system on the MAX? Or I may have made a possible flying mistake which is more likely. The FO (First Officer) was still on his first month and was not able to identify whether it was the aircraft or me that was in error.

Synopsis

B737-MAX8 Captain reported the autothrottles failed to move to the commanded position during takeoff and climb.

ACN: 1587343

Time / Day

Date : 201810

Place

Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Next Generation Undifferentiated
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Taxi

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : General Seating Area
Reporter Organization : Air Carrier
Function.Flight Attendant : Off Duty
Qualification.Flight Attendant : Current
ASRS Report Number.Accession Number : 1587343
Human Factors : Situational Awareness

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation—Procedural : FAR
Anomaly.Deviation—Procedural : Published Material / Policy
Detector.Person : Passenger
Detector.Person : Flight Attendant
Were Passengers Involved In Event : Y
When Detected : Taxi
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Primary Problem : Aircraft

Narrative: 1

I was pass riding this flight on the new 737 Max. From my seat towards the rear of the aircraft, with seats that appear to be higher, it was impossible to see the Flight Attendant perform the safety demo. It was brought to my attention when overhearing a nearby passenger comment that they could not see the demo asking if they were supposed to be able to see it.

Synopsis

Off duty Flight Attendant reported being unable to see the B737 Max cabin safety demonstration because the passenger seats are too high.

ACN: 1583127

Time / Day

Date : 201810
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : DEN.Airport
State Reference : CO
Altitude.MSL.Single Value : 7000

Environment

Flight Conditions : VMC

Aircraft

Reference : X
ATC / Advisory.Tower : DEN
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Flight Phase : Initial Approach

Airspace.Class B : DEN

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Qualification.Flight Crew : Instrument
Experience.Flight Crew.Total : 18000
ASRS Report Number.Accession Number : 1583127
Human Factors : Situational Awareness

Events

Anomaly.Deviation—Procedural : Published Material / Policy
Anomaly.Inflight Event / Encounter : Unstabilized Approach
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

The purpose of this [report] is to explain a situation where I unintentionally used a high rate of descent to recapture a glide path landing in DEN in a 737 MAX. I have flown the MAX a few times [before] but this was the first time I've flown it in a high density altitude airport. The landing was uneventful and I felt like I was in control the entire final approach but the rate of descent was higher than I anticipated or normally use due to my hesitancy to quickly revert from reliance on technology to visual approach procedures. I understand the emphasis on visual approaches in training and safety.

After an uneventful flight to DEN we were given a left downwind turn to base for DEN runway 16L outside of LEETS at 7000 feet. It was a clear night so I accepted the visual when offered and slowed appropriately for the final decent. To increase my familiarity of the MAX, prior to top of descent, I briefed and intended to engage ARM III below 5000 feet AGL and set up the HUD to do so. As we neared LEETS I pushed the Approach ARM button (with 7000 feet in the MCP) but my attention was outside and on the flight display system when I made a rookie mistake. I didn't notice that the Approach mode did not arm.

I have flown the 737 MAX a few times and was familiar with, what I believe to be, slightly different descent characteristics. Also, I armed the speed brakes but apparently when I did so the handle was slightly past the detent. I don't know if the ARM switch wouldn't engage as a result of this or not? Also I don't know if the Landing Attitude Modifier behaves differently due to the speed brake handle not precisely set in detent? Of course since I had 7000 feet in the MCP as we flew past LEETS I lost vertical path display and in the moment(s) it took to evaluate what was happening, I got high on path.

The vertical guidance displays were now unusable so I abandoned the idea of the CAT III practice and adjusted to a high rate of descent to visually get on the PAPI. Since DEN is 5434 feet I rationalized that a higher descent rate was appropriate due to the high density altitude and called "stable" at 1000 feet with a 1200 feet rate of descent but correcting. When I adjusted the throttles, the speed brake green light went to amber and the FO (First Officer) quickly and correctly armed the speed brake. I didn't get enough power in soon enough and ended up getting three reds on the PAPI and a "Glide Slope" announcement to which I adjusted up to regain path. I continued to an uneventful landing.

As a result of this situation which happened very quickly, I will 1) recommit to confirming buttons arm when pushed, 2) recommit to confirming the speed brake handle is fully in the arm detent (in addition to the green arm light) 3) react more swiftly to visual methods (or go around) when appropriate when displays don't appear as expected and 4) continue to ensure stabilized approaches or go around as necessary.

