

STATUS OF THE BOEING 737 MAX: STAKEHOLDER PERSPECTIVES

(116–22)

HEARING
BEFORE THE
SUBCOMMITTEE ON
AVIATION
OF THE
COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES
ONE HUNDRED SIXTEENTH CONGRESS
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U.S. House of Representatives
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JUNE 14, 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: Stakeholder Perspectives”

PURPOSE

The Subcommittee on Aviation will meet on Wednesday, June 19, 2019, at 10:00 a.m. in 2167 Rayburn House Office Building to hold an hearing titled, “Status of the Boeing 737 MAX: Stakeholder Perspectives.” The hearing is intended to gather views and perspectives from aviation stakeholders regarding 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 service. The Subcommittee will hear testimony from Airlines for America, Allied Pilots Association, Association of Flight Attendants—CWA, Captain Chesley (“Sully”) Sullenberger, and Randy Babbitt.

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.² However, in a span of five months, there have been two fatal commercial airline accidents involving the new 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 each year through the early and mid-1990s, claiming more than 1,000 lives annually.³ 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).⁴

I. FOREIGN AIR CARRIER ACCIDENTS INVOLVING THE BOEING 737 MAX

A. LION AIR FLIGHT 610

On October 29, 2018, Lion Air Flight 610 (JT610)—a Boeing 737 MAX—an Indonesian domestic flight en route to Pangkal Pinang from Jakarta, crashed into the

¹On 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.

²NTSB, Loss of Control on Approach, Colgan Air, Inc., Operating as Continental Connection Flight 3407, Bombardier DHC 8 400, N200WQ, <https://www.nts.gov/investigations/AccidentReports/Pages/AAR1001.aspx>.

³David 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/>.

⁴*Id.*

Java Sea at 450 miles per hour approximately 11 minutes after takeoff, killing all 189 on board (184 passengers and 5 crew).

According to the preliminary accident report by Indonesia's Komite Nasional Keselamatan Transportasi (KNKT),⁵ prior to 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 was designed to adjust the handling of the aircraft so that it operates similarly to previous 737 models by pushing the nose of the aircraft down based on certain data inputs. However, due to erroneous AoA data, the MCAS on JT610 activated (i.e., pushed the nose of the aircraft down) more than two dozen times during the 11-minute flight. The pilots' manual attempts to counter the MCAS were ultimately unsuccessful.

The preliminary report provides information on the flight crew, including:⁶

- Pilot in Command: 6,028 hours (including 5,176 hours in the Boeing 737; the number of hours in the Boeing 737 MAX is not provided).
- First Officer: 5,174 hours (including 4,286 hours in the Boeing 737; the number of hours in the Boeing 737 MAX is not provided).

According to the preliminary report, there were problems reported by flight crews operating the aircraft on October 26, 27, and 28. The pilots of the flight immediately preceding the accident flight (on October 28) experienced similar problems to the accident flight on October 29. On the October 28 flight, despite experiencing problems, the pilots continued flying with manual trim, with the stick shaker activated, and without auto-pilot until safely landing at Jakarta more than one hour later. They reported certain problems to the airline but not the stick shaker activation. 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."⁷ 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."⁸ The AD identified existing flight crew procedures to be used in such circumstances.

Indonesia'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, erroneous 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 hit the "STAB TRIM CUTOFF" switches (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 throttle after takeoff and the aircraft accelerated to between 450 and 500 knots. The maximum design speed of the aircraft is 340 knots. As depicted in the image included in Appendix 1, using the manual trim wheel at

⁵Translated means "Transportation Safety National Committee" or "National Transportation Safety Committee."

⁶Lion Air 601 Preliminary Report available at https://reports.aviation-safety.net/2018/20181029-0_B38M_PK-LQP_PRELIMINARY.pdf.

⁷Daniel K. Elwell, FAA, Testimony before the Senate Commerce Committee, Aviation and Space Subcommittee, hearing on State of Airline Safety: Federal Oversight of Commercial Aviation, at 7 (Mar. 27, 2019).

⁸FAA Emergency Airworthiness Directive, AD 2018-23-51 (Nov. 7, 2018), available at [http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgad.nsf/0/83ec7f95f3e5bfbdb8625833e0070a070/\\$FILE/2018-23-51_Emergency.pdf](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgad.nsf/0/83ec7f95f3e5bfbdb8625833e0070a070/$FILE/2018-23-51_Emergency.pdf).

excessive airspeed can be difficult or nearly impossible due to the downward force on the plane's tail. According to the preliminary accident report, the pilots reactivated the motor on the stabilizer, allowing MCAS to push the nose down again. The pilots were unable to recover.

The preliminary report provides information on the flight crew, including⁹:

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

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 previously, 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.

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 United States is the state of design and manufacture of the accident aircraft, the FAA and NTSB are serving as technical experts to examine aircraft design and certification. In accordance with Annex 13 to the U.N. Chicago Convention of the International Civil Aviation Organization (ICAO), 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 ICAO Standards and Recommended Practices, the pilot-in-command requires an Airline Transport Pilot License (ATP). An ATP requires a pilot have "completed not less than 1,500 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 1,500 hours. Credit for such experience shall be limited to a maximum of 100 hours, of which not more than 25 hours shall have been acquired in a flight procedure trainer or a basic instrument flight trainer."¹⁰

ICAO also provides standards to obtain a Multi-Crew Pilot License (MPL), which "allows a pilot to exercise the privileges of a co-pilot in a commercial air transportation on multi-crew aeroplanes."¹¹ 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."¹² 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."¹³ The applicant pilot is required to meet "all the actual flying time for a private pilot license plus additional actual flying time in instrument, night flying and upset recovery."

FAA Certification and Delegation of Authority. All aircraft and aviation products are subject to FAA certification prior to their sale and use in the United States. The FAA is responsible for regulating aviation safety, which includes approving the design and manufacture of new aircraft and aviation products before they enter the National Airspace System (NAS).¹⁴ Therefore, the FAA will need to review and ap-

⁹ 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>.

¹⁰ See ICAO Annex 1, Personnel Licensing, at section 2.6 (regarding airline transport pilot (ATP) license).

¹¹ See ICAO, Multi-Crew Pilot License, <https://www.icao.int/safety/airnavigation/Pages/peltrgFAQ.aspx#anchor24>.

¹² *Id.*

¹³ *Id.*

¹⁴ See 49 U.S.C. §§ 44702, 44704; GAO, *Aviation Manufacturing: Status of FAA's Efforts to Improve Certification and Regulatory Consistency* (July 31, 2014), GAO-14-829T, at 1.

prove any software fix proposed by Boeing and determine whether changes to the 737 MAX training program are needed to get the aircraft back into commercial service.

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. A designee may receive authority to examine, inspect, and test aircraft and persons for the purpose of issuing certificates.¹⁵

The delegation program allows the FAA to leverage limited resources to focus on the areas of highest-risk and make timely certification decisions. According to the Government Accountability Office (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.¹⁶ However, the FAA has ultimate responsibility to ensure appropriate oversight is taken and aircraft are certified in a safe manner.

Since the original 737 aircraft was certified in the 1960s, there have been more than a dozen new models of the aircraft approved for flight. The 737 MAX is the latest version of the 737 aircraft. With regard to the FAA certification of the 737 MAX, the process to issue a type-certificate, from initial application to final certification, took five years, according to the FAA.¹⁷ 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.¹⁸

II. REVIEWS OF THE BOEING 737 MAX

Subsequent to the two fatal foreign airline Boeing 737 MAX accidents, the U.S. Department of Transportation (DOT), FAA, and Boeing have stood up various panels, including those explained below.

A. SAFETY OVERSIGHT AND CERTIFICATION ADVISORY COMMITTEE (SOCAC)

On March 25, 2019, as mandated by Congress in the FAA Reauthorization Act of 2018, DOT announced it will stand up the 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.

B. SAFETY OVERSIGHT AND CERTIFICATION ADVISORY COMMITTEE SPECIAL COMMITTEE

On March 25, 2019, DOT announced it would create a Special Committee to review the FAA's Aircraft Certification Process (Special Committee) within the structure of the SOCAC, described previously.¹⁹ The Special Committee is tasked with reviewing the procedures of the FAA for the certification of new aircraft, including the Boeing 737 MAX.²⁰ 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."²¹ 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 im-

¹⁵ GAO-14-829T at 4.

¹⁶ GAO, *Aviation Safety: FAA Efforts Have Improved Safety, but Challenges Remain in Key Areas* (Apr. 16, 2013), GAO-13-442T, at 3-4. In a May 7, 2019, email to Committee staff, the GAO clarified that the 90 percent number refers to the breadth or scope of FAA activities on which designees can do rather than the amount of certification work done by designees.

¹⁷ See Koenig, *supra* note 3 at 6.

¹⁸ *Id.*

¹⁹ FAA, *DOT Announces Special Committee to Review FAA's Aircraft Certification Process* (2019), available at <https://www.transportation.gov/briefing-room/dot1619>.

²⁰ *Id.*

²¹ DOT, *Letter to General McDew* (2019), available at <https://www.transportation.gov/sites/dot.gov/files/docs/briefing-room/337281/gen-darren-mcdew.pdf>.

proved.²² Its findings and recommendations will then be presented directly to the DOT Secretary and the FAA Administrator for their consideration.²³

C. JOINT AUTHORITIES TECHNICAL REVIEW

On April 2, 2019, the FAA established a Joint Authorities Technical Review (JATR)²⁴ 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.²⁵

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).²⁶ The JATR had its first meeting on April 29, 2019, and is expected to last three months from the date it was established.²⁷ 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.

D. TECHNICAL ADVISORY BOARD

On May 6, 2019, the FAA launched the Technical Advisory Board (TAB). The TAB is tasked with conducting an independent review of Boeing's proposed software change and its integration into the 737 MAX flight control system. The review, which will run parallel to FAA's software reviews and flight tests, will include experts from the FAA, U.S. Air Force, the Volpe National Transportation Systems Center and NASA. The TAB is distinct from the JATR, in that the JATR focuses broadly on the earlier certification of the automated flight control system.

E. 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.²⁸ 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."²⁹

III. ONGOING INVESTIGATIONS

A. 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.

B. DOT INSPECTOR GENERAL

On March 19, 2019, Secretary of Transportation Elaine Chao requested the DOT Inspector General (DOT IG) conduct an audit "to compile an objective and detailed

²² *Id.*

²³ *Id.*

²⁴ 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>.

²⁵ 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 FAA Acting Administrator Daniel K. Elwell, urging the agency 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.

²⁶ *FAA Establishes JATR*, *supra* note 24.

²⁷ *Id.*

²⁸ 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>.

²⁹ *Id.*

factual history of the activities that resulted in the certification of the Boeing 737-MAX 8 aircraft.”³⁰

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-making; 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 Garrett 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.

C. U.S. DEPARTMENT OF JUSTICE

According to multiple news sources, it was reported that the U.S. Department of Justice (DOJ) is conducting a criminal investigation into the FAA’s certification of the Boeing 737 MAX.³¹ Reports indicate the investigation began after the October 2018 Lion Air crash and is primarily focusing on the certification process.³² According to news reports, the FBI Seattle Office and the Justice Department’s criminal division in Washington State are leading the investigation.³³ The Justice Department has declined to comment.

D. U.S. SECURITIES AND EXCHANGE COMMISSION

According to multiple news sources, it was reported that the Securities and Exchange Commission (SEC) is investigating whether Boeing “was adequately forthcoming to shareholders about material problems with the [Boeing 737 MAX]” and whether the company’s “financial statements have appropriately reflected potential impacts from the problems.”³⁴ The SEC has declined to comment.³⁵

IV. NEXT STEPS AND IMPACTS OF THE GROUNDING

Returning to Service in the United States. 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.”³⁶ Boeing CEO Dennis Muilenburg expects the 737 MAX to return to service by the end of 2019,³⁷ although the FAA has not committed to a timeline.³⁸

³⁰The DOT IG reports similar audit requests from 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 DOT OIG, *Audit Announcement: FAA’s Oversight of Boeing 737 MAX Certification*, available at <https://www.oig.dot.gov/sites/default/files/Audit%20Announcement%20-%20FAA%27s%20Oversight%20of%20the%20Boeing%20737%20MAX%20Certification.pdf>.

³¹See Steve Miletich, *FBI Joining Criminal Investigation into Certification of Boeing 737 MAX*, THE SEATTLE TIMES (Mar. 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 Prokuecz, *Justice Department Issues Subpoenas in Criminal Investigation of Boeing*, CNN (Mar. 21, 2019), available at <https://www.cnn.com/2019/03/20/business/boeing-justice-department-subpoenas/index.html>.

³²*Id.*

³³*Id.*

³⁴Bloomberg, *Boeing Faces SEC Probe into Disclosures about 737 MAX Troubles* (May 24, 2019), <https://www.bloomberg.com/news/articles/2019-05-24/boeing-faces-sec-probe-into-disclosures-about-737-max-troubles>.

³⁵*Id.*

³⁶Elwell, *supra* note 7, at 9.

³⁷CNBC, *Boeing CEO Says Troubled 737 MAX Jets Should be Flying by the End of the Year* (June 3, 2019).

³⁸NBCDFW, *FAA Meets with International Regulators Over Boeing 737 MAX* (May 23, 2019), <https://www.nbcdfw.com/news/local/FAA-Meets-With-International-Regulators-Over-Boeing-737-Max-510341841.html>.

International Input. On May 23, 2019, the FAA convened foreign civil aviation authorities from around the world in Fort Worth, Texas, to explain the agency's plan and approach to evaluating Boeing's forthcoming changes to the 737 MAX.³⁹ As stated by Acting FAA Administrator Dan Elwell, "Internationally, each country has to make its own decisions, but the FAA will make available to [its] counterparts all that [it has] learned, all that [it has] done, and all of [its] assistance under [U.S.] International Civil Aviation Organization commitments."⁴⁰ The European Union (EU) has stated it will require four conditions before allowing the 737 MAX to fly again in its skies, including that the European Aviation Safety Agency (the EU's equivalent of the FAA) approves Boeing's updates to the aircraft separate from the FAA determination.⁴¹

Impacts on Airlines and their Customers. There are more than 370 Boeing 737 MAX aircraft worldwide,⁴² and, according to news reports, there are fewer than 100 operated by U.S. airlines and grounded at this time.⁴³ Southwest Airlines is the top 737 MAX operator in the United States. Airlines have cancelled thousands of flights as a result of the international grounding of the 737 MAX aircraft and have made schedule and fleet adjustments to best accommodate passengers.⁴⁴ According to news reports, United Airlines alone has cancelled more than 3,000 flights and has removed its 14 MAX aircraft from scheduled service through August 3, 2019,⁴⁵ and American Airlines has removed its 24 MAX aircraft from scheduled service through September 3, 2019.⁴⁶ It is reported that even after the 737 MAX returns to service, airlines recognize potential difficulty in getting passengers comfortable flying in the aircraft again.⁴⁷ Media reports indicate that at least one airline has cancelled its contract with Boeing for new 737 MAX aircraft altogether.⁴⁸

WITNESSES

- Sharon Pinkerton, Senior Vice President, Legislative and Regulatory Policy, Airlines for America
- Captain Daniel Carey, President, Allied Pilots Association
- Captain Chesley Sullenberger, Pilot, US Airways (Retired)
- Sara Nelson, International President, Association of Flight Attendants—CWA
- The Honorable Randy Babbitt, Former Administrator, Federal Aviation Administration

³⁹ FAA Acting Administrator Dan Elwell's Opening and Closing Remarks at Directorates General Meeting, May 22 & 23 2019, https://www.faa.gov/news/updates/?newsId=93206&omniRss=news_updatesAoc&cid=101_N_U.

⁴⁰ *Id.*

⁴¹ POLITICO, *Shadow of Global Mistrust Colors FAA's 737 MAX Gathering* (May 22, 2019).

⁴² See Boeing, *737 MAX Updates*, <https://www.boeing.com/commercial/737max/737-max-contacts.page>.

⁴³ CNBC, *U.S. Grounds Boeing 737 MAX Planes, Citing Links Between 2 Fatal Crashes* (Mar. 13, 2019), <https://www.cnbc.com/2019/03/13/boeing-shares-fall-after-report-says-us-expected-to-ground-737-max-fleet.html>.

⁴⁴ See American Airlines statement, June 9, 2019, <http://news.aa.com/news/news-details/2019/The-Latest-Information-About-737-MAX-Operations/default.aspx>; Statement of Gary Kelly, Southwest Airlines, April 26, 2019, https://www.southwest.com/html/air/737-MAX-8.html?clk=737MAX8_190408; and CNBC, *United CEO Says He's Not Sure Travelers Will Want to Fly a Boeing 737 MAX—Even After a Fix* (May 30, 2019).

⁴⁵ *United CEO*, *supra* note 44.

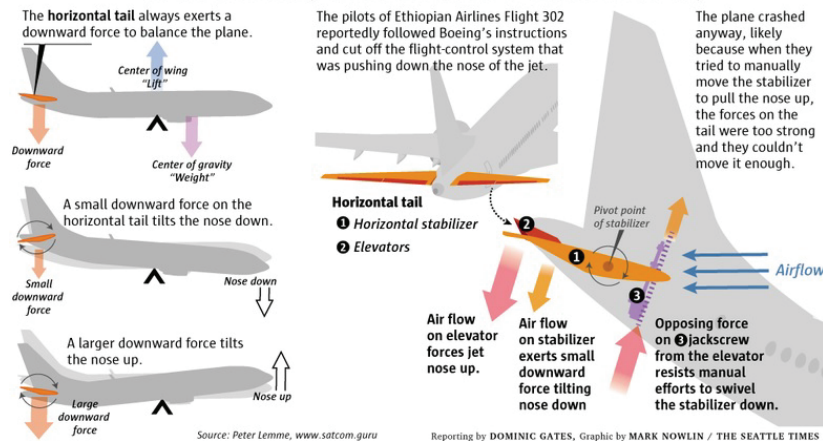
⁴⁶ CNBC, *American Airlines Extends Cancellations from Grounded Boeing 737 Max to Sept. 3* (June 9, 2019), <https://www.cnbc.com/2019/06/09/american-airlines-extends-boeing-737-max-to-september.html>.

⁴⁷ *Id.*

⁴⁸ See e.g., Reuters, *Azerbaijan Cancels \$1 Billion Contract with Boeing for Safety Reasons* (June 3, 2019), <https://www.reuters.com/article/us-boeing-azerbaijan/azerbaijan-cancels-1-billion-contract-with-boeing-for-safety-reasons-idUSKCN1T413D>.

APPENDIX 1.

With the 737 MAX's automatic system cut off, forces on the horizontal tail could make it very difficult for pilots to swivel it manually



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

STATUS OF THE BOEING 737 MAX: STAKEHOLDER PERSPECTIVES

WEDNESDAY, JUNE 19, 2019

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

The subcommittee met, pursuant to call, at 10:03 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 ask unanimous consent the chair be authorized to declare recesses at today's hearing. Without objection, so ordered.

I also ask unanimous consent members not on the subcommittee be permitted to sit with the subcommittee at today's hearing and ask questions. Without objection, so ordered.