Synopsis

B737 MAX Captain reported an unstabilized approach into DEN due to human factors and aircraft familiarization.

ACN: 1583028

Time / Day

Date : 201809

Environment

Light : Daylight

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Next Generation Undifferentiated
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Nav In Use : GPS
Flight Phase : Cruise

Component

Aircraft Component : Powerplant Fuel System
Aircraft Reference : X
Problem : Malfunctioning

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 420
Experience.Flight Crew.Type : 9000
ASRS Report Number.Accession Number : 1583028
Human Factors : Troubleshooting

Events

Anomaly.Deviation—Procedural : Weight And Balance
Anomaly.Deviation—Procedural : Published Material / Policy
Anomaly.Inflight Event / Encounter : Fuel Issue
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Primary Problem : Aircraft

Narrative: 1

My concern is that some MAX 8 aircraft are burning significantly more fuel than what is calculated on the Dispatch release. Perhaps the fuel bias on these aircraft needs to be reevaluated. On this particular flight, the burn rate was so high that the Pilots referred to the MAX AOM (Aircraft Operator Manual) to look up what constitutes a fuel leak. Our flight plan fuel was for a burn of 21,600 pounds from push to touchdown. Our actual burn was 22,900 pounds (actual fuel load of 28,100 at push minus our 5,200 pounds at touchdown. We pulled into the gate with 5,000 pounds). This was 1,300 pounds more fuel burned than planned.

Other than a direct to ZZZ shortly after departing ZZZ1, we flew the flight planned altitude and routing. I also slowed to .76 Mach a couple of times for pockets of turbulence. Winds were close to flight plan and there was minimal off-course ma-

neuvering to avoid a couple of buildups. Based on another long MAX 8 flights where we burned more than flight plan, I kept a detailed fuel log this flight. We pushed with 700 pounds fuel more than flight plan. Fifty minutes into the flight we were plus 500 pounds of fuel over flight plan.

At 1+20 into the flight, we were plus 300 pounds. At 1+49 we were at the calculated flight plan fuel. Eleven minutes later we were at -300 pounds from flight planned fuel. Around that point we contacted Dispatch through ACARS to let them know our fuel was not trending well. We got into the books and ran the Fuel Leak QRH just in case. The flight attendants scanned the engines and the wings. Everything checked out ok with respect to the QRH, except we had an unusual fuel burn. Dispatch, the FO (First Officer), and I came up with a plan to update our status over ZZZ and also over ZZZ2. At 2+11, we were -500 pounds for fuel. The fuel trend stayed constant at -500 pounds from flight plan for the duration of the flight from that point onward.

The weather was VFR at ZZZ3 so we elected to continue over ZZZ and also ZZZ2. I was concerned as my calculations had us landing with less than 5,000 pounds. Dispatch said his calculations had us landing with 6,300 pounds. Dispatch was very helpful throughout the majority of the flight providing updates on weather and asking our fuel status. Dispatch also asked that I call him after landing. We landed uneventfully other than fuel being 900 pounds lower than the Dispatch Release after flying the flight plan. After landing, I walked around the aircraft and went into the main gear well. My concern was a potential fuel leak. I noted none nor any abnormal fuel smells.

After that, I called Dispatch and we had a conference call with Maintenance. The Maintenance Controller said they were noting that several MAX 8 aircraft are not fuel efficient. He said they think the Boeing-recommended engine cleaning cycle is not frequent enough. I was told during this call that when the LEAP engines are dirty they lose all of their efficiency. If this is the case, shouldn't the fuel bias on these aircraft be adjusted accordingly? From now on, I am going to plan on an extra 400 pounds per hour of fuel on each MAX 8 I fly on a leg longer than two and a half hours.

Synopsis

B737 MAX-8 Captain reported the engine fuel burn was higher than expected.

ACN: 1572630

Time / Day

Date : 201808
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Daylight

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Taxi

Component

Aircraft Component : Engine Starting System
Aircraft Reference : X
Problem : Improperly Operated

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck

Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 354
ASRS Report Number.Accession Number : 1572630
Human Factors : Other / Unknown

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : First Officer
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Qualification.Flight Crew : Instrument
ASRS Report Number.Accession Number : 1573224
Human Factors : Other / Unknown

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation—Procedural : Published Material / Policy
Detector.Automation : Aircraft Other Automation
When Detected : Taxi
Result.Flight Crew : Overcame Equipment Problem

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Manuals
Primary Problem : Human Factors

Narrative: 1

We were pushing back from the gate in a MAX 8 and were starting the number 2 engine. The FO (First Officer) configured the air conditioning panel before the tick on the EGT was gone, causing the EEC (Electronic Engine Controller) to abort the engine start. Once we saw the white box flashing, we aborted the engine start, reviewed the QRC, and followed the QRH guidance. After confirming with Maintenance (and a review of the [operation manual]) a second successful start was made.

We conducted a briefing about the MAX engine start and the items that we were going to see, and time limits associated during our normal preflight briefings. I was very surprised when the aborted start happened due to the fact that we had reviewed the start process. I will continue to brief the engine start procedures with a bigger emphasis on the EGT roll back.

Narrative: 2

[Report narrative contained no additional information.]

Synopsis

B737 MAX-8 crew reported failing to follow the engine start procedure resulting in an aborted engine start.

ACN: 1568887

Time / Day

Date : 201808
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Flight Conditions : VMC
Light : Night

Aircraft

Reference : X
ATC / Advisory.Ramp : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Taxi

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 11000
ASRS Report Number.Accession Number : 1568887
Human Factors : Situational Awareness

Events

Anomaly.Conflict : Ground Conflict, Critical
Detector.Person : Flight Crew
When Detected : Taxi
Result.Flight Crew : Took Evasive Action

Assessments

Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

Upon taxi into gate, [guidance system] was active, both pilots cleared ramp area. Approximately 20 ft remaining FO yells for me to stop. I immediately stopped aircraft and FO [advised] fueler was backing up into our safety zone. We were in a B737 MAX with the split winglets and thus the clearance provided below the wingtip was considerably less. After speaking with ramp [personnel] who reviewed the ramp video, I believe the monitoring and quick response of the FO averted possible damage or impact to aircraft. Ramp fueler personnel inattentive to position on ramp. [Not] all ramp personnel may be accustomed to the 737 MAX winglet design and the increased clearance required. Training for this may be beneficial.

Synopsis

B737-800 Captain reported making a sudden stop to avoid a collision with a fuel truck on the ramp.

ACN: 1565207

Time / Day

Date : 201808

Place

Altitude.MSL.Single Value : 33000

Environment

Flight Conditions : VMC

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Next Generation Undifferentiated
Crew Size.Number Of Crew : 2

Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Cruise

Component : 1

Aircraft Component : Data Transmission and Automatic Calling
Aircraft Reference : X
Problem : Malfunctioning

Component : 2

Aircraft Component : Other Documentation
Aircraft Reference : X

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Multiengine
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Last 90 Days : 50
Experience.Flight Crew.Type : 2978
ASRS Report Number.Accession Number : 1565207

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Overcame Equipment Problem

Assessments

Contributing Factors / Situations : Aircraft
Primary Problem : Aircraft

Narrative: 1

At cruise flight, our Wi-Fi stopped working. I then saw that I was unable to access the Pilot Mobile app. Since I do not routinely copy the flight plan to iBook or acrobat (we are not required to do this), I was unable to access the flight plan. I've lost Wi-Fi before but not had this problem. Maybe it's a 737max thing. My First Officer had a copy on iBook and airdropped it to me. Later we were able to restore the Wi-Fi and I could login to pilot mobile but the [flight plan] was not there anymore.

Synopsis

B737NG Captain reported the aircraft Wi-Fi was not working in cruise, which affected the ability to access the flight plan on the iPad.

ACN: 1560763

Time / Day

Date : 201807
Local Time Of Day : 0601-1200

Place

Locale Reference.Airport : BWI.Airport
State Reference : MD
Altitude.MSL.Single Value : 17000

Environment

Light : Daylight

Aircraft

Reference : X
ATC / Advisory.TRACON : PCT
Aircraft Operator : Air Carrier

Make Model Name : B737-800
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Nav In Use : GPS
Flight Phase : Climb
Route In Use.SID : TERPZ 6
Airspace.Class E : PCT

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : First Officer
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Qualification.Flight Crew : Instrument
Experience.Flight Crew.Last 90 Days : 230
Experience.Flight Crew.Type : 1600
ASRS Report Number.Accession Number : 1560763