Good morning. And I want to thank today's witnesses for joining the subcommittee's ongoing discussion on the status of the Boeing 737 MAX. Today's hearing is the second in a series investigating the tragic Boeing 737 MAX accidents. The purpose of today's hearing is to hear from people who fly the airplanes and from the people who fly in the airplanes, and those who represent them.

A total of 346 people have died in the Lion Air and Ethiopian Airlines accidents, and their loved ones deserve answers. The traveling public's confidence in U.S. aviation is shaken. Congress, the administration, and industry must work together to restore confidence in air travel. The foundation of this committee's investigation into the Boeing 737 MAX is ensuring safety.

As I have said before, 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, airplanes don't need to be built. And if there is no need to build airplanes, there will be no jobs in aviation.

The foundation of the aviation industry is its safety, and today's hearing builds on the committee's ongoing investigation. Safety remains this committee's guiding principle. In this committee we use all tools to reduce the likelihood of future tragedies.

I want to start by updating subcommittee members and the public on the committee's work since last month's hearing.

Chair DeFazio and I continue to engage with the Federal Aviation Administration, the NTSB, Boeing, pilots, aviation stakeholders, and others about these accidents. Second, the committee's oversight and investigation team continues to work with the FAA

and Boeing on securing records that the chair and I requested on the certification of the MAX.

More recently, Chair DeFazio and I have recently wrote to Transportation Secretary Chao and FAA Acting Administrator Elwell, expressing concerns about the slow pace of the FAA's response to our records request. It is my expectation that both will cooperate with the committee's investigation in a timely manner. Third, we have written to Boeing, United Technologies Corporation, and the FAA, requesting a timeline and supporting documents related to the awareness of when the angle of attack, or the AOA, disagree alert, on some Boeing 737 MAX planes, was defective, as well as when the groups notified airlines about this defect.

The committee is aware of information suggesting that Boeing decided in November of 2017 to defer a software update to correct the AOA disagree alert defect until 2020, 3 years after discovering a flaw, and only accelerated its timeline after the October 2018 Lion Air accident. This information is deeply concerning, and the committee must find out what Boeing knew, when the company knew it, and who it informed.

I also have questions about the decision to not deem the AOA disagree alert as safety critical. The information the committee is requesting will help us better understand these management decisions. And I as well, again, encourage all members of the subcommittee to continue personally monitoring the situation. Staff continues to be available for any questions the subcommittee may have surrounding our investigation and can provide you with updates as they become available.

What I hope to hear today from witnesses: More than 300 Boeing 737 MAX planes have been grounded worldwide since the Ethiopian Airlines accident in March, and more than 130 are parked. More than 4,500 orders for the MAX worldwide remain unfilled since Boeing stopped delivering, that is over a longer period of time.

Today's hearing is an opportunity to gather views and perspectives from key users of the aircraft—pilots, flight attendants, the industry, and those representing passengers' views—on what the FAA, Boeing, and the airlines need to do before returning the 737 MAX to service. The committee is not here yet to make conclusions as to what caused these accidents, that is the NTSB's job, but as with any aviation accident, investigators must consider a multitude of factors, including aircraft design, aircraft maintenance, weather, and human performance, before making a final determination of probable cause or causes.

In the end, there will be a root cause and there will be contributing factors. Nevertheless, it is critical the public hear from front-line stakeholders as part of our oversight work.

Captain Carey and Captain Sullenberger, I look forward to hearing the pilots' perspective on these accidents, pilots' role in the FAA certification process, and associated pilot training.

Ms. Nelson, flight attendants are on the front lines of passengers. I am interested in hearing your thoughts of what must take place to restore the confidence of the flying public and help you perform your important work.

Ms. Pinkerton, I would like to hear more about the impact of the grounding on the airlines, airlines' engagement with the FAA and Boeing on certification of the aircraft and related fixes, and next steps to ensure safety.

And, Mr. Babbitt, as a former FAA Administrator, I look forward to your thoughts on the importance of coordination of the international aviation community on this issue and how the FAA can regain its credibility and restore the public's trust.

And I hope today's testimony will help this committee better understand what is needed to restore the trust of the flying public and show this committee's commitment to safety by asking all the appropriate questions.

As Congress seeks answers during the Lion Air and the Ethiopian Airlines accidents, this committee must also work to restore the public confidence in the MAX and the FAA's mission, importantly, to maintain the safety of U.S. aviation in aerospace. The committee will continue its thorough investigation until it fully understands all the issues surrounding the 737 MAX accidents.

And I will continue to work with Chair DeFazio and my colleagues, Representative Graves and Representative Graves in the full committee, as well as FAA, NTSB, Boeing, aviation stakeholders, and the families of victims throughout this process.

So, again, I want to thank today's witnesses. I look forward to hearing your insights, and I turn to Representative Graves of Louisiana for an opening statement.

Mr. GRAVES OF LOUISIANA. Thank you, Mr. Chairman. I don't know why you keep mispronouncing my name and pronouncing his the right way.

I want to thank you all for being here today. And I think the most important thing that we all need to stay focused on is the families and the victims. I am, once again, very, very sorry for your loss. Anything we do that loses sight that this is about people, it is about lives lost, it is about safety, is a distraction. And throughout this process, we need to stay 100 percent focused on lessons learned, on safety, and making sure that this does not happen again.

In light of that, I want to go through and reference some of the different committees and efforts that are underway right now to ensure that we do extract every lesson learned from these disasters and make sure that other families don't have to go through the devastating situation that these families are going through today.

Right now, the special committee on Safety Oversight and Certification Advisory Committee, a DOT-initiated group, is going through studying this process, lessons learned, from the disasters. The Safety Oversight Certification Advisory Committee that, once again, DOT has established, is going through and evaluating the lessons learned here. Joint Authorities Technical Review is an FAA-initiated group that is looking at this. The Boeing board of directors has a review committee that Boeing initiated. The Technical Advisory Board, FAA initiated. There are various Department of Transportation inspector general investigations that are underway right now. And as I recently became aware, this committee is doing an investigation and has hired investigators to look at this

as well. So there are numerous efforts that are underway right now to ensure that we chart a better path forward.

I want to thank all the witnesses for being here today. Thank you to every single one of you. And I did have a chance to review your testimony.

Ms. Nelson, you make a really important point in your testimony talking about how we need to ensure that we don't allow this to erode the United States sort of standing in the international aviation community. And you are exactly right about that, we need to ensure we do that.

Captain Sullenberger, thank you for being here. In your testimony, you talk about the chain of events, and I think you used the term "causal chain of events" that contributed to this. We need to make sure, and a lot of people are focused on one single aspect of this, but I think it is important, your testimony is exactly right, that we do need to look at every aspect, not just one. Certainly, the MCAS system has been a focus of this and it needs to continue to be, but we need to make sure we look at every other step in the process as well to make sure that we don't fix one thing and don't recognize perhaps the failures or challenges associated with other aspects of this. And I appreciate that.

Mr. Babbitt, thank you for your testimony. And you talked about your confidence in the FAA certification system, and yet I think you said in your testimony that it is not perfect. But one of the things that you do have faith in, and don't let me put words in your mouth, but I will leave it in your testimony, you talked about how the certification process may be imperfect, but you do have a lot of faith in our ability to adapt and fix it.

One of the things in reviewing all of your testimony, that comes to mind, we are becoming more heavily reliant upon technology. We know it in everything that we do. And I have got my old car that I drive that has virtually no technology, and if I get in somebody who has got a newer car, and all of the different sensors that are out there, and the rearview mirrors when you are changing lanes, when you are fading off, when you are going too fast, it is somewhat overwhelming and it is very different. Is it making us become more complacent in driving, in flying planes? And if so, how do we challenge that? How do we challenge that—us becoming more complacent and ensuring that we stay as alive as on top of what we are doing and don't become too dependent upon this technology.

How does that technology challenge the certification process? How does the certification process need to adapt to the fact that we are becoming more reliant upon technology to ensure, once again, that we are staying alive, that we are paying attention to what is happening?

Look, at the end of the day, I am going to circle back to where I started. This is about safety and it is about people. And there have been many efforts that we have seen over the past few months to make this a partisan effort, and I cannot disagree with that more. I think it is a huge mistake to do that. There is nothing that is partisan about this. Every single one of us that are here today in this room, every one of us that is on this dais, we all need

to stay singularly focused on the fact this is about safety and people.

And I want to thank you, Mr. Chairman, for having this second hearing today, and I am looking forward to the witnesses. I do want to make note, we have a markup in another committee, four bills that are very much related to the State that I represent, and I am going to have to run in and out. I think we have 80 amendments over there.

So I yield back.

[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 also want to express my condolences to the families and friends of those lost in the two accidents, some of whom are with us today. This is the second hearing that the Subcommittee has held on the Boeing 737 MAX, and we are closely following open investigations and the FAA and NTSB process for making key fixes. Throughout this process we must stay focused on lessons learned, safety, and ensuring that this tragedy never repeats itself.

As has been said before, the United States has the strongest aviation safety record in the world. The reason we have such a safe system is that past Congresses and administrations of both parties have pushed partisanship aside and worked together to improve the safety of our system.

When accidents happen, we must ask hard questions and demand that aviation stakeholders do the same.

The FAA is asking itself hard questions, as is Boeing. We would be remiss if we didn't expect airlines and pilot organizations to ask themselves similarly hard questions.

In addition to design and potential certification deficiencies, we have to understand why pilots facing similar challenging circumstances react in very different ways. We have to take a look at industry assumptions on pilot responses and human-computer interfaces. And we have to figure out whether global pilot training requirements adequately prepare pilots for all situations they may face, particularly when automated systems fail.

If we don't work to understand these factors, we are not doing everything we can to keep the flying public safe.

We are all committed to ensuring that automated aircraft systems provide the safety benefits they are supposed to. But when automation fails, a well-trained pilot must be prepared to respond. By looking into all these issues, we can seek to avoid accidents relating to automation failures on other aircraft too.

At some point, the Boeing 737 MAX will fly again. The FAA has laid out a rigorous and uncompromising process for the aircraft to go through before its return to service. Based on what we know currently, we believe it will involve changes to the MCAS system and changes to training requirements.

We can all be confident that the FAA will only unground the 737 MAX when it is certain that Boeing has addressed any identified issue and that the aircraft is completely safe to fly.

I believe that Congress must be at least as meticulous and deliberative as the FAA in our efforts to figure out what went wrong and determine what our next steps are.

Thank you again, Mr. Chairman, for holding today's hearing.

Mr. LARSEN. Thank you, Representative Graves. And it is fair for you to make sure you make your votes and your markup. We appreciate that.

Before I turn to Chair DeFazio for an opening statement, I just ask unanimous consent the following be entered into the record of today's hearing: A June 12 letter from Ms. Nadia Milleron and Mr.

Michael Stumo to Chair DeFazio, and the written testimony from the Association of Professional Flight Attendants.

Hearing no objection, so ordered.

[The information follows:]

**Letter from Nadia Milleron and Michael Stumo, Submitted for the Record
by Hon. Larsen**

Wednesday, June 12, 2019

Chairman Peter DeFazio
House Transportation Committee
2134 Rayburn Office Building
Washington DC 20515

Dear Chairman DeFazio,

We are a family who lost our daughter, Samya Rose Stumo, on March 10, 2019 in the Ethiopian Airlines crash.

We would like to testify for 5 minutes on June 19 at the House Aviation Subcommittee Hearing featuring stakeholder perspectives. We, as parents of a passenger destroyed by an unsafe aircraft are stakeholders. We are Americans who trusted that our government would only certify safe aircraft. Our daughter trusted and she is dead. Our informed perspective must be included formally to force complete and thorough safety review. We have met with FAA Acting Administrator, Daniel Elwell and NTSB Chairman, Robert Sumwalt for almost 2 hours each.

Thank you for considering our inclusion,

Nadia Milleron and Michael Stumo

Statement of Lori L. Bassani, National President, Association of Professional Flight Attendants, Submitted for the Record by Hon. Larsen

On behalf of the National President of the Association of Professional Flight Attendants (APFA), I am submitting this testimony to the Committee on Transportation and Infrastructure. APFA is the largest mainline Flight Attendant Union in the world and represents the 28,000 plus Flight Attendants of American Airlines. First and foremost, APFA grieves for our professional colleagues, the 12 Flight Attendants who lost their lives in the Lion Air and Ethiopia Airlines crashes, as well as for the 330 passengers and 4 pilots who perished. These people expected the Boeing 737 MAX 8 planes they were flying on and operating to be fit for service. We now know that they were not.

These accidents account for a massive loss of life. In the wake of this loss, we are left with a dire commitment to fulfill. As safety professionals, we in the aviation industry must ensure that accidents like these never happen again. We need our investigative agencies to set aside all political interests to uncover exactly what happened with the MAX 8 and why it happened. We need our agencies to spare no ex-

pense, or time, to ensure that when the 737 MAX returns to the air it is 100% air-worthy.

The members of APFA are and will be on the forefront of the issues surrounding the MAX 8. Aside from Southwest, American Airlines flies the largest fleet of the MAX 8 among all airlines. The 24 planes in our fleet have been pulled from service and this has affected over 100 flights a day. The flying public and schedules of flight crew have been impacted.

Though various parties will be involved in determining the timeline to get the MAX 8 in operation again, as Flight Attendants, we will be the ones fielding the questions and concerns of passengers when the plane is reintroduced. Our Flight Attendants must be included every step of the way as they must be 100 percent comfortable and confident in the aircraft's airworthiness to transport customers and crew.

Let me state that we have the highest regard for our pilots, members of our brother union, the Allied Pilots Association, which represents American Airlines' pilots. We stand in solidarity with APA as they continue to advocate for what they need to feel confident in the aircraft they are flying. Recently, it was reported that our flight deck crewmembers were denied access to a 737 MAX simulator. APA wanted their own safety experts to test this full-motion simulator that has integrated the new fixes for the Boeing MCAS before it went through the FAA certification process. Our pilots expected to be able to test these new systems prior to certification so that their input would have real bearing on the final solution. In a statement last week, Jason Goldberg, a spokesperson for APA said, "We really have no idea why this stance would be taken towards our participation. We can't understand why." We don't either. This is not acceptable. The pilots who fly the 737 MAX every day must be involved, like the Flight Attendants at every step in the reintroduction.

I would like to point out one key issue that must be addressed prior to the 737 MAX going back into service. The overriding question or issue is one of trust. Does the public, and do our Flight Attendants and pilots, trust our management, the FAA, and Boeing to make their decisions solely based on safety?

Let me be clear. While we understand management's position that the grounding of the 737 MAX has created a hardship during the busy summer travel season, financial considerations should never trump safety. We applaud Mr. Ali Bahrami, the FAA's Associate Administrator for Safety, who recently stated that although the FAA is "under a lot of pressure," the MAX would be returned to service only after design reviews, flight testing and the other safety checks are successfully completed. While Mr. Bahrami was reluctant to give a date, he agreed with Boeing's estimate of a return by the end of 2019. We believe the public gets mixed messages when members of AA management make arbitrary statements that the MAX will be "ready to go" by mid-August. Let me assure you that as cabin crew, we spend the greatest amount of time with the traveling public and they rely on us to reaffirm that we have, and will continue to have, the safest aviation system in the world. As Flight Attendant safety professionals, our top priority is safety, period.

To underscore the trust deficit that our regulators and manufacturers have developed, NPR recently polled its listeners and out of 1,600 respondents, over 1,000 said that they would not fly the MAX when it is returned to service.

Again, I have raised the issue of trust because it is the Flight Attendants who will be on the front line when this plane goes back in the air. If the public does not believe that the process of returning the 737 MAX 8 to service is not the result of a thorough, rigorous, and transparent safety-driven process, then this aircraft will likely be forever tainted.

The Transportation and Infrastructure Committee must continue to exercise its constitutionally mandated responsibility to conduct oversight of executive branch agencies. I congratulate Chairman DeFazio and Chairman Larsen for conducting this important hearing. I look forward to future hearings once the FAA approval software and training fixes are announced. Congress must continue its oversight functions on behalf of all people, airline passengers and crew.

Mr. LARSEN. And with that, I will turn to Chair DeFazio for an opening statement.

Mr. DEFazio. Thank you, Mr. Chairman.

This is, of course, our second hearing. I don't think we should be here today. I don't think 346 people should have died, and I believe that this was preventable.

We have family here today who lost a daughter, and we will hear from them at a future meeting. But there are a lot of questions

that still remain unanswered, and we are pressing forward with this as a very comprehensive investigation. A lot of it leads back to the Organizational Designation Authorization process, certification process.

The question about the role of engineers in this process versus that of operators, pilots, and other safety professionals who work on those planes. It is inexplicable to me, and I asked—in the first hearing, I asked the Acting Administrator, I said, is this a safety critical system, MCAS? And he said, yes. And my question then was: How could we allow a safety critical system with a single point of failure? We do not allow that in the aviation industry. Well, the answer from Boeing, at an early meeting after Lion Air was, well, the pilots were the backup system. The pilots didn't know it existed.

And the original system was relatively mild, .6 degrees of deflection, you know, not repeated overrides of the pilot's command, and, you know, that was in the manual. But then the Boeing engineers changed it to 2½ degrees repeated overriding the pilot's decision, and asked the FAA to take it out of the manual. Now, that to me is shocking. It is in the first manual when it is a relatively mild system that kind of is similar to what we are going to—they are proposing with their fix, except it will have two angle-of-attack sensors input and other modifications.

So how could the FAA agree to that? Did they understand what it did? Did anybody understand what this would do? I don't think the implications were fully known.

There have been 14 versions of this plane since 1967. It has been an incredible workhorse airplane. You know, I have flown on one, I am sure, thousands of times. I have flown 6 million miles since I have been in Congress, so many, many, many times. But at some point, you got to think there is a cutoff, where this is a new plane and it is different than the one from 1967. And it shouldn't just be an amended-type certificate, it has to go through recertification. Now, of course, that is a longer process. It is more expensive, it might require pilot retraining. And the question is, why didn't we get to that point with this plane? And that also goes for the longer term looking at the certification ODA process.

Further, we discovered that the disagree light was inoperable in many of the planes, the ones that hadn't bought the extra package, apparently inadvertently, according to engineers. But this was not reported to FAA for a year. And until it became public, Boeing had no intention of fixing that till 2020. Could that have played a role in helping to prevent these tragedies? Well, we will never quite know that, will we? You know, that is unacceptable.

And we have been in touch with both Boeing itself and United Technologies Corporation, who designed that software, to ask for a timeline and some explanation of how they think that is a proper procedure. You know, we are going to hear today from a number of people who are going to provide compelling testimony. I won't go through the list again, others have mentioned it. But I want to thank you for being here today.

We have now begun to receive substantial numbers of documents from both Boeing and the FAA, and I have the oversight staff and the aviation staff going through those documents. And we will, I

expect, fully expect, at a future hearing have the FAA back in and have Boeing in to this committee once we have the documentation digested that we need to ask the meaningful, very pointed questions we will ask.

With that, I yield back the balance of my time.

Mr. LARSEN. Thank you, Chair DeFazio.

I recognize the ranking member of the full committee, Representative Graves of Missouri.

Mr. GRAVES OF MISSOURI. Thank you, Mr. Chairman. And thank you and Ranking Republican Graves for having this hearing. And I also want to express my condolences to the families and friends of the accident victims.