Events

Anomaly.Deviation—Altitude : Crossing Restriction Not Met
Anomaly.Deviation—Procedural : Published Material / Policy
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Airspace Structure
Primary Problem : Airspace Structure

Narrative: 1

I have flown out of BWI on the TERPZ 6 to either OTTTO or RAMAY the last three weeks. Each time I have flown a 737-800 or MAX8. The first two times in the 737-800 we had to adjust our climb out speed below the ECON Schedule (which was around 300) to make the 17,000ft., or above restriction at FOXHL (FMC warnings were received "unable next altitude"). In the 737 MAX8, it was less. So by starting early to adjust our profile we were able to meet the restriction. It appears like a trend that heavy 737-800 aircraft in summertime will have a hard time meeting the climb restriction, and if you do not catch it soon enough you may not make the FOXHL restriction.

[Suggestion].In the Departure Section of the SID add a note. If departing the TERPZ 6 to OTTTO or RAMAY be aware that high gross weights and hot temperatures may not allow you to climb via the FMC ECON Speed and meet the 17,000ft., or above restriction at FOXHL.

Synopsis

B737-800 First Officer reported that departing out of BWI, the aircraft is unable to make the 17000ft. restriction at FOXHL on TERPZ 6 departure.

ACN: 1555013

Time / Day

Date : 201806

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Aircraft

Reference : X

Aircraft Operator : Air Carrier
Make Model Name : B737 Undifferentiated or Other Model
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Flight Phase : Parked

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Total : 10861
Experience.Flight Crew.Type : 1660
ASRS Report Number.Accession Number : 1555013
Human Factors : Human-Machine Interface
Human Factors : Training / Qualification

Events

Anomaly.Deviation—Procedural : Published Material / Policy
Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Manuals
Contributing Factors / Situations : Procedure
Primary Problem : Company Policy

Narrative: 1

I had my first flight on the Max [to] ZZZ1. We found out we were scheduled to fly the aircraft on the way to the airport in the limo. We had a little time [to] review the essentials in the car. Otherwise we would have walked onto the plane cold.

My post flight evaluation is that we lacked the knowledge to operate the aircraft in all weather and aircraft states safely. The instrumentation is completely different—My scan was degraded, slow and labored having had no experience w/ the new ND (Navigation Display) and ADI (Attitude Director Indicator) presentations/format or functions (manipulation between the screens and systems pages were not provided in training materials. If they were, I had no recollection of that material).

We were unable to navigate to systems pages and lacked the knowledge of what systems information was available to us in the different phases of flight. Our weather radar competency was inadequate to safely navigate significant weather on that dark and stormy night. These are just a few issues that were not addressed in our training.

I recommend the following to help crews w/ their introductory flight on the Max: Email notification the day before the flight (the email should include: Links—Training Video, PSOB and QRG and all relevant updates/FAQ's) SME (Subject Matter Expert) Observer—the role of the SME is to introduce systems navigation, display management, answer general questions and provide standardized best practices to the next generation aircraft.

Additionally, the SME will collect de-identified data to provide to the training department for analysis and dissemination to the line pilots regarding FAQs and know systems differences as well best practices in fly the new model aircraft.

Synopsis

B737 MAX First Officer reported feeling unprepared for first flight in the MAX, citing inadequate training.

ACN: 1550073

Time / Day

Date : 201806

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Next Generation Undifferentiated
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Flight Phase : Cruise

Component

Aircraft Component : Air/Ground Communication
Aircraft Reference : X
Problem : Design

Person

Reference : 1
Location Of Person : Company
Reporter Organization : Air Carrier
Function.Maintenance : Other / Unknown
ASRS Report Number.Accession Number : 1550073
Human Factors : Communication Breakdown
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Flight Crew

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation—Procedural : Published Material / Policy
Detector.Person : Maintenance
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Equipment / Tooling
Primary Problem : Ambiguous

Narrative: 1

Ever since the 737MAX, it seems most 737 controllers are not getting ACARS messages or Electronic Logbook write-ups the crew sends. The messages are not coming through on Maintenance Control ACARS/ELB page or through the Maintenance Control's alert manager application.

Yesterday on a flight, I received a call from dispatch asking if I could answer the crew. Since I had not received any messages and no other controllers had either we were in the dark. Dispatcher gave me the info I proceeded to reply to Captain's inquiry, also telling him to message both dispatch and Maintenance Control, as we were not receiving the messages from him. We never got a response, but dispatch called and said Captain received our message and problem was resolved.

After this situation, I decided to try and test it out on another aircraft, which had just arrived in our base. I sent a test log page. Again, we did not receive any pop up on Maintenance Control [page] or Maintenance Control's alert manager informing us of the write-up.

Synopsis

Maintenance personnel reported that on Boeing 737MAX, Maintenance Control is not receiving ACARS or Electronic Logbook write-ups the flight crew sends.

ACN: 1538699

Time / Day

Date : 201804

Place
Locale Reference.ATC Facility : ZZZ.TRACON
State Reference : US
Relative Position.Distance.Nautical Miles : 15
Altitude.MSL.Single Value : 3000

Environment
Flight Conditions : VMC

Aircraft
Reference : X
ATC / Advisory.TRACON : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737 Undifferentiated or Other Model
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Initial Approach
Airspace.Class B : ZZZ

Person : 1
Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Last 90 Days : 496
Experience.Flight Crew.Type : 2200
ASRS Report Number.Accession Number : 1538699
Human Factors : Situational Awareness
Human Factors : Human-Machine Interface
Human Factors : Training / Qualification
Human Factors : Distraction

Person : 2
Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Multiengine
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Instrument
Experience.Flight Crew.Last 90 Days : 327
ASRS Report Number.Accession Number : 1538699
Human Factors : Troubleshooting
Human Factors : Confusion
Human Factors : Human-Machine Interface

Events
Anomaly.Deviation—Altitude : Overshoot
Anomaly.Deviation—Track / Heading : All Types
Anomaly.Deviation—Procedural : Clearance
Detector.Automation : Aircraft Other Automation
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : FLC Overrode Automation
Result.Flight Crew : Became Reoriented
Result.Air Traffic Control : Provided Assistance

Assessments
Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Company Policy

Contributing Factors / Situations : Human Factors
Primary Problem : Aircraft

Narrative: 1

While on a 300 degree intercept heading, at an assigned altitude of 3000 feet, autopilot engaged, we received clearance "Maintain 3000 ft until established, cleared for the ILS Approach", and were handed over to the Tower. The pilot flying "armed" VOR/LOC, which was verified on the FMA (Flight Mode Annunciator). Approaching the extended centerline of the runway, the pilot flying determined that VOR/LOC had failed to "capture" and was overshooting the final. The pilot flying then made immediate correction back toward centerline via manual input with the control yoke, which disengaged the autopilot in all axes. The pilot flying noted there was no ILS "raw data" presented on his EADI (Electronic Attitude Direction Indicator). Pilot not flying noted he did have CDI (Coursed Deviation Indicator) and glideslope pointers, but did not have VOR/LOC capture yet. Both pilot flying and pilot not flying verified that proper frequencies and inbound courses were set correctly.

The pilot flying had the runway in sight visually at that point and continued hand flying toward the runway. The pilot not flying's FMA then "captured" VOR/LOC, while pilot flying's remained in "arm". At that time we were outside of the Final Approach Fix. We then received instruction from Final Monitor to climb back to 3000 feet. The pilot flying immediately returned to altitude, while maintaining centerline track to the runway visually. In the distraction, we had inadvertently descended to approximately 2450 feet. Inside of the Final Approach Fix, pilot flying set and descended to 2700 feet. Pilot not flying's FMA remained in VOR/LOC with glideslope pointer descending the scale toward the "centered" position, while pilot flying's "raw data" indications remained blank, with VOR/LOC "armed" on his FMA. At, or just prior to, ZZZZZ at 2700 feet, LOC and glideslope indications suddenly appeared, and VOR/LOC captured on the pilot flying's FMA. Pilot flying selected APP mode on the MCP (Mode Control Panel). Glideslope immediately "captured" on the pilot flying's FMA, and indications remained normal without further anomaly. Approach and landing were made on without incident.