You know, today's hearing is going to focus on how to safely return the 737 MAX back to service. And this process, it has to be careful, it has to be deliberative, and all involved have to be absolutely laser focused on safety. I believe everyone at the FAA and at Boeing understand that to do anything less than that is absolutely unacceptable. We owe it to all of those who tragically lost their lives to get it right.

As this process moves forward, input from the stakeholders, both in the United States and around the world, is going to be very important. And today, the subcommittee is going to hear from some of those stakeholders.

As many of you know, I am extremely proud of our aviation system here in the United States, and much of that pride stems from how safe our system has been. And knowing how imperative it is that we maintain this record and reputation, for that matter, I want to share some of my thoughts on safely ungrounding the 737 MAX.

First, the FAA's process to certify the 737 MAX—to certify the fix on the MAX, it has to be and will be a very intensive process. The FAA is going to conduct technical and operational reviews and assessments, simulator and flight testing. There is going to be evaluations and reevaluations and reevaluations on top of that. And they are also going to share information with and consider the comments and recommendations from the stakeholders that are out there. And ultimately, I anticipate that the FAA is going to issue multiple notices and multiple directives and orders.

In addition, the Technical Advisory Board, or the TAB, and we will hear a lot of about that with experts on there from the FAA, from the U.S. Air Force, from NASA, from the Volpe National Transportation Systems Center, they are all going to conduct parallel and an independent review, and the FAA is going to consider their recommendations in this process.

Boeing is going to need to demonstrate compliance with safety regulations and with the FAA directives. U.S. airlines are also going to have to demonstrate compliance with all FAA directives, and they will need to implement the required training across their fleets.

Internationally, each country is going to have to make its own ungrounding decision. The FAA is going to share information, and they are going to provide assistance as it is requested. And I am glad that the FAA is working with the international regulators to-

wards finding consensus regarding the certification and return to service the 737 MAX.

The second thing is the FAA is working with Boeing, they are working with the airlines, they are working with pilots and international regulators, and they are going to determine what training is going to be required both prior to the ungrounding and as recurrent training obviously moves forward in this process. And I believe it is critically important that we avoid focusing primarily just on pilot training on the old MCAS system and what occurred in the two MAX accidents. Because there is real concern that training to the old system could result in negative training by unintentionally introducing or reinforcing outdated information or inapplicable concepts which could actually decrease safety, and they could, they could actually decrease safety.

The third thing is, I think it is vitally important that we allow for the various investigations and reviews to run their full course before we take any legislative action. To act preemptively would only be—it is only going to be for optics. And for people to be able to say that we did something, that is what that would only be about, rather than solving what I think is an identifiable problem in our system. Aviation accidents rarely have one contributing factor. Those of us who fly, we know that. There is always a number of investigations, and there are a number of investigations that are looking at the certification of the 737 MAX. And if problems are found, I do believe that they have to be addressed.

But in reading the preliminary accident reports as well as obviously many others with a lot of flying experience, many have raised concerns with the pilot training, with pilot experience, with aircraft maintenance, and definitely with airline operations. And all of these issues have to be investigated and they have to be reviewed. To ignore any possible factor or to jump to any predetermined conclusions about those factors, it creates the risk of future accidents that could have been prevented by full and thorough investigations.

And my final thing is we have to avoid politicizing our aviation system. Safety is what the core—it is absolutely at the core of what every pilot, every flight attendant, every air traffic controller, engineer, repairman, manufacturer, every inspector, every operator, and every regulator strives for each and every day. It is the reason why in the last decade here in the United States there have been nearly 7 billion passengers on 90 million commercial flights with 1 fatality. That is a heck of a record for the FAA and the aviation community in the United States, and it is a heck of a record to be very proud of.

And certainly, one loss of life is one too many. But that unprecedented safety record is due to the safety culture of the aviation industry, which includes a collaborative and nonpunitive approach to certification and safety oversight. And we must uphold that strong safety culture and that reputation.

Over the next few months, the FAA and Boeing are going to work hard at ensuring that the safe return of the 737 MAX, that it is safely returned to service. And their progress is obviously going to be very closely monitored, not only by this committee, but by the entire world. But I can say without any hesitation that I believe that the Acting Administrator of the FAA, that I believe him

when he said that the FAA will return the 737 MAX to service in the United States only—only when it determines, based on the facts and technical data, that it is safe to do so. Only then will it happen.

So, again, I want to thank you, Chairman, for having 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 would also like to again express my condolences to the friends and families of the accident victims.

The focus of today's hearing is how to *safely* return the 737 MAX to service. This process must be careful and deliberative, and all involved must be laser-focused on safety. I believe everyone at the FAA and Boeing understand that to do anything less is absolutely unacceptable.

We owe it to all those who tragically lost their lives to get this right.

As this process moves forward, input from stakeholders, both in the United States and around the world, is very important. Today the Subcommittee will hear from *some* of those stakeholders.

As many of you know, as a pilot I am extremely proud of our aviation system in the U.S., and much of that pride stems from how safe our system has been. Knowing how imperative it is that we maintain this record and reputation, I want to share some of my thoughts on safely ungrounding the 737 MAX.

First, the FAA's process to certify the 737 MAX fix must be—and will be—intensive. The FAA will conduct technical and operational reviews and assessments, simulator and flight testing, and evaluations and reevaluations. They will also share information with, and consider comments and recommendations from, stakeholders. Ultimately, I anticipate that the FAA will issue multiple notices, directives, and orders.

In addition, the Technical Advisory Board (TAB), with experts from the FAA, the U.S. Air Force, NASA, and the Volpe National Transportation Systems Center will conduct a parallel and independent review, and the FAA will consider their recommendations.

Boeing will need to demonstrate compliance with safety regulations and FAA directives. U.S. airlines will also have to demonstrate compliance with FAA directives, and they will need to implement required training across their fleets.

Internationally, each country will make its own ungrounding decision, and the FAA will share information and provide assistance as requested.

I am glad that the FAA is working with international regulators towards finding consensus regarding the certification and return to service of the 737 MAX.

Second, the FAA is working with Boeing, airlines, pilots, and international regulators, and will determine what training will be required, both prior to the ungrounding and as recurrent training going forward.

I believe it is critically important that we avoid focusing pilot training on the old MCAS system and what occurred in the two MAX accidents. There is a real concern that training to the old system could result in negative training by unintentionally introducing or reinforcing outdated information or inapplicable concepts, which could actually decrease safety.

Third, it is vitally important that we allow the various investigations and reviews to run their course before we take legislative action. To act preemptively would only be for optics—for people to be able to say we did something—rather than solving an identifiable problem in our system.

Aviation accidents rarely have one contributing factor. There are a number of investigations looking at the certification of the 737 MAX, and if problems are found they must be addressed. But, in reading the preliminary accident reports I, as well as many others with flying experience, have also raised concerns with pilot training, pilot experience, aircraft maintenance, and airline operations. All of these issues must also be investigated and reviewed.

To ignore any possible factor or to jump to predetermined conclusions about those factors creates the risks of future accidents that could have been prevented by full and thorough investigations.

Finally, we must avoid politicizing aviation safety. Safety is at the core of what every pilot, flight attendant, controller, engineer, repairman, manufacturer, inspector, operator, and regulator strives for each and every day. It is the reason that in the last decade in the United States, there have been nearly 7 billion passengers on 90 million commercial flights, with only one fatality. That is a heck of a record for the FAA and aviation community in the U.S. to be proud of. Certainly, one life lost is one too many, but that unprecedented safety record is due to the safety culture of the aviation industry, which includes the collaborative, non-punitive approach to certification and safety oversight. We must uphold that strong safety culture.

Over the next few months, the FAA and Boeing will be hard at work ensuring the safe return to service of the 737 MAX. Their progress will be closely monitored not only by this committee but by the world. But I can say without any hesitation that I believe the Acting Administrator of the FAA when he said, "the FAA will return the 737 MAX to service in the United States only when [it] determine[s], based on facts and technical data, that it is safe to do so."

Thank you again for holding today's hearing.

Mr. LARSEN. Thank you, Representative Graves.

I want to now welcome our witnesses. I am not going to read titles and biographies, but we will have Sharon Pinkerton from A4A; Captain Dan Carey of Allied Pilots; Captain Chesley Sullenberger, retired pilot; Sara Nelson from the AFA-CWA; and Honorable Randy Babbitt, former Administrator, FAA.

And I recognize each of you for 5 minutes. Without objection, though, our witnesses' full statements will be included in the record. Since it has been made part of the record, we request you limit your oral testimony to 5 minutes.

And first, we will recognize Sharon Pinkerton for 5 minutes.

TESTIMONY OF SHARON PINKERTON, SENIOR VICE PRESIDENT, LEGISLATIVE AND REGULATORY POLICY, AIRLINES FOR AMERICA; CAPTAIN DANIEL CAREY, PRESIDENT, ALLIED PILOTS ASSOCIATION; CAPTAIN CHESLEY B. "SULLY" SULLENBERGER III, PILOT, US AIRWAYS (RETIRED); SARA NELSON, INTERNATIONAL PRESIDENT, ASSOCIATION OF FLIGHT ATTENDANTS—CWA, AFL-CIO; AND HON. J. RANDOLPH BABBITT, FORMER ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION

Ms. PINKERTON. Good morning. Chairman DeFazio, Ranking Member Graves, Chairman Larsen, Ranking Member Graves, thank you for having this hearing today. My name is Sharon Pinkerton. I am the senior vice president for policy at Airlines for America. It is an honor and privilege to be here today to talk about aviation safety. Nothing is more fundamental to this industry than a commitment to safety.

U.S. carriers have led the world in aviation safety for decades, and we are very proud of that record, but the events that are bringing us here today have humbled us. These are sobering tragedies. And as an industry, as Americans, as human beings, we mourn the lost lives on Lion Air flight 610 and Ethiopian Airlines flight 302.

I want to convey, not just our condolences, but also our industry's commitment to support policies and actions that are going to help ensure the highest level of aviation safety.

Our industry doesn't simply shrug off failures like this; we fixate on root and proximate causes in order to learn from what happened, and take that knowledge to better ensure the safety of our passengers and crew.

As an industry, we are constantly challenging ourselves to meet and exceed the highest levels of safety. It has to be said that travel on U.S. passenger carriers remains exceptionally safe, as the committee knows, because you have played a role in shaping this system. We have flown almost 8 billion people on 94 million flights over the last 10 years. And in that time, there was one fatality, and although that is too many, our record is remarkable.

Commercial aviation remains the safest mode of transportation by a wide margin, but we cannot and we will not rest on the status quo, and that is our promise to you and to the families that are here.

As you know, several authorities are still reviewing the two overseas accidents. It is important to allow those investigations to conclude before rendering final judgment. But we know from experience that there are usually several factors, not just one, that contribute to any accident. While we wait for the findings and recommendations, Boeing has taken responsibility and pledged to make improvements by updating the flight control software. Our response must be deliberate, rely on facts and data, before we form recommendations, which is how the FAA is approaching these accidents.

The FAA's safety and regulatory framework is the gold standard in the world, and our safety record is the proof of that. We have a culture of collaboration in aviation where everyone throughout the system, public and private employees, manufacturers, carriers, everyone is encouraged to speak up and speak out if they see a potential safety issue.

The industry does work closely with the FAA, and we believe that a transparent and collaborative relationship is critical to making the safest aviation system in the world even safer.

Our safety record is the result of deliberate and systemic improvements over many years. We have moved from an early 1990s very forensic approach, looking back to determine what happened, to a very proactive and predictive data-driven approach to determine that anticipates and prevents accidents before they occur.

It was really in the mid-1990s that the industry and the FAA started to rely more on data: data from the plane, data from our employees, data from the controllers. The Commercial Aviation Safety Team, or CAST, was formed to give all of the players, labor unions, operators in the FAA, manufacturers, a seat at the table to share information. And the 1996 FAA bill provided protection to entities to help create a safe environment for that information sharing. The Aviation Safety Information Analysis and Sharing program, otherwise known as ASIAS, represents the overarching program that connects all of the FAA's safety programs and shares data from across those programs and uses that information to identify risk and develop mitigation strategies.

What is extraordinary about how this industry approaches data sharing, it is unique to the aviation mode. Aviation data is not pro-

prietary. We don't compete. We communicate and we collaborate when it comes to safety.

With respect to the impacts of the grounding of the MAX on passengers, there were three U.S. carriers that were operating the MAX when the aircraft was grounded in March; those carriers immediately began reassigning existing resources to minimize disruption passengers. Fortunately, carriers were able to accommodate over 99 percent of impacted travelers through rebooking and re-routing.

Of course, the question still remains, when will the MAX be returned to service? And the answer is, not before the FAA, working with our pilots, certifies that it is safe, and not before adequate training is performed.

The FAA, working closely with our pilots unions, our technical experts—

Mr. LARSEN. Ms. Pinkerton, I am going to have to ask you to wrap up.

Ms. PINKERTON [continuing]. And Boeing, is engaging in a rigorous process.

I will close by saying safety is something not that our industry doesn't take for granted, and we never will. For us in the aviation community, our hearts break for the family members. However, we take solace in the fact that there are dedicated professionals, both public and private, that will do everything they can to maintain our tremendous safety record and build on it moving forward.

Thank you.

[Ms. Pinkerton's prepared statement follows:]

**Prepared Statement of Sharon Pinkerton, Senior Vice President,
Legislative and Regulatory Policy, Airlines for America**

Chairman Larsen, Ranking Member Graves, Members of the Committee,
Before I begin, on behalf of our industry, I would like to offer both profound and heartfelt condolences to the families, friends and loved ones of the passengers and crew members aboard both Lion Air 610 and Ethiopian Airlines 302 as well as our commitment to actions and policies to help ensure the highest level of aviation safety. Our hearts and thoughts are with them.

My name is Sharon Pinkerton and I am the Senior Vice President of Legislative and Regulatory Policy for Airlines for America (A4A). Thank you for the opportunity to testify. We welcome and appreciate the opportunity to discuss our most important and paramount priority, aviation safety.

Nothing is more foundational to our industry than our deep commitment to safety; it is an ingrained second nature that touches every aspect of our global industry. The entire aviation community understands that safety is the bedrock upon which consumer confidence is built. When it comes to safety, our baseline is perfection. When perfection is not attained, it is critical we undertake a methodical and deliberate review of all the components of our extremely complex and technical system to make sure we isolate problems and identify the fixes necessary to make our system better. As an industry, we look forward to playing a constructive role in building upon and improving the tremendous safety record we have all worked so hard to achieve. That's why the flying public can have tremendous confidence in the U.S. airline industry today. We have an unparalleled safety record that any other industry—let alone any other mode of transportation—should envy. We must not lose sight of the fact that aviation is THE safest mode of transportation by any measure.

AVIATION SAFETY—FACTS MATTER

Safety of our passengers and employees is at the core of U.S. airline operations and everything we do. The unprecedented safety record of U.S. carriers has been the result of deliberate and systemic improvements over many years. We've moved

from a forensic approach of determining what happened in aviation accidents to a proactive, data-driven approach which identifies risks and hazards aimed at preventing accidents before they occur.

The nation's impressive commercial aviation safety record is due in large part to the aviation industry and government voluntarily investing in calculated safety enhancements to further reduce the nearly infinitesimal fatality risk in U.S. commercial air travel. For example, the work of the Commercial Aviation Safety Team (CAST) data driven regulations, and other industry safety activities, contributed to reducing the fatality risk for commercial aviation in the U.S. by 83 percent from 1998 to 2008. Today, the CAST aims to reduce the remaining risk (50 percent) by 2025 by further leveraging industry data and analytical tools from the Aviation Safety Information Analysis and Sharing Program (ASIAS). These efforts and others like them have helped the U.S. achieve the safest period in its history.

Because there are few commercial aviation accidents and no common causes, more data points are needed. Voluntary programs such as the Aviation Safety Action Program (ASAP), Flight Operational Quality Assurance (FOQA) program and Air Traffic Safety Action Program (ATSAP) give air carriers and the government insight into millions of operations so potential systemic safety issues and trends can be identified.

Together with our industry partners, the FAA and labor, we identify and manage risk through several collective efforts and those voluntary programs. For example, the ASAP encourages voluntary reporting of safety issues and events that come to the attention of pilots, cabin crew, mechanics and dispatchers. ASAP is based on a safety partnership that includes the FAA, the certificate holder and employee labor organizations. Employees report instances of noncompliance and safety concerns without fear of recrimination. ASAP reports are analyzed and evaluated, and corrective measure are taken by the industry to address the safety concerns raised.

Similarly, CAST and ASIAS represent long-standing commitments to building safety partnerships between government and industry that focus on pursuing safety improvements in a collaborative and proactive manner. ASIAS connects a wide variety of voluntarily provided safety data from airline aircraft performance data and safety reports as well as other information sources from across industry. The ASIAS program works closely with a variety of integrated safety teams to analyze safety data, identify risks and develop mitigation strategies. The program continues to evolve but has matured to the point that it now incorporates voluntarily provided safety data from operators that represent 99 percent of U.S. air carrier operations in the National Airspace System (NAS).

While any loss of any life is tragic, the odds of suffering a fatality are far greater as a pedestrian, riding a bike, being a passenger in a car or even being struck by lightning, based on data from the collaborative efforts between government and industry to improve aviation safety.

We strongly believe the FAA's safety and regulatory framework is the gold standard in the world, and our U.S. safety record demonstrates its success. As an industry, we will continue to adapt to change; identify new risks and hazards; collectively and collaboratively analyze risk; develop mitigation strategies; and continue to make the safest airspace system in the world even safer. Our continued success depends on these strong partnerships built on trust.

INDUSTRY IMPACT, ASSESSMENT AND RESPONSE

For A4A member airlines that operated the 737 MAX, the FAA decision to ground the aircraft created several immediate operational challenges. These challenges were most acute at the onset of the grounding as carriers were forced to make quick operational decisions to accommodate passengers and adjust schedules. The extent of the necessary adjustments varied based on overall fleet size, segments operated, available spare aircraft and other factors. Below is a table showing the 737 MAX aircraft in U.S. airline fleets as of March 31, 2019:

U.S. Airline	737 MAX Fleet as of 3/31/19
Southwest	34
American	24
United	14
Subtotal USA	72

Impacted carriers immediately started a process of forensically analyzing their individual operations for available aircraft to cover flight segments in order to minimize customer disruption as much as possible. While each carrier dealt with the situation in a manner consistent with their respective business, in general, the industry employed an array of mechanisms to cope with the disruptions, including but not limited to:

- Trimmed 2019 capacity growth;
- Incorporated spare aircraft into the active schedule;
- Increased daily utilization of other aircraft types;
- Deferred some painting, Wi-Fi installation/upgrades, and selected other discretionary enhancements;
- Reduced frequency on longer routes where alternative routings were practicable;
- Temporarily suspended lighter routes;
- Leveraged automated rebooking tools (99 percent of passengers rebooked within 24 hours); and
- Consideration of leasing additional aircraft or deferring retirements.

In the initial days after the grounding, it was unclear how long the aircraft would remain grounded. Given the uncertainty, carriers made schedule adjustments in order to accommodate the loss of the aircraft for three- to four-week periods. Many of those short-term plans have now been extended for months. The lack of certainty remains to this day, which means carriers will have to continuously revisit schedules and operational plans as the situation progresses. The bottom line is that impacted air carriers will do everything they can to make sure customers are accommodated.