Contributing factors were this was the first flight of a morning trip. Also both pilots first flight in MAX aircraft so there was a lot of looking around for information that has become instinctual in the NG. The weather was ragged SCT-BKN layer between 3000-3200 feet. More time in the MAX aircraft would be helpful. Time spent looking for information on redesigned display layout was definitely a distraction. I have never seen such a disparity between Captain and First Officer instrumentation like we experienced, where one side has good data and the other has none (assuming both are tuned/setup identically, which ours were). I'm not sure if this issue is MAX specific. As the pilot monitoring, I should have done a better job monitoring our altitude, especially after the autopilot was disconnected. I became too distracted by the problem and trying to quickly correct it. I should have recognized and called out the altitude deviance.

Narrative: 2

[Report narrative contained no additional information.]

Synopsis

B737 MAX pilots reported flying through the final approach course and descending below published altitudes due to confusion with the new style instrument displays.

ACN: 1517486

Time / Day

Date : 201802
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Daylight

Aircraft

Reference : X

Aircraft Operator : Air Carrier
Make Model Name : B737 Undifferentiated or Other Model
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Taxi

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 1517486
Human Factors : Communication Breakdown
Human Factors : Training / Qualification

Events

Anomaly.Deviation—Procedural : Published Material / Policy
Anomaly.Ground Event / Encounter : Other / Unknown
Detector.Person : Flight Crew
When Detected : Aircraft In Service At Gate
When Detected : Taxi

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Airport
Contributing Factors / Situations : Procedure
Contributing Factors / Situations : Human Factors
Primary Problem : Procedure

Narrative: 1

As we contacted the Pushback Driver for the required exchange of call outs, we finished running the Before Pushback Checklist. The First Officer and I, and Company Dispatcher doing his annual qualification on the jumpseat, were all listening on the Flight interphone to the exchange between the Pushback Driver and me. All call outs were normal up to the pushback call for "Brakes Set". Once the return reply "Brakes Set" was said by me, at that second the communication plugs were pulled and the communications ended. All three of us in the cockpit heard the headset connection plugs pulled out along with the door shut. I also watched the Ramp Agent walk away with the box in hand.

This was very disturbing because we were starting the new 737 MAX engines, and number 2 was not stable and running yet. I was hoping for them to stay until we cleared them off, as per procedure. They all started to walk off without even any hand signals. I opened my window, and with number 1 still shut down, I got the attention of the nearby Wing Walker, and asked him to tell the pushback to "hook back up". After enduring their looks as if I had asked them to do something insane, they hooked back up. At this point all three of us in the cockpit listened to what I could only call a cover up for their poor and improper adherence to our procedures.

We didn't have any communication problems during this push; it was crystal clear, all up to this re-plug in. It was still very clear; however, every time I made a call or statement on the interphone, it was followed by the pushback saying "can you hear me". I changed the pace of my calls, different intervals, and was never interrupted, just the reply, "can you hear me" after each of my responses. You could tell they were making a joke out of this. I stated on the intercom that this entire pushback is so wrong, and their attitudes showed they don't care. "I will write this up, and this activity will stop".

After my comments, he responded in a manner that showed he heard me just fine. All three of us in the cockpit listened and observed this low moment in communications intended for Safety. The other two Crew Members are willing to verify this report. This type of unsafe, anti-procedure behavior cannot be tolerated. This is becoming a nationwide trend, with this being one of the worst examples. I'm sure excuses will be made concerning poor communications involving equipment. I will not buy that excuse in this example. The attitudes on the Ramp came through loud and clear on this day that they do not buy into our Company procedures.

Synopsis

A pilot reported a tug driver and ramp crew did not follow proper procedures during pushback.

ACN: 1501507

Time / Day

Date : 201711
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Next Generation Undifferentiated
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Taxi

Component

Aircraft Component : Data Processing
Problem : Design

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : First Officer
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 1501507
Human Factors : Confusion
Human Factors : Human-Machine Interface

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Detector.Person : Flight Crew
When Detected : Taxi
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Primary Problem : Aircraft

Narrative: 1

I have flown the MAX aircraft for four legs on two separate occasions. The first time I flew it we landed and taxied clear at Bravo and I went to call Ground. I had gotten used to looking for the flight number in its new location, digitally displayed on the dash. I keyed the MIC and looked for the call sign, only to see that it had disappeared. While this only caused a temporary distraction, at busy airports it's not ideal. Since the flight number disappearing on landing doesn't make any sense at all, I figured it was an anomaly to that particular aircraft. However, I noticed the same occurrence on all four legs that I've flown MAX aircraft (2 different aircraft). The last time this happened was [a flight the day prior].