Fleet management is a continual challenge. As the Committee knows, U.S. airlines have been making significant upgrades to their fleets over the past decade, which means new aircraft are coming on-line every day, including several 737 MAX. In addition to the scheduling accommodations made for existing aircraft, carriers have had to adjust flight schedules and service plans based on the unknown delivery schedule. Following is a table of 737 MAX orders for A4A members as of March 31, 2019:

A4A Member Airline	On Order as of 3/31/2019
Southwest	268 (44 in the remainder of 2019)
American	76 (16 in the remainder of 2019)
United	171 (16 in the remainder of 2019)
Alaska	32 (3 in the remainder of 2019)
Subtotal USA	515 (76 in the remainder of 2019)
Air Canada	37 (12 in the remainder of 2019)

As indicated, several dozen 737 MAX aircraft were slated for delivery between the date of the grounding and the remainder of the year, and the return of the aircraft is generally not expected in time for the peak summer travel season. In fact, A4A has projected summer 2019 air travel on U.S. airlines to rise for the tenth consecutive year to an all-time high of 257.4 million passengers (2.8 million per day). The more 737 MAX time is built into the schedule, the more aircraft time is needed to cover lost availability. A4A estimates 737 MAX-related summer flying reductions of approximately 250 daily flights and 43,000 daily seats for American, Southwest and United alone. This pull-down in capacity is likely to put upward pressure on load factors.

The high load factors and use of spare aircraft for active flying—to partially offset the void left by the grounded MAX fleet—will make irregular operations caused by severe weather or other factors more difficult to mitigate. Carriers are preparing accordingly and will continue to be as nimble as possible to provide a seamless operation, capitalizing on investments in equipment, staff and training made over the past several years.

AIRWORTHINESS—RETURN TO SERVICE DECISION

As noted, there is currently significant uncertainty related to the timeline upon which the 737 MAX will be approved to return to service. However, we recognize and agree that a full and robust process of analyzing and testing any software de-

sign and training requirements is of the utmost importance and the first step toward re-establishing public confidence. Boeing has indicated they have put the software update through hundreds of hours of analysis, laboratory testing, verification in a simulator, and test flights. As the industry continues to await guidance from Boeing and the FAA on the impending 737 MAX software enhancements and training requirements, we are encouraged by the reported progress and proposed path forward for returning the aircraft to service. We are confident that, once certified by the FAA, the proposed enhancements will support the safe operation of the MAX—making the aircraft one of the safest in the sky. We are confident in our employees, procedures, airplanes, training, maintenance, and performance monitoring systems. Boeing has said that the software update will provide another layer of safety to the operation of the MAX aircraft. We look forward to the FAA's final guidance and will fully comply with any modifications and additional training requirements to strengthen the reliability of the 737 MAX.

We fully expect the 737 MAX eventually will be deemed airworthy and will return to service. When that decision is made, each carrier will take specific steps based on its operations, maintenance and training programs. In fact, much of the planning has been on-going since the initial removal from service. Multiple departments at the airlines including aircraft maintenance, training, crew planning and scheduling as well as network planning and scheduling have roles in returning the aircraft to service. While specific timing may vary, generally, once the 737 MAX is approved for return to service several steps will be taken, including but not limited to:

- Necessary modifications to software and/or physical installations resulting from the Maneuvering Characteristics Augmentation System (MCAS) review must be implemented, completed and inspected;
- While A4A members who operate the 737 MAX support the findings of the FAA Flight Standards Board (FSB) for Level B training and checking for the MCAS system, we are awaiting a release of training guidance and will review and comment once that training guidance has been issued.
- Assurance that aircraft are in compliance with all current Airworthiness Directives that may have been issued or that became due during the out-of-service period;
- Assurance that any calendar-scheduled maintenance tasks are accomplished;
- Accomplish all pre-flight service checks per applicable maintenance manuals;
- Review the aircraft's Maintenance Logbook and execute an Airworthiness Release for flight; and
- Execute any required maintenance flight tests.

We are confident that the collaborative global process the FAA has undertaken will eventually lead to a decision that will be supported by manufacturers, operators, pilots and foreign regulatory bodies as well as the flying public. The FAA has been transparent with international regulators throughout this process by sharing their safety response to these accidents as well as their data and testing. Make no mistake, it will take a significant amount of work, but a collaborative message and understanding will go a long way toward building public confidence in the aircraft. We look forward to playing a constructive role in that process.

RECOMMENDATION

We believe it is more important than ever that we make fact-based data-driven decisions when it comes to policy toward our aviation safety system. Our industry has learned over the decades to wait for ongoing investigations to conclude before rushing to judgment. Our aviation system is safer than ever, and the U.S. commercial aviation safety record is second to none.

Our safety record has evolved over decades with collaboration between the FAA, manufacturers, air traffic controllers, pilots, operators and many others. An open culture of effective collaboration should not be misconstrued with coziness. There is no doubt or disagreement that a balance is needed when it comes to a regulator and the industry it oversees, but factual assessment of the results achieved by that relationship should weigh heavily on the minds of those so anxious to change it. Airlines do not compete when it comes to safety. Safety is simply not something anyone in our industry takes for granted, and it never will.

Mr. Chairman, I would be remiss not to take the opportunity to thank you for your work on H.R. 1108, the Aviation Funding Stability Act of 2019. We sincerely appreciate the Committee's leadership and focus on practical solutions to mitigate federal shutdown impacts. As you know, the impact of government shutdowns is particularly acute on the aviation industry. With a robust FAA Airport and Airway Trust Fund balance there is absolutely no reason that thousands upon thousands of people should be forced to work without pay. As we look down the barrel of yet

another controversial budget and funding season—we will continue to support your efforts. The systemic approach to improving aviation safety means you fixate on and reduce risk across all components. I think we can all agree, taking government shutdowns out of the picture will certainly improve our system.

Thank you for the opportunity to testify. I look forward to your questions.

Mr. LARSEN. Thank you.

Captain Carey, 5 minutes as well. Be sure, everyone, that you are pulling the microphone right up to your mouth.

Captain Carey, 5 minutes. Thank you.

Mr. CAREY. Good morning, Chairman Larsen, Ranking Member Mr. Graves of Missouri, Chairman DeFazio, Ranking Member Mr. Graves of Louisiana, honorable members of this committee. My name is Captain Daniel Carey. I am a 35-year career pilot at American Airlines. I am also president of the Allied Pilots Association, the largest independent airline pilots union in the world.

I also serve as a member of the board of the Coalition of Airline Pilots Associations here in Washington, a trade group representing 32,000 professional airline pilots whose concern is safety and security of the traveling public.

The piloting profession is in my family. My father and two uncles were fighter pilots in World War II, one of whom lost his life in the service of our Nation. My father was an early pioneer with Trans World Airlines, and my daughter pursues a professional career as a commercial pilot today.

I would also like to recognize the family of Samya Stumo, who is here today. God bless you all. Samya was a young woman as well, pursuing her career and young life, and tragically lost her life on ET 302.

Mr. Chairman and members of the committee, what brings us together today is the tragic accidents of two Boeing MAX aircraft. We owe it to those 346 souls and the flying public around the world to make sure these kinds of events never happen again.

In my 35-year career at American Airlines, I have operated as captain on five different types of airplanes, 28 years on Boeing aircraft. I am here to tell you, Boeing designs and engineers and manufactures superb aircraft.

Unfortunately, in the case of the MAX, I will have to agree with the Boeing CEO, they let the traveling public down in a fatal and catastrophic way. As said here earlier by some of the speakers, we will await the conclusion of the several investigations underway around the world before we determine the final judgment of the MAX disasters.

There are a few facts we do know. The MAX was designed to provide the same aircraft feel as the 737. This was intended to minimize costs to Boeing's customers by allowing the MAX to be certified as a 737 typed aircraft. This led Boeing engineers to add the MCAS system. Many mistakes were subsequently made by Boeing, as the MCAS was designed as a federated, not an integrated aircraft system.

As a single port of failure, this design meant that the redundancy of the system went back to the captain and first officer of the aircraft. The huge error of omission was the fact that Boeing failed to disclose the existence of the MCAS system to the pilot community around the world. The final fatal mistake was, there-

fore, the absence of robust pilot training in the event of an MCAS failure.

The most important issue now is the question of the airworthiness of the MAX aircraft. I believe the Boeing engineers have indeed found the problems to the software problems—issues facing the MAX. And, therefore, the redundancies are now embedded in the aircraft in the event of a misfiring of the MCAS going forward. However, at APA, we remain concerned about whether the new training protocol, materials, and methods of instruction suggested by Boeing are adequate to ensure that pilots across the Nation and around the world can operate the MAX fleet with absolute and complete safety.

In fact, during a meeting with the FAA in April, the FAA officials highlighted a critical checklist that Boeing directed pilots to use to recover the MAX after an MCAS firing. The FAA officials stated that this critical checklist had not been validated since 1967. This is an example of why the APA has integrated into the flight standardization board comments, calling for the review, improvement, and training of critical MCAS misfire recovery checklists.

I don't have all the answers today, nobody does, but I do have some questions. First, is the FAA sufficiently independent of the manufacturers as to provide legitimately rigorous audit of manufacturing design and engineering? Second, should a federated system, which may lead to an unrecoverable event, be certified ever by the FAA? Third, should the FAA aircraft certification, as for example, a 737 designation from 1967, have a timeline or a sunset date? Finally, is the FAA sufficiently equipped to ensure that pilot training protocols are vigorous and robust as aircraft become more and more sophisticated?

Mr. Chairman, these are among the questions that I hope this committee examines, and of course, there are many others. Unfortunately, as pilots know, improvements in aviation are often, too often, written in the blood of the unfortunate victims of these airplane accidents. But all of us—pilots, flight attendants, airline companies, manufacturers, the executive branch of our government, and Congress—owe it to the victims at the highest level of diligence to make sure these kind of accidents never happen again.

This is a global aviation crisis of trust and will require global solutions to restore and bolster culture and respect—

Mr. LARSEN. I am going to have to ask you to wrap up.

Mr. CAREY. The pilots of the Allied Pilots Association are humbled and proud to be part of this noble cause. Thank you, and I look forward to your questions.

[Mr. Carey's prepared statement follows:]

Prepared Statement of Captain Daniel Carey, President, Allied Pilots Association

Good morning, Chairman Larsen and Ranking Member Mr. Graves of Louisiana. Good morning, Chairman DeFazio and Ranking Member Mr. Graves of Missouri. Good morning to you, Honorable Members of the Committee.

My name is Daniel Carey. I am a 35-year career captain with American Airlines and president of the Allied Pilots Association. The Allied Pilots Association is the largest independent pilot union in the world. I am not just privileged, but honored to represent the 15,000 professional men and women pilots of American Airlines. I can tell you that they are an outstanding group of professional pilots dedicated to

ensuring the safe passage of all people who fly on American Airlines in our country and around the world. I am also a member of the board of the Coalition of Airline Pilots Associations, a trade association representing 32,000 professional pilots dedicated to airline safety and security.

The piloting profession is in my DNA. My father and two uncles were distinguished World War II fighter pilots who served our nation, one of whom gave his life. My father was also an early pilot pioneer for Trans World Airlines. My daughter, his granddaughter, continues the family tradition as a commercial pilot.

Mr. Chairman and Members of the Committee, what brings us together today are the tragic accidents involving two Boeing 737 MAX aircraft. The hearts of all our 15,000 American Airlines pilots go out to the families, friends and associates of the 346 souls lost in the Lion Air and Ethiopian Air crashes. We owe it to those lost souls and to the flying public, worldwide, to make sure these kinds of events never happen again.

In my 35-year career at American Airlines, I have flown as Captain in five models of American's aircraft with more than 28 years on Boeing aircraft. My professional view is that the Boeing Corporation has manufactured superbly engineered and designed aircraft over many decades. Unfortunately, in the matter of the 737 MAX, I completely agree with the Boeing CEO's assessment that the company let down the public with catastrophic consequences.

As professional pilots, we understand that the ultimate conclusion regarding the causes of these accidents must await the final findings of the exhaustive investigations underway.

There are certain facts we know:

1. The 737 MAX was designed to provide the same aircraft feel to the pilots as the 737. This was intended to minimize the operating cost to Boeing's customers by allowing the MAX to be certified by the FAA as a 737. The point was to provide Boeing's customers with a new advanced aircraft while minimizing the training cost associated with a different aircraft certification. This led Boeing's engineers to add the MCAS system. Many mistakes were subsequently made by Boeing engineers as MCAS was designed as a "federated" not "integrated" system. As a single-point-of-failure design, this meant that any redundancy to the system, if it failed, was completely dependent on the Captain and First Officer of the aircraft.
2. The huge error of omission is that Boeing failed to disclose the existence of MCAS to the pilot community.
3. The final fatal mistake was, therefore, the absence of robust pilot training in the event that the MCAS failed.

I can tell you that the members of APA are offended by remarks made by those who seem to blame the pilots killed in those two crashes. Some negative aspersions have appeared in the press relating to the quality of pilots trained in Africa. I am here to tell you that I worked in Africa and trained African pilots to fly large aircraft. I am very familiar with Ethiopian Air's pilot training program and facilities, and I can tell you that they are world-class. In fact, while not one U.S. airline has a MAX simulator, one non-U.S. airline does—Ethiopian Air. To make the claim that these accidents would not happen to U.S.-trained pilots is presumptuous and not supported by fact. Vilifying non-U.S. pilots is disrespectful and not solution-based, nor is it in line with a sorely needed global safety culture that delivers one standard of safety and training. Simply put, Boeing does not produce aircraft for U.S. pilots vs. pilots from the rest of the world.

The most important issue now is the question of the airworthiness of the 737 MAX fleet. I believe that the Boeing engineers have indeed made significant positive changes with the new software fixes, many of which our pilots demanded when we met with Boeing officials in November 2018. There are now redundancies embedded in the aircraft in the event of the "firing" of MCAS. However, at APA we remained concerned about whether the new training protocol, materials and method of instruction suggested by Boeing are adequate to ensure that pilots across the globe flying the MAX fleet can do so in absolute complete safety.

In fact, during a meeting with the FAA on April 12, 2019, with U.S. airlines and pilot unions, FAA officials highlighted a critical checklist that Boeing directed pilots to use to recover the MAX after an MCAS misfire. The FAA official stated that this critical checklist had not been validated since 1967, noting that the 737 has been dramatically modified many times since. The FAA official cited potential issues with pilot "manual trim effort" required and challenging "elevator loads" confronting pilots when this checklist is executed. This is an example of why APA's comments to the Flight Standardization Board include calling for a review, improvement and training of critical MCAS misfire recovery checklists.

With regard to the public policy issues generated by the fatal MAX crashes, the foremost and most urgent, in my view, is assessment of the adequacy of the FAA aircraft certification process. This is a complex subject because the certification process is extremely sophisticated. So, I do not have all the answers about ways to improve the FAA aircraft certification process, but I do have some questions:

1. First, is the FAA sufficiently independent of the manufacturers so as to provide a legitimately rigorous audit of the manufacturers' design and engineering?
2. Second, should a "federated" system, which may lead to an unrecoverable event, ever be certified by the FAA?
3. Third, should an FAA aircraft certification—such as a 737 designation from 1967—have a date for termination or sunset?
4. Finally, is the FAA sufficiently equipped to ensure that pilot training protocols are vigorous and robust as aircraft are becoming more and more technologically sophisticated?

Mr. Chairman, these are among the questions that I respectfully hope this committee examines. Of course, there are many others as well. Unfortunately, as pilots know, improvements in aviation are often written in the blood of the unfortunate victims of airplane accidents. But all of us—the pilots, flight attendants, airline companies, manufacturers, the executive branch of our government, and Congress—owe those victims the highest level of diligence to make sure these kinds of accidents never happen again.

This is a global aviation crisis of trust and will require global solutions to restore and bolster aviation's global safety culture and reputation. As sad and grim as these crashes were, there is an opportunity to lead and bring something positive out of this darkness. As the last line of defense for our passengers, the members of the Allied Pilots Association are humbled and proud to be a part of this noble cause.

Thank you and I look forward to your questions.

Mr. LARSEN. Thank you.

The Chair now recognizes Captain Chesley B. Sullenberger III, for 5 minutes.

Mr. SULLENBERGER. Thank you, Chairman Larsen, Ranking Member Graves, Chairman DeFazio, Ranking Member Graves, and other members of the committee. It is my honor to appear today before this Subcommittee on Aviation. Like Americans and many others around the world, I am shocked and saddened by these two awful tragedies and terrible loss of life.

I just met the parents of 24-year-old Samya Stumo, and I saw in their eyes the incomprehensible immensity of their loss. These crashes are demonstrable evidence that our current system of aircraft design and certification has failed us. These accidents should never have happened. The accident investigations of these crashes will be not completed but for many months, but some things are clear, accidents are the end result of a causal chain of events, but in this case, the chain began with decisions that had been made years before to update a half-century-old design.

Boeing added MCAS, but the existence of it was not communicated to pilots until after the first crash. Some have said that even though MCAS software had flaws, the pilots on these flights should have performed better and been able to solve the sudden, unanticipated crisis they faced. Boeing has said that they did not categorize a failure of MCAS as more critical because they assumed that pilot action would be the safeguard.

From my 52 years of flying experience and my many decades of safety work, I know that we must consider all the human factors of these accidents and how system design determines how many and what kinds of errors will be made and how consequential they will be. These two recent crashes happened in foreign countries. But if we do not address all the important issues and factors, they can and will happen here.

We owe it to everyone who flies, passengers and crews alike, to make sure that pilots will be able to handle an unexpected emergency and keep their passengers and crew safe, but first, we should design aircraft for them to fly that do not have inadvertent traps set for them.

I am one of a relatively small group of people who have experienced such a crisis and lived to share what we learned about it. I can tell you firsthand that the startle factor is real and it is huge. It absolutely interferes with one's ability to quickly analyze the crisis and take effective action.

Within seconds, these crews would have been fighting for their lives in the fight of their lives. In both 737 MAX accidents, the failure of a single angle-of-attack sensor quickly caused multiple instrument indication anomalies and sudden loud and in some cases false warnings, creating major distractions, masking the cause, and would have made it even harder to quickly analyze the situation and take effective corrective action.

I recently experienced all these warnings in a 737 MAX flight simulator during recreations of the accident flights. Even knowing what was going to happen, I could see how crews could have run out of time before they could have solved the problems.

Prior to these accidents, I think it is unlikely that any U.S. airline pilots were confronted with this scenario in simulator training. We must make sure that everyone who occupies a pilot seat is fully armed with the information, knowledge, training, skill, judgment and experience to be the absolute master of the aircraft and all its component systems and of the situation simultaneously and continuously throughout the flight.

As aviation has become safer, we can no longer define safety solely as the absence of accidents. We must do much more than that, we must be more proactive than that. In essence, we must investigate accidents before they happen. We should all want pilots to experience these challenging situations for the first time in a simulator and not in flight with passengers and crew on board. And reading about it on an iPad is not even close to sufficient. Pilots must experience it physically firsthand.

If we don't learn from these crashes, if we just file the findings away on a shelf to gather dust, we will only compound these tragedies. We will make the loss of lives in these accidents even more tragic if we say that these were just black swan events, unlikely to happen again, and decide not to act and, instead, just protect the status quo.

Only by discovering and correcting the ways in which these tragedies occurred can we begin to regain the trust of our passengers, flight attendants, pilots, and the American people.

[Mr. Sullenberger's prepared statement follows:]

**Prepared Statement of Captain Chesley B. "Sully" Sullenberger III, Pilot,
US Airways (Retired)**

Thank you, Chairman Larsen, Ranking Member Graves, Chairman DeFazio, Ranking Member Graves, and other members of the committee. It is my honor to appear today before the Subcommittee on Aviation.

We are here because of the tragic crashes within five months of Lion Air 610 and Ethiopian 302, two fatal accidents with no survivors on a new aircraft type, something that is unprecedented in modern aviation history.

Like most Americans and many others around the world I'm shocked and saddened by these two awful tragedies and the terrible loss of life. Now we have an obligation to find out why these tragic crashes happened, and keep them from ever happening again.

These crashes are demonstrable evidence that our current system of aircraft design and certification has failed us.

We don't yet know in every way how it has failed us. Multiple investigations are ongoing. We owe it to everyone who flies to find out where and how the failures occurred, and what changes must be made to prevent them from happening in the future.

It is obvious that grave errors were made that have had grave consequences, claiming 346 lives.

The accident investigations of these crashes will not be completed for many months, but some things are already clear.

Accidents are the end result of a causal chain of events, and in the case of the Boeing 737 MAX, the chain began with decisions that had been made years before, to update a half-century-old design.

Late in the flight testing of the 737 MAX, Boeing discovered an aircraft handling issue. Because the 737 MAX engines were larger than the engines on previous 737 models they had to be mounted higher and farther forward for ground clearance, which reduced the aircraft's natural aerodynamic stability in certain conditions. Boeing decided to address the handling issue by adding a software feature, Maneuvering Characteristics Augmentation System (MCAS), to the 737 MAX. MCAS was made autonomous, able in certain conditions to move a secondary flight control by itself to push the nose down without pilot input.

In adding MCAS, Boeing added a computer-controlled feature to a human-controlled airplane but without also adding to it the integrity, reliability and redundancy that a computer-controlled system requires.

Boeing also designed MCAS to look at data from only one Angle of Attack (AOA) sensor, not two. One result of this decision was that it allowed false data from a single sensor to wrongly trigger the activation of MCAS, thus creating a single point of failure. A single point of failure in an aircraft goes against widely held aircraft design principles.

On both accident flights, the triggering event was a failure of an AOA sensor. We do not yet know why the AOA sensors on these flights generated erroneous information, triggering MCAS, whether they were damaged, sheared off after being struck, were improperly maintained or repaired, or for some other reason.

Boeing designers also gave MCAS too much authority, meaning that they allowed it to autonomously move the horizontal stabilizer to the full nose-down limit.

And MCAS was allowed to move the stabilizer in large increments, rapidly and repeatedly until the limit was reached. Because it moved stabilizer trim intermittently, it was more difficult to recognize it as a runaway trim situation (an uncommanded and uncontrolled trim movement emergency), as appears to have happened in the first crash.

Though MCAS was intended to enhance aircraft handling, it had the potential to have the opposite effect; being able to move the stabilizer to its limit could allow the stabilizer to overpower the pilots' ability to raise the nose and stop a dive toward the ground. Thus it was a trap that was set inadvertently during the aircraft design phase that would turn out to have deadly consequences.

Obviously Boeing did not intend for this to happen. But to make matters worse, even the existence of MCAS, much less its operation, was not communicated to the pilots who were responsible for safely operating the aircraft until after the first crash.

Also with the MAX, Boeing changed the way pilots can stop stabilizer trim from running when it shouldn't. In every previous version of the 737, pilots could simply move the control wheel to stop the trim from moving, but in the MAX, with MCAS activated, that method of stopping trim no longer worked. The logic was that if MCAS activated, it had to be because it was needed, and pulling back on the control wheel shouldn't stop it.

It is clear that the original version of MCAS was fatally flawed and should never have been approved.

It has been suggested that even if the MCAS software had flaws, the pilots on these flights should have performed better and been able to solve the sudden unanticipated crises they faced. Boeing has even said that in designing MCAS they did

not categorize a failure of MCAS as critical because they assumed that pilot action would be the ultimate safeguard.

We owe it to everyone who flies, passengers and crews alike, to do much better than to design aircraft with inherent flaws that we intend pilots will have to compensate for and overcome.

Pilots must be able to handle an unexpected emergency and still keep their passengers and crew safe, but we should first design aircraft for them to fly that do not have inadvertent traps set for them.

We must also consider the human factors of these accidents.

From my 52 years of flying experience, and my many decades of safety work—I know that nothing happens in a vacuum, and we must find out how design issues, training, policies, procedures, safety culture, pilot experience and other factors affected the pilots' ability to handle these sudden emergencies, especially in this global aviation industry.

Dr. Nancy Leveson, of the Massachusetts Institute of Technology, has a quote that succinctly encapsulates much of what I have learned over many years: "Human error is a symptom of a system that needs to be redesigned."

These two recent crashes happened in foreign countries, but if we do not address all the important issues and factors, they can and will happen here. To suggest otherwise is not only wrong, it's hubris.

As one of our preeminent human factors scientists, Dr. Key Dismukes, now retired as Chief Scientist for Human Factors at the NASA Ames Research Center, has said, "Human performance is variable and it is situation-dependent."

I'm one of the relatively small group of people who have experienced such a sudden crisis—and lived to share what we learned about it. I can tell you firsthand that the startle factor is real and it is huge—it interferes with one's ability to quickly analyze the crisis and take effective action.

Within seconds, these crews would have been fighting for their lives in the fight of their lives.

These two accidents, as well as Air France 447 which crashed in the South Atlantic in June 2009, are also vivid illustrations of the growing level of interconnectedness of devices in aircraft. Previously, with older aircraft designs, there were mostly stand-alone devices, in which a fault or failure was limited to a single device that could quickly be determined to be faulty and the fault remain isolated. But with integrated cockpits and data being shared and used by many devices, a single fault or failure can now have rapidly cascading effects through multiple systems, causing multiple cockpit alarms, cautions and warnings, which can cause distraction and increase workload, creating a situation that can quickly become ambiguous, confusing and overwhelming, making it much harder to analyze and solve the problem.

In both 737 MAX accidents, the failure of an AOA sensor quickly caused multiple instrument indication anomalies and cockpit warnings. And because in this airplane type the AOA sensors provide information to airspeed and altitude displays, the failure triggered false warnings simultaneously of speed being too low and also of speed being too fast. The too slow warning was a 'stick-shaker' rapidly and loudly shaking the pilot's control wheel. The too fast warning was a 'clacker', another loud repetitive noise signaling overspeed. These sudden loud false warnings would have created major distractions and would have made it even harder to quickly analyze the situation and take effective corrective action.

I recently experienced all these warnings in a 737 MAX flight simulator during recreations of the accident flights. Even knowing what was going to happen, I could see how crews could have run out of time and altitude before they could have solved the problems.

Prior to these accidents, I doubt if any U.S. airline pilots were confronted with this scenario in simulator training.

We must make sure that everyone who occupies a pilot seat is fully armed with the information, knowledge, training, skill, experience and judgment they need to be able to be the absolute master of the aircraft and all its component systems, and of the situation, simultaneously and continuously throughout a flight.

As aviation has become safer, it has become harder to avoid complacency. We have made air travel so safe and routine, some have assumed that because we haven't had a lot of accidents in recent years we must be doing everything right.

But we can no longer define safety solely as the absence of accidents. We must do much more than that; we must be much more proactive than that.

We need to proactively find flaws and risks and mitigate them before they lead to harm.

We must investigate accidents before they happen.

Each aircraft manufacturer must have a comprehensive safety risk assessment system that can review an entire aircraft design holistically, looking for risks, not only singly, but in combination.

We must also look at the human factors and assumptions made about human performance in aircraft design and certification, and pilot procedure design.

In addition to fixing MCAS in a way that resolves all the many issues with it, including that the AOA Disagree light be made operative on all Max aircraft, we must greatly improve the procedures to deal with uncommanded trim movement, provide detailed system information to pilots that is more complete, give pilots who fly the 737 MAX additional Level D full flight simulator training so that they will see, hear, feel, experience and understand the challenges associated with MCAS, such as Unreliable Airspeed, AOA Disagree, Runaway Stabilizer and Manual Trim. They must have the training opportunity to understand how higher airspeeds greatly increase the airloads on the stabilizer, making it much more difficult to move manually, often requiring a pilot to use two hands, or even the efforts of both pilots to move it. And in some cases, how it cannot be moved at all unless the pilot flying temporarily stops trying to raise the nose and relieves some of the airloads by moving the control wheel forward.

Pilots must develop the muscle memory to be able to quickly and effectively respond to a sudden emergency. Reading about it on an iPad is not even close to sufficient; pilots must experience it physically, firsthand.

We should all want pilots to experience these challenging situations for the first time in a simulator, not in flight with passengers and crew on board.

We must look closely at the certification process. There have been concerns about the aircraft certification process for decades. Just a brief search revealed 18 reports produced by GAO, DOT OIG, and Congressional committees since 1992.

Many questions remain to be and must be answered:

Has the Federal Aviation Administration (FAA) outsourced too much certification work?

Should FAA be selecting the manufacturer employees who do certification work on behalf of FAA, instead of the employer, as is currently the case?

Did oversight fail to result in accountability?

Do the Federal Aviation Administration (FAA) employees and Boeing employees doing certification work have the independence they need to ensure safe designs?

Was there a failure to identify risks and their implications?

Was the analysis of failure modes and effects inadequate?

How was it that critically important information was not effectively communicated and shared with airlines and pilots?

Many other questions must be asked about the role Boeing played in these accidents:

Was there a leadership failure?

A governance failure?

An engineering failure?

A risk analysis failure?

A safety culture failure?

Whistle-blower protection must be strong and effective, and if it is not strong enough, we must strengthen it.

Key leaders and members of each safety-critical aviation organization must have subject matter expertise; in other words, they must be pilots who understand the science of safety. There should be at least one person so qualified on each corporate board of directors of each aviation company. Top project engineers of aircraft manufacturers must also be pilots.

Airlines worldwide must adhere to the highest standards of aircraft maintenance and crew training.

All the layers of safety must be in place. They are the safety net that helps keep air travelers and crews from harm.

Only by investigating, discovering, and correcting the ways in which our design, certification, training and other systems have failed us and led to these tragedies can we begin to regain the trust of our passengers, flight attendants, pilots and the American people. And, of course, in order for passengers to trust that the 737 MAX is safe to fly, pilots will have to trust that it is.

We have a moral obligation to do this.

If we don't—if we just file the findings away on a shelf to gather dust, we will compound these tragedies. What would make the loss of lives in these accidents ever more tragic is if we say these were black swan events, unlikely to happen again, and decide not act on what we learn from them. To protect the status quo.

The best way to honor the lives tragically lost is to make sure that nothing like this ever happens again.

Mr. LARSEN. Thank you, Captain Sullenberger.

I now recognize Sara Nelson, Ms. Nelson, for 5 minutes.

Ms. NELSON. Thank you, Chairman DeFazio, Ranking Member Graves, Chairman Larsen, Ranking Member Graves, and the entire committee, for the opportunity to testify on the issues surrounding the Boeing 737 MAX.

As a 23-year flight attendant and international president of the Association of Flight Attendants—CWA, AFL—CIO, representing nearly 50,000 of aviation's first responders at 20 airlines, I am here today because the public looks to flight attendants when it comes to aviation safety. We are aviation's first responders and last line of defense, and we have more public contact and interaction than any other profession within aviation, and the public trusts us to look out for their interests.

We are all here today because 346 lives were lost on Lion Air flight 610 and Ethiopian Airlines flight 302. This hearing room has many people in it who have lost loved ones due to tragedy in aviation. We can see their faces, feel the warmth of their smiles, and try with all our strength to carry on without them. Some days we do this with more success than others.

But we also know, with certainty, that if there was anything at all that we could have done to prevent their lives being cut short, we would do it. This reality is inescapable. We know that aviation safety and security is written in their blood, and we must ensure their sacrifices mean that we fully examine the chain of events that led to their death so that this is never repeated.

As I stated on March 13, shortly after the grounding of the 737 MAX, lives must always come first. But a brand is at stake as well, and that brand is not just Boeing, it is America. What America means in international aviation and by extension in the larger world more generally, that we set the standard for safety, competence, and honesty in governance of aviation.

Under various agreements between the FAA and other countries or groups of countries, foreign authorities agree to work with the FAA to accept U.S. certification of aircraft and manufactured aeronautical products. This system of international aircraft certification has been built upon global recognition of the FAA and its statutory mandate to maintain safety at the highest possible level. This is now under question, and it means that the FAA must ensure that it has taken all measures to assure the safety of the 737 MAX within the U.S. as well as all countries who must also approve the aircraft for its return to service.

Both Boeing and the FAA seem to recognize the need to win back public support and the importance of involving stakeholders in the process. Over the course of the last several months, our union has witnessed a chastened tone from Boeing and what appears to be a real desire to regain trust. This is critically important if remaining questions are to be answered and stakeholders around the world are to be convinced that the 737 MAX is safe to fly.

It is significant that the FAA has formed the Technical Advisory Board and that they are engaging the rest of the world and conducting a rigorous review of the software fix and full accounting of human interaction with the functionality of the plane. The fix must be rigorously tested and communicated with utmost transparency

and required training. And while this is not an area of expertise for our union, flight attendants must be assured that operators, pilots, regulators, and an independent assessment is confident in the safe return to flight. We put our own lives on the line when we return to flight, and we will do so knowing all has been done to ensure safety.

We are heartened to receive assurance that Acting Administrator Elwell is working in close coordination with worldwide regulators in returning the MAX to service. Mr. Elwell's time in leadership has not been easy, and yet he is tasked with securing the confidence of regulators around the world and the traveling public, and we need to do all we can to help him.

Questions remain, but we believe that the FAA's engagement of all stakeholders is the right leadership approach. We encourage both Boeing and regulators to continue efforts with stakeholders to answer all the questions and communicate fully the lessons learned, along with any necessary changes in procedure.

Flight attendants take our role in aviation seriously. And while we are not yet there, we look forward to assuring the public that it is safe to return to flight.

We continue to receive questions from the traveling public about the 737 MAX, and there is confusion about the progression of the 737 aircraft models. It is common for crew to receive questions, when working the 737 NG, about whether or not the aircraft is safe. This signals the fundamental question about the progression of the 737 aircraft models and whether or not the MAX should have been designated as an entirely new aircraft type. And this is the type of question that has to be answered if we can regain public confidence. I should also note that we do not have one question from flight attendants asking when we will regain the flight hours that we have lost with the 737 MAX, because safety is nonnegotiable.

We believe that we need to take a close look at ODA and the process for certification, and we also think that this committee's work to ensure a review of cabin aircraft certification in the FAA Reauthorization Act of 2018 is critically important. We believe that funding and ensuring a government shutdown—

Mr. LARSEN. I would ask, Ms. Nelson, to wrap up.

Ms. NELSON [continuing]. Never happens again is critically important, and we support H.R. 1108 to ensure that doesn't happen.

Again, we commend this committee for its diligence in promoting aviation safety, and we look forward to the continued leadership from Acting Administrator Elwell in promoting a 737 MAX return to service that inspires confidence among aviation workers, our counterparts around the world, and the traveling public.

Thank you.

[Ms. Nelson's prepared statement follows:]

Prepared Statement of Sara Nelson, International President, Association of Flight Attendants—CWA, AFL-CIO

Thank you Chairman DeFazio, Chairman Larsen, Ranking Member Sam Graves, and Ranking Member Garret Graves for the opportunity to testify on the issues surrounding the Boeing 737 Max. My name is Sara Nelson, International President of

the Association of Flight Attendants—CWA, AFL–CIO (AFA), representing nearly 50,000 of aviation’s first responders at 20 airlines.

As I said on March 13th shortly after the U.S. grounding of the 737Max,
“It is good news that the 737 MAX will now get the focus it needs to address the concerns of undetermined safety issues. We must focus on the needed fix, rather than the uncertainty of flight. Lives must come first always. But a brand is at stake as well. And that brand is not just Boeing. It’s America. What America means in international aviation and by extension in the larger world more generally—that we set the standard for safety, competence, and honesty in governance of aviation.”

I am here today because the public looks to flight attendants when it comes to aviation safety. We are aviation’s first responders and last line of defense. We have more public interaction than any other profession within aviation, and the public trusts us to look out for their interests.

That is why both Boeing and the Federal Aviation Administration (FAA) have individually come to our union to engage us in discussions about our concerns and the process to return the 737 MAX to service.

Both Boeing and the FAA deserve credit for recognizing the need to win back public support and the importance of involving stakeholders in this process. The truth is that these tragic incidents and the revelations surrounding them have shaken the public trust in our entire aviation system due to the decisions made by Boeing during the original certification process, the slow and inadequate response in the wake of the loss of Lion Air flight 610 and Ethiopian Airlines flight 302, and the questions surrounding FAA oversight throughout.

Over the course of the last several months our union has witnessed a chastened tone from Boeing and what appears to be a real desire to regain trust. This is critically important if remaining questions are to be answered and stakeholders around the world are to be convinced the 737 Max is safe to fly.

It is significant that the FAA formed the Technical Advisory Board, with individuals not involved in any aspect of the Boeing 737 MAX certification including NASA, the U.S. Air Force and Volpe National Transportation Systems Center, to evaluate Boeing and FAA efforts related to Boeing’s software update and its integration into the 737 MAX flight control system. We are also heartened to receive assurance from Acting Administrator Elwell that certification of the 737 Max is being done in close coordination with world-wide regulators under the most conservative approach and all of the time necessary to regain public trust around the world.

Regaining that trust first and foremost requires transparency. Congressional oversight is important, and we commend this Committee for its diligence in investigating the events surrounding the loss of 346 lives, and what must be done to ensure this never happens again.

We recognize the efforts of both Boeing and the FAA for seeking our input and help in reassuring the public. Questions remain, but we believe this is the right leadership approach. We encourage both Boeing and regulators to continue efforts with stakeholders to answer all questions and communicate fully the lessons learned along with any necessary changes in procedures. Flight Attendants take seriously our role in aviation safety. While we are not there yet, we look forward to being able to reassure the public when this process is complete.

QUESTIONS REMAIN

On May 15, 2019, the House Transportation and Infrastructure Committee held a hearing on the “Status of the Boeing 737 MAX.” In their opening remarks,¹ Committee Chair Peter DeFazio and Aviation Subcommittee Chair Rick Larsen addressed the importance of this and subsequent hearings and investigations by this Committee and other investigative bodies into the two fatal accidents that occurred in a five month span of time and involved Boeing 737 MAX airplanes.