From best I can tell, the disappearance of the flight number is linked to either weight on wheels or airspeed. For example, when the airspeed drops below a certain value, the flight number disappears. Nonetheless, this is very distracting and occurs

at absolutely the worst possible time as things get very busy for a First Officer (FO) as we exit the active runway, call Ground, and get our taxi instructions to the gate. Even more frustrating, is that it makes no sense whatsoever for the call sign to disappear at that time in the flight. It would seem that it should disappear once the aircraft blocks in at the gate. I'm hopeful that this [report] may shed some light on this issue and create an impetus for a software fix to allow the call sign to remain visible until the aircraft blocks in at the gate.

Preventative Measures: 'I think this whole issue could be fixed with a simple software change. Please inquire to see what possibility exists to allow the flight number to remain visible until the aircraft blocks in at the gate.'

Synopsis

B737 Max First Officer reported that the flight number disappears from the digital display after the aircraft has landed making it difficult to communicate with ATC from landing to the gate.

ACN: 1495437

Time / Day

Date : 201711

Place

Altitude.AGL.Single Value : 0

Aircraft

Reference : X
ATC / Advisory.Tower : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737 Next Generation Undifferentiated
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Landing
Flight Phase : Takeoff

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 1495437
Analyst Callback : Attempted

Events

Anomaly.No Specific Anomaly Occurred : All Types
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : Work Refused

Assessments

Contributing Factors / Situations : Aircraft
Primary Problem : Aircraft

Narrative: 1

Takeoff wingtip strike in the Max threat is not addressed. [Company] ops specs call for rotation on takeoff towards 10 degrees of pitch. Operations Manual states in a note "In some instances (gusty crosswinds, windshear) it may be necessary to hesitate at 10 degrees until liftoff occurs". As the pitch increases, the wingtip clearance decreases since the 737 is a highly swept wing aircraft and the wing tips are aft of the center of rotation for pitch. In other words as the nose rises while the plane is on the runway, the wingtips go down. There are crosswind landing wingtip strike concerns when landing the [B737] Max with the cross control technique. This wingtip strike is of concern at a body angle of approximately 5 degrees at max crosswind (33 knots) during a cross control landing.

In [the operating manual concerning] Takeoff in Gusty Wind or Strong Crosswind Conditions it states regarding liftoff, under sub paragraph Rotation and Takeoff, "The aircraft is in a side slip WITH CROSSED CONTROLS at this point. A slow, smooth recovery from this side slip is accomplished after liftoff by slowly neutralizing the control wheel and rudder pedals". Translation and concern is this—by the [operating manual] definition of crosswind takeoff techniques, the aircraft will be, during a strong crosswind takeoff, up to an approximately 5 degree higher pitch attitude (10 degrees, mentioned above) than during landing with the aircraft in a fully cross controlled state until well after liftoff. This guarantees, by the [operating manual] and sim pilot [B737] Max landing instruction training, a severe wingtip runway strike!

At max crosswind there will be insufficient wing tip clearance during a textbook crosswind takeoff in gusty wind conditions. No mention is made of any [B737] Max takeoff guidance in any documents I can find, even though by current takeoff technique guidance and wing tip strike charts, an incident is guaranteed by my observation, at crosswinds well below max demonstrated crosswind limits. If I am correct, this must be addressed prior to line flying the [B737] Max. I cannot in good conscience fly the [B737] Max with crosswinds until this threat is addressed.

Synopsis

B737-MAX Captain reported an unresolved threat of a wingtip strike during crosswind landing and takeoff operations.

ACN: 1488017

Time / Day

Date : 201710
Local Time Of Day : 1201-1800

Environment

Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Undifferentiated or Other Model
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Descent

Component

Aircraft Component : FMS/FMC
Aircraft Reference : X
Problem : Design
Problem : Malfunctioning

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Type : 522
ASRS Report Number.Accession Number : 1488017
Human Factors : Human-Machine Interface
Human Factors : Troubleshooting

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation—Procedural : Published Material / Policy
Anomaly.Deviation—Procedural : FAR
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : FLC Overrode Automation

Assessments

Contributing Factors / Situations : Aircraft
Primary Problem : Aircraft

Narrative: 1

During training, for the 737-MAX there was no mention that using the Altitude Intervention (ALT INTV) button would change the FMC altitude. However, when we entered a lower altitude from cruise altitude and selected the ALT INTV button, the MCP altitude was entered into the FMC. When we received a new lower altitude and entered it in the MCP and with VNAV selected the aircraft did not start a descent like previous NG aircraft.