Chair Larsen noted, “[i]f 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 ... the foundation of the U.S. aviation system is safety.” Clearly, AFA and the aviation industry agree that the “foundation of the U.S. aviation system is safety.” Without safety, the commercial aviation system our economy is so reliant upon today would simply not exist, and neither would tens

¹House Committee on Transportation and Infrastructure, *Chairs DeFazio, Larsen Statements from Hearing on “Status of the Boeing 737 MAX”*, May 15, 2019. <https://transportation.house.gov/news/press-releases/chairs-defazio-larsen-statements-from-hearing-on-status-of-the-boeing-737-max>, accessed June 12, 2019.

of thousands jobs held by flight attendants, pilots, dispatchers, maintenance technicians, baggage handlers, customer service representatives, the list goes on and on.

In his opening remarks on May 15, Chair DeFazio remarked on the historical process the Federal Aviation Administration (FAA) has used to approve airplane designs, noting that “[s]ince 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.” Some of the questions Chair DeFazio asked regarding FAA oversight include the following: “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?”

Obtaining comprehensive answers to these questions through an open, transparent public investigative process will be the first step to addressing the concerns of crew members and the traveling public regarding the safety of commercial aviation. Equally critical to ensuring confidence is the effectiveness of any subsequent legislative and regulatory measures taken in response to identified shortcomings. This process will be long and resource intensive, but it is absolutely critical that it be done right to guarantee that the foundation of the U.S. aviation system continues to be safety.

On March 10, 2019, the Association of Flight Attendants released a statement regarding the crash of Ethiopian Airlines Flight 302 and called on U.S. airlines to “work with Boeing, the FAA, and the NTSB to address concerns and take steps to ensure confidence for the traveling public and working crews.” In a March 11, 2019 letter addressed to Acting FAA Administrator Dan Elwell, AFA recommended a comprehensive, public review of all potential issues that may have contributed to the two tragic accidents involving Flight 302 and last October’s Lion Air Flight 610 accidents. We noted at the time that these reviews should consider at minimum the “certification basis, maintenance practices, operational procedures, and crew training aspects of the 737 MAX program.”

CERTIFICATION ISSUES

The 737 MAX program is not the first recent Boeing aircraft to face intense scrutiny of its design certification process following a safety-related incident. In January, 2013, an auxiliary power unit (APU) lithium-ion battery on a Japan Airlines Boeing 787-8 caught fire, which led to the grounding of the U.S. 787 fleet, an investigation by the National Transportation Safety Board (NTSB), and modifications to the main and APU batteries. In its November, 2014 final report² on the 787 APU battery incident, the NTSB noted several safety issues that occurred during the design certification process. These issues bear troubling similarities to problems that may have occurred during certification of the 737 MAX as alleged in recent media reports.

For example, the NTSB stated that the Boeing battery analyses “did not consider the possibility that cascading thermal runaway of the battery could occur as a result of a cell internal short circuit.” This may have reflected a lack of imagination, with unfortunately severe economic consequences for Boeing. A lack of imagination during the 737 MAX certification process may have led to far more tragic consequences. A June 1, 2019 article in the New York Times³ states that while some potential failures of the MCAS were flight-tested, the one test not conducted was activation of the MCAS “as a result of a faulty angle-of-attack sensor—a problem in the two [Lion Air and Ethiopian Airlines] crashes.”

The NTSB report also stated that there was insufficient guidance provided in “determining and justifying key assumptions in safety assessments” for the 787 batteries. Boeing had assumed that “an internal short circuit within a cell would be limited to venting of only that cell without fire.” The NTSB report noted that the “assessment did not explicitly discuss this key assumption or provide the engineering rationale and justifications to support the assumption. Also, as demonstrated by the circumstances of this incident, Boeing’s assumption was incorrect, and Boeing’s assessment did not consider the consequences if the assumption were incorrect or

²NTSB, *Incident Report—Auxiliary Power Unit Battery Fire, Japan Airlines Boeing 787-8, JA829J, Boston, Massachusetts, January 7, 2013*, Adopted November 21, 2014. <https://www.ntsb.gov/investigations/AccidentReports/Reports/AIR1401.pdf>, accessed June 12, 2019.

³New York Times, *Boeing Built Deadly Assumptions Into 737 Max, Blind to a Late Design Change*, June 1, 2019. <https://www.nytimes.com/2019/06/01/business/boeing-737-max-crash.html>, accessed June 12, 2019.

incorporate design mitigations to limit the safety effects that could result in such a case.” The June 1, 2019 New York Times article suggests that incorrect assumptions by Boeing engineers working on the 737 MAX design may have also occurred: “Current and former employees at Boeing and the Federal Aviation Administration who spoke with The New York Times said they had assumed the system [MCAS] relied on more sensors and would rarely, if ever, activate. Based on those misguided assumptions, many made critical decisions, affecting design, certification and training.”

The NTSB 787 battery report also noted that insufficient guidance was provided to FAA certification engineers whose role was to ensure compliance with certification requirements: “Guidance to FAA certification staff at the time that Boeing submitted its application for the 787 type certificate, including FAA Order 8110.4, ‘Type Certification,’ did not clearly indicate how individual special conditions should be traced to compliance deliverables (such as test procedures, test reports, and safety assessments) in a certification plan.” Similarly, the June 1, 2019 New York Times article appears to suggest that insufficient guidance provided to FAA engineers during the certification process may have also contributed to the flawed 737 MAX safety assessment: “Regulators didn’t conduct a formal safety assessment of the new version of MCAS. The current and former employees, many of whom spoke on the condition of anonymity because of the continuing investigations, said that after the first crash, they were stunned to discover MCAS relied on a single sensor. ‘That’s nuts,’ said an engineer who helped design MCAS. ‘I’m shocked,’ said a safety analyst who scrutinized it. ‘To me, it seems like somebody didn’t understand what they were doing,” said an engineer who assessed the system’s sensors.”

Another issue that may have impacted the 737 MAX certification process arises from conflicts of interest due to inappropriate relationships between regulator and regulated party. An example of how a personal relationship has affected oversight was discussed on March 27, 2019 by the Department of Transportation (DOT) Inspector General (IG) in testimony to Congress.⁴ He made the following points regarding the relationship one inspector had with the regulated party, an airline: “FAA guidance recognizes the impact that a single inspector can have on safety culture and establishes standards that require inspectors to act impartially and avoid the appearance of preferential treatment when they perform their official duties. Nonetheless, our recent work identified concerns regarding an FAA inspector’s oversight of [an airline’s] flight test program, which is used to verify the airworthiness of aircraft following major repairs. We found that an inspector had developed a personal relationship with the head of the carrier’s flight test program and appeared to give the carrier preferential treatment when safety concerns were raised. The inspector also worked with the carrier to suppress future complaints. Ensuring that FAA’s inspector workforce meets standards of impartiality remains a key oversight challenge for the Agency to strengthen its safety culture and effectively identify and mitigate risks.” Compare this to the following from the June 1, 2019 New York Times 737 MAX article: “On March 30, 2016 ... [the 737 MAX chief technical pilot] sent an email to senior F.A.A. officials with a seemingly innocuous request: Would it be O.K. to remove MCAS from the pilot’s manual? The officials, who helped determine pilot training needs, had been briefed on the original version of MCAS months earlier. ... Under the impression that the system was relatively benign and rarely used, the F.A.A. eventually approved ... [the] request, the three officials said. ... [The chief technical pilot], a former F.A.A. employee, was at the front lines of this effort.”

The close relationship between the FAA, airplane manufacturers and airlines can be seen in how the FAA has changed policy over the years regarding design changes and its certification requirement that an airplane with a passenger seating capacity of more than 44 seats can be evacuated from the airplane to the ground within 90 seconds, often referred to as the 90 second rule.

Design standards are used in the design phase of a project, and can be verified while the product, in this case, an airplane, “is still on the drawing board.” i.e., before the airplane is built. Performance standards evaluate the performance of the product, often under the influence of factors that cannot be effectively integrated or evaluated during the design. Typically, a performance standard involves a test of the product after it is built. In the case of a full scale evacuation demonstration (a

⁴DOT/OIG, *Perspectives on Overseeing the Safety of the U.S. Air Transportation System, Statement of Calvin L. Scovel, III, Inspector General, U.S. Department of Transportation, Before the Committee on Commerce, Science, and Transportation, Subcommittee on Aviation and Space, United States Senate, March 27, 2019.* https://www.oig.dot.gov/sites/default/files/Aviation%20Safety%20Long%20Statement_3-27-19_final.pdf, accessed June 12, 2019.

performance standard) of an airplane, the factors that must be evaluated are the performance of the passengers and crew.

Clearly, the original intent of the evacuation demonstration was to show the satisfactory accomplishment of emergency evacuation procedures. The final rule reinforced this intent and required airlines, as a Part 121 operational requirement, to conduct evacuation demonstrations. (30 FR 3200, March 9, 1965).

The following year, FAA Notice 66-26 (31 FR 10275, July 29, 1966) proposed to establish comparable requirements for the airplane manufacturers. This notice stated that "... traditionally, it has been considered sufficient to provide the necessary components for emergency evacuation through detailed quantitative requirements prescribed in the airworthiness rules. However, experience has shown that compliance with these requirements does not ensure that the airplane can be evacuated, during an emergency, within an acceptable time interval. Differences in the relationships between elements of the emergency evacuation system introduce a considerable variation in evacuation time, and this variation is expected to be even more marked on larger transport aircraft under development." Thus, it was acknowledged that relationships between the various elements of the evacuation system, not just the elements themselves, had a critical influence on evacuation time. In other words, the whole was considerably more complicated than the sum of its parts. Since the manufacturer would be demonstrating the basic capability of a new airplane type without regard to crewmember training, operating procedures and similar items (such demonstration of procedures was still required under Part 121, the operational requirements), this new demonstration was not expected to validate the evacuation procedures of the air carriers or operators. FAA Notice 66-26 also proposed that once a manufacturer had successfully conducted an evacuation demonstration for a particular airplane type, the passenger seating capacity could be increased by no more than five percent if the manufacturer could substantiate, by analysis that all the passengers could be evacuated within the prescribed time limit. This appears to be the first proposal to suggest the use of "analysis" in lieu of full-scale evacuation testing. However, this analysis was intended to provide comparison with the full-scale evacuation actually conducted on the airplane. These proposals were adopted as a final rule (32 FR 13255, September 20, 1967).

The tests conducted by operators to show satisfactory accomplishment of emergency evacuation procedures and by manufacturers to show that the aircraft interior configuration and the relationship between the elements of its emergency evacuation system could be evacuated within a specified time period were allowed to be satisfied under a single test under Amendment 25-46 (43 FR 50578, October 30, 1978). Under this amendment, the FAA also stated that "A combination of analysis and tests may be used to show that the airplane is capable of being evacuated within 90 seconds under the conditions specified in 25.803(c) of this section if the Administrator finds that the combination of analysis and tests will provide data with respect to the emergency evacuation capability of the aircraft equivalent to that which would be obtained by actual demonstration." The FAA recognized the problems with this new provision and in its discussion of it concluded that: "Several commentators objected to the proposed amendment to 25.803(d) which would allow analysis in showing that the airplane is capable of being evacuated within 90 seconds. One commentator stated that analysis alone is an incomplete means of showing compliance and should not be allowed. Another commentator stated that extrapolations based on analytical testing have no practical relation to actual conditions which occur in accidents and evacuation demonstrations. The FAA agrees that the limitations on the use of analytical procedures should be made clear. The requirement that the Administrator find the analysis data acceptable was intended to *preclude approvals which might be based on insufficient test data, such as in the case of a completely new model or a model which has major changes or a considerably larger passenger capacity than a previously approved model*" (Italics ours.)

Despite this intent, the FAA granted a request from Boeing to remove a pair of exits from the B747 airplane in the early 1980's. AFA strongly protested this action that would make it more difficult for flight attendants to safely evacuate passengers from the airplane.

In a 1985 hearing before the U.S. House of Representatives Subcommittee on Investigations and Oversight of this Committee (formerly named Public Works and Transportation Committee) and its Chairman, James Oberstar, AFA testified and presented data and past accident experience to illustrate our concerns, as well as those of passengers, with this emergency exit reduction. The FAA Administrator took steps that resulted in no US airline removing exits from their 747s, and at this hearing, suggested that a reassessment of regulations pertaining to emergency evacuation of transport airplanes was warranted. Consequently, an Emergency Evacuation Task Force, open to the public, for that purpose was established in September,

1985. The continued use of full-scale emergency evacuation demonstrations was one of the matters considered by that task force. One of the presentations, by Boeing, suggested that a rudimentary analytical procedure be used in lieu of full scale demonstrations. Basically, the manufacturers favored analysis, while the representatives of people who flew on the airplanes, either as crewmembers or passengers, opposed analysis. The task force was unable to reach consensus on when to accept analysis in lieu of a demonstration. A similar process was undertaken by an advisory committee to the FAA in the 1990s with the same failure to reach consensus.

The procedures used by the flight attendants in a full scale emergency evacuation certification demonstration are intended to become the baseline procedures for the aircraft type and model tested. This was the reason for the promulgation of the 1965 rule requiring operators to conduct full scale emergency evacuation demonstrations. These procedures are found in the Flight Standardization Board Report for each type and model of aircraft. Yet some demonstrations conducted since 1996 have utilized a procedure, with FAA allowance, that makes it easier for the manufacturer to pass the test, but it is not a procedure that is used by U.S. scheduled operators. The intent of the regulation requiring full scale evacuation demonstrations is not being carried out by the FAA.

The analytical method does little more than calculate that, if the design standards are met, the aircraft could be evacuated within the requirements of the performance standard. Since the design requirements were intended to provide an airplane capable of being evacuated within the requirements of the performance standard, use of the analytical method is redundant.

Analysis is not a method that can predict failure of an emergency evacuation system, unlike a full-scale demonstration utilizing appropriate evacuation procedures.

The result of the FAA's policy and of the currently inadequate "state of the art" analytical methods accepted under the policy, is that the first full scale evacuation of a new airplane will be performed by the traveling public under emergency conditions rather than by paid test subjects under the controlled test conditions of a demonstration. There is no assurance that the evacuation would be successful. For this reason, the FAA should be required to rescind its policy of allowing the use of analysis in lieu of the full-scale demonstration until a scientifically valid method is developed, including current demographic changes in the passenger population.

This close relationship between FAA, airplane manufacturers and airlines was further touted and cemented on February 20, 2003 when, in her first major speech⁵ after becoming FAA Administrator, Marion Blakey referred to those regulated by the FAA as its "customers." She said that the FAA needed to be more consistent in responding to "our customers." Then Ms. Blakey said:

"So, I'm announcing today a new customer-service initiative that provides written guidance and training to all managers and supervisors in our regulation and certification offices throughout the country on applying FAA rules and policies in a standard and consistent manner. And, we want to know from our customers if we're not being consistent. We're going to let them know that they have the right to ask for review on any inspector's decision on any call that's made in the certification process ... that they can "buck it up" to first-line supervisors, field office managers, regional division managers, or even to Washington if necessary—with no fear of retribution. Information on how to do this—names, titles, and phone numbers—will be prominently displayed on the Web and in all our regional and field offices. We need your help to make this program a success."

According to a USA Today article's⁶ reference to an April 3, 2008 hearing before this Committee, "Inspectors who testified before Congress last month and others who spoke in recent interviews said they bitterly recalled the introduction of the program. They said it sent a not-too-subtle message that the airlines were encouraged to complain about them and had the upper hand in any dispute over safety-compliance issues."

In addition to its effect on safety regulation of airlines, the FAA "Customer Service Initiative" specifically stated that customers "have the right to ask for review on any inspector's decision on any call that's made in the certification process" from all levels including FAA Washington.

⁵ FAA, Speech—"The Spirit of December 14th", Marion C. Blakey, Washington, DC, February 20, 2003. https://www.faa.gov/news/speeches/news_story.cfm?contentKey=2992, accessed June 12, 2019.

⁶ USA Today, *FAA's Customer Initiative Undercut Safety Inspectors*, May 30, 2008.

On October 13, 2005, the FAA published its final rule⁷ (*Establishment of Organization Designation Authorization Program*, 70 FR 59931) establishing the Organization Designation Authorization (ODA) program. This rule expanded the scope of approved tasks, increased the number of eligible organizations, and established a systems-based approach to managing designated organizations. According to the rule's summary, the "effect of this program will be to increase the efficiency with which the FAA appoints and oversees designee organizations, and allow the FAA to concentrate its resources on the most safety-critical matters." Of course, not all who submitted comments to this rule agreed; one dissent in particular, from the National Air Traffic Controllers Association, was summarized in the rule's preamble as arguing that the "proposed ODA program significantly modifies the current regulatory oversight system, deteriorating the established technical FAA oversight by going to a 'systems' oversight approach that would provide less specific and technical FAA oversight and would, in time, reduce safety." The FAA disagreed, asserting that a systems approach will increase safety, as more effective delegation programs will free up resources for tasks more critical to safety. Unfortunately, the subsequent incidents involving the 787 main battery and 737 Max crashes appear to support the commenter's prediction that safety will, in fact, be reduced over time.

Under various agreements between the FAA and other countries or groups of countries, foreign authorities agree to work with the FAA to enable acceptance of US Type certificated and manufactured aeronautical products, including aircraft, engines, propellers, rotorcraft, and aeronautical components. In many of these agreements, the FAA is relied upon to assist in the certification process of products for the aviation authority and country to approve these products. This system of international aircraft certification has been built upon global recognition of the FAA and its statutory mandate to maintain safety at the highest possible level. The loss of this past esteem of FAA certification and regulation of US aviation and the profound tragedies of two US aircraft crashes within five months, in addition to the other safety problems we've discussed, means that the FAA must ensure that it has taken all measures to assure the safety of the 737 MAX within the U.S. as well as in all countries who must also approve the this aircraft for return to service.

In 2006, the NTSB published the results of a study, *Safety Report on the Treatment of Safety-Critical Systems in Transport Airplanes*.⁸ This report, which focused on certification of systems critical to flight safety and seems as relevant today as then, was prompted by four recently-concluded accident investigations involving two Boeing, one McDonnell-Douglas, and one Airbus aircraft: USAir flight 427 in 1999; TWA flight 800 in 2000; Alaska Airlines flight 261 in 2002; and American Airlines flight 587 in 2004. The NTSB suggested improvements to the certification process for the following three reasons, quoted directly from the report:

1. The process for assessing risks to aircraft systems does not adequately address important failure conditions associated with structures and with human/system interaction.
2. The results of the process for assessing risks to safety-critical systems are not adequately preserved to support continued airworthiness of certificated airplanes.
3. Existing policy, practices, and procedures for the ongoing assessment of risks to safety-critical systems do not ensure that the underlying assumptions made during design and certification are adequately and continuously assessed in light of operational experience, lessons learned, and new knowledge.

The NTSB also concluded that "a program must be in place, once the type certification process is completed, to ensure the ongoing assessment of risks to safety-critical systems. Such a program must recognize that ongoing decisions about design, operations, maintenance, and continued airworthiness must be done in light of operational data, service history, lessons learned, and new knowledge, for designs that are derivatives of previously certificated airplanes."

Given the possibility that problems in the type certification process may have contributed to the recent 737 MAX accidents, as well as the concerns that have been expressed by Congress, the NTSB, DOT IG, and others, a return to the FAA certification processes prior to the 2005 FAA rule on ODA, footnote 7 *supra*, with inclusion of learned safety enhancements since then may be the best way to prevent a certification applicant's pecuniary and market-based interests from interfering with ensuring safety of the airplane and related requirements directly by the FAA. Such a return to direct FAA certification with designated engineering representatives will

⁷ FAA, *Establishment of Organization Designation Authorization Program*, 70 FR 59931, October 13, 2005. <https://www.federalregister.gov/documents/2005/10/13/05-20470/establishment-of-organization-designation-authorization-program>, accessed June 12, 2019.

⁸ NTSB/SR-06/02, Adopted April 25, 2006

likely require increased FAA personnel and funding, with compensation for certification engineers to be more competitive with the private sector.

STABLE FUNDING FOR AVIATION SAFETY

The “foundation of the U.S. aviation system is safety.” In the case of the Boeing 737 Max we not only need a conservative, transparent process for certification—we need to recognize the systemic issues that have undermined safety. We need an aviation system that is supported by stable, long-term funding and is shielded from political cliffs of government funding.

AFA supports HR 1108, the “Aviation Funding Stability Act of 2019,” introduced by Transportation & Infrastructure Committee Chairman Peter DeFazio and Aviation Subcommittee Chairman Rick Larsen. Aviation safety is non-negotiable. HR 1108 would authorize the FAA to keep all of its programs running and all of its employees working by drawing from the Airports and Airways Trust Fund (AATF) during any lapse in typical government appropriations. By drawing from the AATF during a shutdown, the FAA would ensure that all FAA employees would be paid for work during a funding lapse and FAA programs would continue to operate. This bill should be acted on with urgency.

We encourage Congress to give serious attention in all budgeting to properly funding the Department of Transportation and the Federal Aviation Administration in order to fully support aviation safety.

CLOSING

Safety is not something “customers” buy, it is something we all fundamentally expect as a baseline of operation. Regulator oversight cannot be put in terms of client/customer relations.

Again, we commend this Committee for its diligence in promoting aviation safety. We look forward to continued leadership from Acting Administrator Elwell in promoting a 737 Max return to service that inspires confidence among aviation workers, our counterparts around the world, and the traveling public.

Mr. LARSEN. Thank you.

I now recognize Randy Babbitt, former Administrator of FAA, for 5 minutes. Good to see you, Randy.

Mr. BABBITT. Good morning. Pardon me.

Good morning. Chairman Larsen, Ranking Member Graves, Chairman DeFazio, and Ranking Member, also, Graves, and to the full members of the committee, thank you for the opportunity to come here today and discuss the return to service and certification issues surrounding the Boeing 737 MAX.

I would also like to take a second and offer my condolences, heartfelt condolences to the family and the friends and the loved ones of the passengers and the crew, crewmembers, and all aboard Lion Air 610 as well as the Ethiopian flight 302.

In interest of disclosure, not in my original testimony, I have had the opportunity to fly the Boeing simulator yesterday, and I flew both scenarios of the old software and the new software. Obviously, this came after I turned in my testimony.

But I have had a pilot’s license from the time I soloed in 1962 to date. I have also been an aviation safety advocate for over 40 years, so I do bring some background and, I believe, some understanding of accident investigations and changes that have been made subsequently to improve aviation safety and efficiency over the last 40 years.

As president of ALPA in the nineties, I championed the One Level of Safety, which essentially melded the regulations under part 121 into the operations of part 135, and that provided a vast improvement of regional carriers airline safety standards. And while serving as the FAA’s Administrator, the program for Aviation Safety Information Analysis and Sharing, known as ASIAS, was in-

troduced, and today, provides a collection of data that has dramatically improved safety by having stakeholders and operators reporting and sharing problems and issues that they encounter, operational issues, and they report these before they become accidents.

We also began to purposely focus on collaboration with all facets of aviation operations to be more forthcoming with mistakes, errors uncovered, and other issues, and we have also asked that the FAA consider to be less punitive in order to inspire more voluntary disclosures.

Following the tragic accident in Buffalo, I called on the industry and the organizations representing the professional airplane pilots of the country together for a call to action focused on professionalism. We revisited a lot of past actions and then entered into a partnership with the industry to actively address concerns raised by the discoveries uncovered in the Colgan Air flight 3407 tragedy.

We identified steps to strengthen and improve pilot training, hiring, testing, and all the practices surrounding aviation at the regional airlines and major carriers. Participants agreed on best practices and changes to them for pilot record checks, development of pilot mentoring programs, and reassessing rules for pilot fatigue, flight, and duty time, and this time based on scientific research about fatigue.

And we should acknowledge that the FAA's mission is to provide the safest and most efficient transportation and aerospace system in the world. In an aviation system, data is our friend. Ninety million flights, seven billion passengers carried over the last decade in the U.S. is the most incredible safety record the world has ever seen, and it is also not symptomatic of a flawed safety structure.

In 1970, to take a look back, in 1970, we were losing a hull in this country every 6 weeks. Eight accidents a year. And looking back today, we haven't lost a hull in 10 years. That is quite a dramatic recommendation of the dramatic efforts that safety continues—or that continuous safety improvements will bring you.

Our Nation's system of certification of aircraft has been evolving also for over 60 years, and it must continue to evolve and improve. But as we move forward with increased reliance on automation, the linkage and the interface between man and the machine must also evolve. It is imperative that pilots have a full and complete understanding of the automation of the equipment that they operate and the systems designed to protect the operational envelope of the aircraft. But of equal importance is ensuring that pilots have the full training, operational knowledge, and understanding of those operational boundaries and the limitations of those systems.

Automation and training must also keep improving on maintaining situational and operational awareness of what equipment and automation is actually controlling. Pilots need to understand the operational realm in which automation takes control of an aircraft and be aware of the situation calling for the action, as well as the full range of possibility that that action can be.

No pilot should ever be surprised by an event that takes place in an airplane in which they are certified. That includes training exposure to all phases of the operational envelope as well as the safety protections that are designed to protect the operating envelope and protect it from excursions.

In closing, a retrospective look into the introduction of service shows that assumptions were made by Boeing and accepted by the FAA and design changes incorporated that should have been more rigorously tested and flight crews better educated and trained in reaction to a new safety protection system that Boeing had introduced.

History tells us that this is not a new problem, but in fact, has been part of aviation history, unfortunately. Going back to aircraft such as early jets, like the Comet, and metal fatigue, later Douglas DC-10s, Lockheed Electra engine mounts had to be redesigned—

Mr. LARSEN. Thank you.

Mr. BABBITT [continuing]. Douglas pitch trim compensators, all of which had to be redesigned, but those aircraft did finish out their lives with—successfully after the required modifications.

I am comfortable, in closing, that the FAA and Boeing, working together, have rigorously evaluated and reevaluated the design, along with revised training requirements that will ensure reintroduction—

Mr. LARSEN. I have to ask you to wrap up.

Mr. BABBITT [continuing]. To service by the 737 MAX.

Thank you, and I look forward to your questions.

[Mr. Babbitt's prepared statement follows:]

**Prepared Statement of Hon. J. Randolph Babbitt, Former Administrator,
Federal Aviation Administration**

Good morning, Chairman Larsen, Ranking Member Graves, and Members of the Subcommittee. Thank you for the opportunity to discuss the Status of the Boeing 737 MAX: Stakeholder Perspectives.

I would also like to offer my most heartfelt condolences to the families, friends and loved ones of the passengers and crew members aboard both Lion Air 610 and Ethiopian Airlines 302. My thoughts and prayers are with them.

BACKGROUND

I have had a pilot's license from the time I soloed in 1962 to date. I have been an aviation safety advocate for over 40 years, so I do bring some background and understanding to accident investigations and changes that have subsequently been made to improve aviation safety and efficiency over the last forty plus years.

As the President of ALPA I championed "One Level of Safety" which essentially melded the regulations of Part 121 operations into Part 135 providing a vast improvement of Regional Carriers safety standards. While serving as the FAA's Administrator the program for Aviation Safety Information Analysis and Sharing ("ASIAS") was introduced and provides data today that dramatically has improved safety by having stakeholders and operators reporting and identifying problems and operational issues before they become accidents. We also began to purposely focus on collaboration with all facets of aviation operations to be more forthcoming with mistakes and errors and at the same time moving the FAA to be less punitive to inspire more voluntary disclosures.

Following the tragic accident in Buffalo I called on the industry and the organizations representing Professional Airline pilots of the country together for a "Call to Action" focused on professionalism. Safety starts with professionalism and we revisited our past actions and then entered into a partnership with the industry to actively address concerns raised by the Colgan Air Flight 3407 tragedy. We identified immediate steps to strengthen and improve pilot hiring, training, and testing practices at airlines that provide regional service, as well as at our major air carriers. Participants agreed on best practices for pilot record checks, development of pilot mentoring programs and reassessing rules for pilot flight and duty time to incorporate scientific research about fatigue. Professionalism is not something we can regulate, but I am proud to note that Labor organizations answered our Call to Action and supported either the establishment or expansion of professional standards and ethics committees, codes of ethics, and safety risk management meetings be-

tween FAA and major and regional air carriers. The FAA has worked in full cooperation with the industry to raise professional standards and improve cockpit discipline. I believe the "Call to Action" has proven the critical importance of professionalism in aviation safety.

SAFETY

The FAA's mission is to provide the safest, most efficient aerospace system in the world. And in the aviation system, data is our friend. 90 million flights and 7 billion passengers carried over the last decade in the U.S. is the most incredible safety record the world has ever seen and is not symptomatic of a flawed safety structure. But, like aviation itself, we must strive to improve and continue to evolve in our ever-changing environment of advancing technology and oversight. And the evolution and adoption of safety management systems has proven success. In 1970 the U.S. was suffering major airline hull losses of one every 6 weeks! As noted earlier, we have not lost a domestic aircraft in over a decade which reflects the dramatic effect of continuous safety improvements.

Quoting from my own testimony made almost a decade ago, "Safety remains the vital core of the FAA mission. The flying public must have confidence that the airplanes they board are properly designed and maintained. They must know that their pilots are qualified, trained for their mission, and fit for duty. Nothing less is worthy of the FAA name, or our responsibility for preserving the lives of the flying American public." I concluded with the observation that "The FAA has demonstrated a consistent track record of protecting the safety of the flying American public. Our successes in aviation safety continue to set a global standard of American leadership that is not only acknowledged, but also emulated throughout the world." I believe those statements are equally valid today.

CERTIFICATION

Our nation's system of Aircraft certification has been evolving for over 60 years and must continue to evolve and improve. But as we move forward with increased reliance on automation, the linkage or interface between man and the machine must evolve as well. It is imperative that pilots have a full and complete understating of the automation of the equipment they operate. The FAA works with the industry to improve Flight deck layout and alert/warning display strategies that influence a crew's ability to interface with their airplane. And today's modern Aircraft continue to introduce systems that now incorporate even better systems to protect the "operational envelope" of the aircraft but of equal importance is ensuring that pilots have a full training and operational knowledge and understanding of those operational boundaries and the limitations of those systems. We also must continue to improve the operational knowledge and training of our flight crews. And we should be fully aware—to quote Chris Hart, former Chairman of the NTSB "Weaknesses in pilot skills are masked by automation when it works but amplified when it doesn't".

We have made remarkable technological improvements and the current safety record is proof positive of their importance. And key to continuing our introduction of innovative improvements to tomorrow's aircraft operational and safety systems is to ensure that safety regulations not stifle innovation, but to ensure that changes and innovation have safety and risk assessment as part of the design incorporated and built into them.

AUTOMATION & TRAINING

Automation and therefore training must keep improving to maintain the man-machine interface. Training should also include maintaining situational and operational awareness of what equipment including artificial intelligence and automation is controlling. Pilots need to understand the operational realm in which automation takes control of an aircraft and be appropriately aware of the situation calling for the action as well as the full range of possibility of that action.

Pilots in today's system need to continue improved training to operate in today's operational environment. We have the technology to expand training with the use of visual reality and high-fidelity simulation so that no pilot should ever be surprised by event that takes place in an aircraft in which they are certified. That includes exposure to all phases of the operational envelope and environment as well as the built-in safety protections that are designed to protect the operating envelope from excursions.

CLOSING

A retrospective look into the introduction into service shows that assumptions were made, and design changes incorporated that should have been more rigorously tested and flight crews better educated and trained in reaction to a new safety protection system that Boeing had introduced.

History shows us that this is not a new problem but in fact has been part of Aviation history unfortunately. Going back to aircraft such as early jets and understanding metal fatigue that occurred in the de Havilland Comet. Later, Douglas DC 10 and Lockheed Electra engine mounts required redesign and maintenance procedures. Douglas DC-8 Pitch Trim compensators, all of which had to be re-designed after introduction to service. All of those aircraft finished their aviation lives successfully after required modifications.

And I am quite comfortable that Boeing and the FAA together have rigorously re-evaluated the redesign along with revised training requirements that will ensure the re-introduction to service by the Boeing 737 Max will be safe and successful.

Thank you for the opportunity to testify. I look forward to your questions.

Mr. LARSEN. Thank you, Mr. Babbitt. I appreciate it.

I appreciate everyone's patience with my impatience as well. And we now move to Member questions, and we will recognize Members for 5 minutes, and I will start by recognizing myself.

My questions are going to largely focus on the training and training standard, the training recommendations that will be necessary to get to return to service, and I just want to explore that.

Captain Sullenberger, although you weren't specific, you were more generalized, is it your position that there ought to be required simulator training for pilots on the new—on the—for the software fix for the 737 MAX before it is returned to service, versus a computer-based simulator training?

Mr. SULLENBERGER. Yes. It is critical that we address all the issues. It is critical that pilots, as soon as possible, experience in a full motion level D simulator and not just a part task trainer, all the effects of the MCAS system, and also all the other things that likely have not been trained either at all or since initial qualification on the airplane, like unreliable air speed, manual trim operation, including manual trim operation at very high indicated air speeds where it may require either two hands or the efforts of two pilots to actually move the trim manually, or in some cases it may not be possible to move to trim manually until air loads are reduced. They need to develop a muscle memory of their experiences so that it will be immediately accessible to them in the future, even years from now, when they face such a crisis.

Mr. LARSEN. OK. I am just going to ask our staff, and we don't need to get into the technical details of what D level versus B level training is, but if staff can do a memo for the subcommittee members, that is kind of some basic stuff, so we don't need to spend time here talking about those differences, but if you could do that for the Members so we understand that.

Captain Carey, do Allied Pilots have a different position or the same position as Captain Sullenberger?

Mr. CAREY. Thank you, Chairman Larsen. While Captain Sullenberger's recommendations are certainly the best-case scenario, logistically, American Airlines has 4,200 pilots on the 737 MAX, Southwest would have 9,000 737 pilots, we are in favor of the scenario that Captain Sullenberger described in a video concept. And we do 9-month training protocols, so our pilots would receive a CBT program—

Mr. LARSEN. CBT means what?

Mr. CAREY. Computer-based training.

Mr. LARSEN. OK.

Mr. CAREY. And then the video training program of the scenario that Captain Sullenberger suggests. And after that, we have a 9-month training program, which would enable every American Airlines pilot to go through that simulator scenario and that muscle memory exercise within 10 months.

Mr. LARSEN. So it would be—

Mr. SULLENBERGER. May I add that a spot scenario might help get pilots in the simulator more often and sooner.

Mr. LARSEN. Spot scenario?

Mr. SULLENBERGER. I understand that that is a logistical matter of great importance, but the point is, there are other ways to accommodate more pilots sooner than waiting for their recurrent training cycle to occur.

Mr. LARSEN. OK. Ms. Pinkerton, from the airlines' perspective, how does this—where do you come down on this training issue to get to return to service?

Ms. PINKERTON. As you know, I am not a pilot, so I don't have this kind of expertise, but we are relying on people who do have the expertise. The FAA is utilizing the Flight Standards Board on this very topic. And we are confident that working with those independent experts, involving our pilots' unions, they will come to the right decision about what kind of training is needed, and we will provide that training.

Mr. LARSEN. So from the airline perspective, you are saying that the Flight Standards Board, given the recommendation of the FAA, is where this committee should look for advice on how we should think about the training necessary to go to return to service?

Ms. PINKERTON. Yes.

Mr. LARSEN. OK. Mr. Babbitt, have you considered this decision, and could you give us your views on it?

Yeah. Have you considered this question, and give us your views?

Mr. BABBITT. Yes. I think that, you know, some training—as I said in my testimony, I don't think a pilot should ever be surprised by anything that happens in an airplane, and this is a pretty substantial piece, and I had the opportunity to see it both ways. However, I think it is a very similar maneuver to other things that happen in the aircraft.

My suggestion would be to evaluate it. And quite often, I know ALPA was often involved with the FAA and carriers to decide what training was needed. And I think a consortium of a group like that could make a recommendation, perhaps it is give them computer-based training, but maybe the next check—next cycle of checks that you should be exposed to it.

Mr. LARSEN. Thanks. And, President Nelson, I have a question for you. I just want to affirm what you said. Flight attendants are the ones answering the questions from the flying public about is this—is this that plane or is this a different kind of plane. So I just want to emphasize, the FAA needs to continue to include you all in the outreach because you are the ones answering the questions of the flying public more so than any other group of people.

Ms. NELSON. I appreciate that. And I think that there has been a recognition of that that we have to be fully involved for there to be a successful return to flight.

Mr. LARSEN. Thank you.

I understand, on the Republican side, we are going to go with Mr. Mitchell first for 5 minutes.

Mr. MITCHELL. Thank you, Mr. Chair.

I share the concern, and I can't imagine the pain of the families of the victims of both flights. I will meet tomorrow with the family of Ms. Stumo to talk about this. They can share with me their concerns. Couldn't schedule it today.

They have a need for answers to the problems, what caused this. They have a need for responses sooner than later.

I am concerned—I talked to Chairman Larsen about the delays of the FAA responding to questions that were asked several months ago. We haven't had much response from FAA as to some simple questions. The design of MCAS. The review of certification process of MCAS. What role Boeing had versus what roles were undertaken by the FAA. So they need to be reviewed.

It should be clear to us, however, that what happened in both flights were cascading issues, errors, whatever term you want to put on it. One fed another. There was a chain of events that if any one or more—if a couple of those things hadn't happened, we would not have had the outcomes we had. I raised at the last hearing that also included in that is the qualifications and training of the pilots, both in terms of MCAS and in general.

One thing I think the families deserve is full information. Not having bits and pieces wander out or have pieces used for political process has been noted.

Captain Carey, you have made more than a few headlines of late by releasing portions of an apparently secret recording made in November. I would like to ask you some questions about that. First—and I would like your responses also for the record if you are unable to respond—who made that recording, sir?

Mr. CAREY. I did, Mr. Mitchell.

Mr. MITCHELL. Thank you. Did the board of directors authorize that or know in advance you were making a recording?

Mr. CAREY. No, sir.

Mr. MITCHELL. Did you tell Boeing officials you were making that recording prior to the meeting or subsequent to that?

Mr. CAREY. No, sir. That is not required under Texas law.

Mr. MITCHELL. I am glad you are aware of that. Are you aware that—I am sure you are—that in April, you issued a press release fully confident in the Boeing 737 MAX and its capabilities? This is your organization, correct?

Mr. CAREY. Yes, sir.

Mr. MITCHELL. Shortly thereafter, and this is deeply concerning to me, that then portions of the tape were released in the midst of a union campaign, being it is everyone's problems, that it is Boeing's fault, they did it. Bits and pieces of information.