We noticed that the FMC had a new cruise altitude that we had not entered through the FMC. (The altitude had automatically been entered from the MCP.) We selected the ALT INTV button to allow the aircraft to descend again. This happened two or three times.

This safety issue was unexpected and could lead to an altitude violation and safety hazard. 737-MAX FRM (Fault Reporting Manual) 4.1.3 item 10 Altitude Intervention switch: under "push-(during VNAV cruise)" states: "Lower FMC cruise altitude cannot be entered using ALT INTV switch." Our aircraft DID reset the FMC altitude with the ALT INTV switch.

Synopsis

Captain reported procedural issues with the FMS on the 737-MAX in reference to descent capabilities.

ACN: 1486024

Time / Day

Date : 201710
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Daylight

Aircraft

Reference : X
ATC / Advisory.Ground : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737 Undifferentiated or Other Model
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Taxi

Component

Aircraft Component : Pneumatic Valve/Bleed Valve
Aircraft Reference : X
Problem : Improperly Operated

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Last 90 Days : 609
Experience.Flight Crew.Type : 13800
ASRS Report Number.Accession Number : 1486024
Human Factors : Distraction
Human Factors : Situational Awareness

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : First Officer
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Type : 950
ASRS Report Number.Accession Number : 1486042
Human Factors : Human-Machine Interface
Human Factors : Situational Awareness
Human Factors : Communication Breakdown
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Flight Crew

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation—Procedural : Published Material / Policy
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : Taxi
Result.Flight Crew : Returned To Gate

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Procedure

Narrative: 1

It was the second day ever to fly together and the first flight for both of us in the MAX. Normal pushback. We received Impending Hot Start on Number 2 engine with auto shutdown. My attention was totally outside the aircraft as I was in the process of clearing the Ground Crew off. My attention was drawn back inside to see the white flashing box around the EGT with the motor rolling back. At the time, the F/O (First Officer) had no idea what may have caused it, so we ran appropriate QRH items for a suspected malfunction, started number 1 engine, and taxied back to the gate, making a logbook write-up, and calling Maintenance.

Having time to discuss what may have happened, looking through numerous publication sources, and sleeping on it, the F/O is now sure that he prematurely isolated/ventilated just momentarily, but long enough to steal the air source causing an incomplete and auto aborted start. Despite being patient and pre-briefing that we would not rush our first MAX experience in any way, anxiousness over the newness and the longer start process must have still affected our pacing. The Isolation switch to Isolate and the Pack switch to ON before engine rollback obviously caused the engine to shut down.

More training would be great, and hands-on training would certainly have been beneficial. Still, we felt prepared, but the hype of the new aircraft with the unfamiliar pacing caused an unfortunate situation.

Narrative: 2

It was a normal pushback. The Captain indicated to start number 2 engine. I followed procedures for start and everything appeared normal. During the end of the start, I thought I heard the Captain say "Start number 1." I was looking at the number 2 engine EGT and it had appeared to peak so I reached up and selected isolation valve CLOSED and right pack ON. I then reached over to start number 1.

When I glanced down at the number 2 EGT I realized there was still a red tick mark so I did not start number 1. Within a second or two, I noticed the number 2 engine EGT box white and flash and the Oil Pressure light illuminate and the engine rolled back. We accomplished the Aborted Start Checklist, started the number 1 engine and taxied to Gate XX.

When I heard start number 1, I should have verified that a full rollback had indeed taken place prior to moving my hand away from the start lever. Instead since it appeared the temperature had peaked I made an assumption that it was incorrect. Obviously, this was a new variant so out of an abundance of caution we went back to the gate instead of attempting another start. In hindsight I should have also voiced turning on the pack more loudly to Maintenance, but at the time we were

not really sure what caused the rollback. There is already a note in the Aircraft Operating Manual regarding pack usage during start. This was just a pure mistake on my part in turning on the switch to early.

Synopsis

B737 Max flight crew reported that an Auto Shutdown of the Number Two engine on engine start was probably due to the First Officer activating the Isolation switch and the Pack switch during the start.

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