What is—what is the value of that to either the system or the family in doing that? We don't have complete information out yet, so explain to me what warranted that.

Mr. CAREY. Sir, the APA is founded on safety. Safety first always, and safety is not for sale. Boeing came to visit us in November 27 of 2018. We were ready to record the meeting if we thought it was a PR meeting and not a sincere exchange of technical data.

Mr. MITCHELL. Stop a second. It wasn't we, because you said they were unaware. So you—

Mr. CAREY. We, my team. My subject matter experts at APA, my safety committee chairman, and my training committee chairman, and our subject matter experts. My team. We decided if we thought Boeing was insincere at the meeting, we would record the meeting.

Boeing has a history with the 737 rudder control back in the nineties, a USAir accident, which Captain Sullenberger is very familiar with, of being dishonest, or less than forthright. Talk about honesty, sir. I made FOIA requests on November 28, 2018, on all MCAS data between the FAA and Boeing. To date, we have not had one piece of data arrive.

Mr. MITCHELL. Well, I have not had a response either to the requests I made to the FAA, so I share your frustration.

Mr. CAREY. Thank you, sir.

Mr. MITCHELL. But let me make a point, which is, your board supports the equipment, and then shortly thereafter in May, you release—

Mr. CAREY. Sir, our initial press release—

Mr. MITCHELL. Let me finish the question, sir. That is the way it works.

You then release portions of a tape, portions of it. I would ask you for the record here that you submit the entire tape so we can hear it in its entirety.

Mr. CAREY. The entire tape has been submitted to the committee, sir. It has been submitted to Chairman DeFazio.

Mr. MITCHELL. Mr. Chairman, do you have it? Mr. DeFazio?

Mr. CAREY. We submitted an entire transcript of the tape to Chairman DeFazio and the tape itself.

Mr. MITCHELL. Do we have that?

OK. I would like to hear that.

Let me make one final comment because we are almost out of time.

Mr. CAREY. We will certainly—APA will certainly supply you, sir, with a copy of that written transcript and the tape.

Mr. MITCHELL. I would appreciate that.

One final comment before I get gaveled out here. I believe, as I said earlier, it is a cascade of errors. One of the questions I posed in the last hearing, which continues to trouble me a great deal, is the pilots of Ethiopian Air, their hours give me a great deal of question. The pilot in the right seat could not fly under our standards here. We need to look at the ICAO standards versus our standards in North America for pilot qualifications and training, and reconcile that, along with all these other questions, because there are a series of them. And until we get those answers, I would respectfully ask let's not give up bits and pieces because it is damaging.

Mr. LARSEN. Thank you, Mr. Mitchell.

I turn to Chair DeFazio for 5 minutes.

Mr. DEFAZIO. Captain Carey, it says in your testimony, 737 MAX does not provide the same aircraft field to the pilots as the 737. This was intended to minimize the operating costs to Boeing's customers by allowing the MAX to be certified by the FAA as a 737. And then in Captain Sullenberger's testimony, he mentions that it disturbed the engine mounts, disturbed the natural aerodynamic stability of the 737 in certain conditions.

I got a—what are those conditions, and why was this necessary? Or was it just about avoiding certification and pilot training? What are those conditions? Can either of you answer that quickly? We got only 5 minutes.

Mr. SULLENBERGER. I would like to know and hear from Boeing why MCAS was necessary. Was it to meet a certification standard or was it to achieve a common type certificate that would not require additional training for pilots and, therefore, for airlines?

Mr. DEFAZIO. OK. So we don't know the answer to that question. That's a pretty critical question.

Mr. SULLENBERGER. I do not know the answer.

Mr. DEFAZIO. OK. Anybody there know the answer?

Mr. CAREY. Sir, there is some speculation or there is some data coming in from Boeing engineers that have contacted us that there may be some negative dynamic stabilization problems with the aircraft, which required Boeing engineers to add the MCAS system to the 737 MAX 8 and 9 design.

Mr. DEFAZIO. OK. We really need—

Mr. BABBITT. If I could comment?

Mr. DEFAZIO. We really need to—quickly.

Mr. BABBITT. If I might comment, Boeing's description to me was that the airplane, at high angles of attack, had a softer elevator feel than the original aircraft, and they wanted it to have more field.

Mr. DEFAZIO. Feel. But it wasn't dangerous. So the pilots would be trained to deal with that.

Mr. BABBITT. That is correct, and that is quite common.

Mr. DEFAZIO. But if they hadn't experienced it, they wouldn't be trained to deal with it.

Mr. BABBITT. It is quite common in the industry. For example, Airbuses, I have flown every Airbus made, and—

Mr. DEFAZIO. Well, I don't want anybody, if you could, avoiding, you know, things that cost a little bit of money or delay the deployment of an aircraft that could lead to pilots who are not informed as to all the characteristics of that aircraft, which you already said earlier, the MCAS, people should be informed of this system.

Now, there is also, you know, because of the pilot discussion, there is in Captain Sullenberger's, he said that there were many false warnings simultaneously?

Mr. SULLENBERGER. Yes. As opposed to older aircraft designs where cockpit instruments were essentially standalone devices and information was not shared between them, and a fault in one could be easily identified and isolated and disregarded.

Now, in modern airplanes with higher levels of integration—that is, higher levels of electronic interconnectedness and sharing of data between devices—it is now possible, as happened on these cases and in the June 1, 2009, crash of Air France 447, where a

single errant data bit, a single fault, a single failure can now have cascading effects rapidly through multiple systems and create a condition of multiple warnings, some of them false. It is difficult to sort it out because of the startle factor, the workload, the task saturation to identify the root cause, and it can be contradictory, ambiguous, confusing, and ultimately overwhelming.

Mr. DEFAZIO. Would a disagree light have helped in that situation?

Mr. SULLENBERGER. It might. With so much going on, such loud warnings, so many other disparate indications, they might have missed it, but had they seen it, it might have had been that one——

Mr. DEFAZIO. Captain Carey, looks like you wanted to say something there. Did you, or are you just taking notes?

Mr. CAREY. Yes, sir, I would like to comment. Excuse me, Captain Sullenberger.

The MCAS system is a federated system, which means it is not integrated into the control laws and logic of the computers on the 73 MAX aircraft. Again, the failure was that Boeing did not disclose the existence of MCAS to the pilot community around the world. Therefore, robust training was not conducted.

The last line of defense in the MCAS system—when we asked Boeing at the November 27th meeting in Texas what the last line of defense was with the MCAS firing and firing and firing till the aircraft stabilized was full nose down, they said the pilots. Well, they didn't ever tell us the system existed. So, therefore, we did not have robust training.

Mr. SULLENBERGER. And let me add, I think some false assumptions were made about how the system would operate, how it would be noticed or become aware of by pilots, and what human performance would be in those conditions. I think it was a false assumption to think that, before MCAS' existence, much less its operation, was even disclosed to pilots, that they would interpret this particular scenario——

Mr. DEFAZIO. One other quick thing here——

Mr. SULLENBERGER [continuing]. As a runaway trim——

Mr. DEFAZIO. Thank you. And that leads to some of Ms. Nelson's testimony that I wanted to get to, which is questioning engineering assumptions. She questions the engineering assumptions that went into the battery on the 787. They were wrong. She is questioning the engineering assumptions that went into the MCAS system as they radically changed it on the 737 MAX and didn't disclose it, and then also evacuation standards, which will be an ongoing concern of this committee, which are only computer simulated. Computers are not humans. They are not human factors. They don't anticipate everything.

With that, I yield back the balance of my time.

Mr. LARSEN. Thank you, Mr. Chair.

I now recognize for 5 minutes Ranking Member Graves of Missouri.

Mr. GRAVES OF MISSOURI. I yield back.

Mr. LARSEN. OK. Thank you.

Then we will go with—I think we have Representative Balderson from Ohio.

Mr. BALDERSON. Thank you, Mr. Chairman.

Thank you to the folks here testifying today. I appreciate your time.

My first question is for Ms. Pinkerton. You note that following the grounding of the 737 MAX, the airline industry employed a variety of mechanisms to cope with the disruptions. Southwest has the most 737 MAX air jets in operation of any carrier in the United States. Southwest is also the largest passenger carrier in central Ohio. Can you discuss how Southwest and A4A member carriers have accommodated the loss of the 737 with minimal disruptions for service?

Ms. PINKERTON. Yes. As I mentioned, the A4A carriers that had the MAX grounded have done several things: rebooking passengers, rerouting. But in addition to that, they have had to make systemic changes. They are utilizing spare aircraft. They are doing things like delaying optional enhancements like souped-up Wi-Fi and painting the aircraft. Unfortunately, we have had, our carriers have had to completely eliminate some service or take flights on markets that are more likely flown and reduce frequencies, but for the most part, carriers have been able, like I said, to accommodate 99 percent of folks.

We are anticipating that, despite the capacity drawdown that Southwest, American, and United have had to do, we are going to see a 3-percent increase in seats overall this summer, and that is with other carriers filling in the capacity and different airlines, different aircraft coming online also that are providing that capacity.

Mr. BALDERSON. OK. Thank you very much.

My next question is for Captain Carey and Captain Sullenberger. You both mentioned the need to ensure pilot training protocols are vigorous and robust, especially as aircraft are becoming more and more high tech. I agree that passenger safety should always be the most important aspect of our aviation industry and that our pilots should receive the best possible training.

Are there any obvious or necessary changes you believe should be made to licensure requirements or pilot training?

Mr. CAREY. Thank you, Mr. Balderson. I was interested to know that Boeing afforded Captain Babbitt, former Captain Babbitt, retired Captain Babbitt the opportunity to utilize their simulator, their 737 MAX simulator full-motion down in Miami yesterday. Boeing invited two of our pilots who are here today who have accumulated over 5,000 hours on the Boeing 737 aircraft to use that simulator on June 5. Shortly before that appointment, Boeing rescinded that invitation.

So it is curious to me, while Boeing is working on this fix, they don't want the people who fly it to actually see it. So as far as the APA getting behind the software changes and the FAA recertification of the 737 MAX return to service, we would like our safety committee chairman and our safety committee and training experts to be permitted to fly the 737 MAX simulator. The only one in existence right now in North America is in Boeing's facility in Miami. However, there is another one. It is in Addis Ababa. It belongs to Ethiopian Airlines.

Mr. BALDERSON. Captain.

Mr. SULLENBERGER. It needs to be a priority for every manufacturer, for every airline to provide all pilots and flight attendants with all the information that they need to operate their equipment safely, to understand it. As complexity increases, it makes resilience harder without the proper knowledge. And the most important trait that every technology must have is that it be intuitive. It has to make sense. It has to—it has to be additive to one's training, one's experience, and not contrary to it.

And so especially for things that operate in a surprising or counterintuitive way, we must be made aware of it and its complications and its implications. We must experience it firsthand in the simulator before we face a crisis in flight with an airplane full of passengers and crew.

Mr. BALDERSON. Thank you both very much.

I yield back my remaining time, Mr. Chairman.

Mr. LARSEN. Thank you, Representative Balderson.

Representative Lipinski for 5 minutes.

Mr. LIPINSKI. I thank you, Chairman Larsen and Ranking Member Graves for holding this hearing.

It is clear we all know, we all agree, we need to get to the bottom of what happened with these two crashes so that we can provide answers to the families and friends of the victims, but also to do all we can to try to ensure nothing like this ever happens again.

I want to focus my questions on the certification process. You know, I had said at the hearing we had a few weeks ago, I think that there was something went wrong. We need to figure out what that is. We are still waiting for answers and investigation here. But I want to ask more general questions about the ODA program, and I want to start with Captain Sullenberger.

In your testimony, you pose a lot of important questions for Congress to consider with respect to the certification process. Do you have any specific recommendations at the moment with regards to general reforms of the process?

Mr. SULLENBERGER. It is important that oversight include accountability or it means nothing. First, it is important that FAA be provided the budgets that are sufficient consistently to fulfill its responsibilities—the safety of the traveling public—in terms of staffing, in terms of providing those who oversee certification with the subject matter expertise to be able to do their jobs, especially as technology improves and especially in this global aviation industry.

It is often very difficult internationally for FAA to have the budget, the staffing, and the subject matter expertise to do the oversight that is necessary, in particular for foreign manufacturers.

It is important, as Captain Carey has said and Ms. Nelson has said, that the FAA have the independence to do their jobs without political or economic influence. It is important that whistleblower protections be in place, and that the safety culture in our organizations, FAA and manufacturers, be strong enough that those who have the integrity and the courage to insist on the highest design standards for the safety of the public not be overruled by supervisors with other agendas.

Mr. LIPINSKI. How do we do those things?

Mr. SULLENBERGER. Pardon me?

Mr. LIPINSKI. How do we do those?

Mr. SULLENBERGER. We start with the organization itself, and we start with how the incentives in each organization are aligned. Are they aligned for expedience or for economy, or are they aligned for consistent application of best practices? Are people hired and promoted and receive bonuses based upon production numbers or based upon quality safety?

We get what we measure, we get what we reward. And right now, in the important ways, the incentives are not aligned toward consistent public good sufficiently in all our organizations. Key members and leaders of each safety-critical aviation organization must have subject matter expertise, and in some cases, they must not be only engineers, they must also be pilots, so they understand in a firsthand way the implications of design choices.

Every design involves compromises between strength and weight, performance and cost. We need to make sure that these decisions are made in a fully informed fashion, in a transparent way, and that communication about them is communicated effectively at every level so we know what risks are and why we are taking them.

We also must look at faults, not just individually, but in combination. I think that may be a part of what happened here, that there was not a full appreciation of the magnitude of the risk to a single fault to these systems and the lack of knowledge among the operators.

Mr. LIPINSKI. I want to give Ms. Nelson a chance to address this in the last minute I have.

Thank you.

Ms. NELSON. OK. So we have talked with engineering experts who advised us that a culture of safety would engineer a plane from a clean sheet and a software fix is not a fix to a manufacturing problem. Now, they have also assured us that there can be, it is possible to have a software fix to make the 737 MAX safe, but starting from a place of the FAA, turning at the same time to say that the manufacturers and the airlines or their customers, as opposed to providing that direct oversight and creating the Organizational Designation Authorization program, ODA, there were many warnings that, over time, this program would lead to a deterioration of safety. And that is because there is not the rigorous oversight throughout the process that may have led Boeing, from the very beginning, to make very different decisions here because of the oversight that would have been involved if we were to return to the FAA oversight prior to ODA.

Mr. LIPINSKI. Thank you very much.

I yield back.

Mr. LARSEN. Thank you.

I now recognize Representative Spano for 5 minutes.

Mr. SPANO. Thank you, Mr. Chairman.

Thank you, witnesses, for being here. We appreciate it.

And thank you to the family members for being here. Again, I want to as well wish you all the best, and express our condolences to you, and tell you that our prayers are with you. And so thank you for being here.

I would like to ask a series of questions to the panel, if I may, just have you respond, if you would, by raising your hand, all right,

then I will acknowledge which one of you—for the record, I will indicate which ones of you have answered in the affirmative.

How many of you would describe yourselves as a safety advocate?

Let the record reflect that every single person on the panel has raised their hand.

How many of you are pilots?

Let the record reflect that Captain Carey, Captain Sullenberger, and Mr. Babbitt are pilots.

How many of you are licensed airline pilots?

Let the record reflect as well that Captain Carey, Captain Sullenberger, and Mr. Babbitt are licensed airline pilots.

How many of you are aeronautical engineers?

Let the record reflect that no one on the panel is an aeronautical engineer.

How many of you have designed a commercial transport aircraft?

Let the record reflect that no one on the panel has designed a commercial transport aircraft.

How many of you are software engineers?

Let the record reflect that no one on the panel is a software engineer.

How many of you have designed software for commercial transport aircraft?

Let the record reflect that no one on the panel has designed software for commercial transport aircraft.

How many of have you certified a commercial transport aircraft?

How many of you have certified a commercial transport aircraft?

Let the record reflect that Mr. Babbitt has certified a commercial transport aircraft.

And finally, how many of you have conducted an accident investigation or been an official party representative to an accident investigation?

Let the record reflect—raise your hand. OK. Let the record reflect that Captain Carey, Captain Sullenberger, Ms. Nelson, and Mr. Babbitt have been an official party representative to an accident investigation.

Thank you for that. I follow up with a couple of questions.

First of all, Captain Sullenberger, you indicate in your statement that we can, quote/unquote, “no longer define safety solely as the absence of accidents.”

From a layperson’s perspective, to me, safety is preventing an accident. So can you unpack that statement for me? Why is it that we can no longer define safety as the absence of accidents?

Mr. SULLENBERGER. The short answer is because we have been able to make them much more rare. And if we do only that, we are not doing our jobs. We need to look at all the near misses. We need to look at all the unresolved systemic risks and latent conditions. We need to do a lot more of what we are currently doing, doing audits, relying upon self-reporting of safety incidents, all the little things that become links in a causal chain that might lead to an incident or an accident.

Mr. SPANO. Understood. Thank you.

Mr. SULLENBERGER. And to intervene and break that chain, to resolve these risks and these conditions before they can lead to harm. And then—and we have been doing that for many years. We

are doing it more and more, but we need to do it even more than we are. If we had, we might have been able to avoid these two most recent ones.

Mr. SPANO. My next question is for Mr. Babbitt, and then if any of you want to follow up with a response as well.

Can you just briefly speak to the challenge that we face to ensure public safety in a global aviation landscape? Like—so, for instance, what are the FAA's duties and responsibilities? What are our responsibilities as policymakers? What should our objectives be? What should the regulatory framework look like when we have many variables around the world that we cannot control?

Mr. BABBITT. That is an excellent question, and it presents quite a challenge to the FAA or any regulator. And the challenge is you have to make assumptions on the base level of education that you have for pilots, and if you say, for example, two pilots sitting here and you say, do either of you—put your hand up if you have an ATP, and we both put our hands up. We have got one captain down here who has got, you know, 35 years with American Airlines. And the one sitting next to me over here has an ATP in a 172.

Mr. SPANO. Could you clarify—could you—let me interject. So what is an ATP, just for the record, if you could clarify?

Mr. BABBITT. I am sorry. Air transport pilot.

Mr. SPANO. Thank you.

Mr. BABBITT. But you can get an air transport pilot rating in a Cessna 172. That doesn't compare to Captain Carey's experience or Captain Sully's experience, but yet they both have ATPs. So we make these assumptions. We need a little more information when we design airplanes to say, well, they have to have an ATP. Well, OK. They have an ATP, but we need more than that.

And I agree with Captain Sullenberger that, you know, the data mining that we have today, ASIAs—ASIAs, that I mentioned in my testimony, is providing incredible data where everyone can report, without repercussion, and we use that data to prevent accidents. We would rather investigate data today than we would accidents. It is that simple. But we also need to have a better understanding of the assumptions that the FAA, the manufacturers—because the assumptions we make in the United States may not be the assumptions made in Germany or France or other places.

Mr. SPANO. Thank you. Thank you, sir.

Mr. Chair, I yield back.

Mr. LARSEN. I recognize Representative Johnson of Georgia for 5 minutes.

Mr. JOHNSON OF GEORGIA. Thank you, Mr. Chairman. Thank you for holding this hearing.

I want to express my condolences to the friends and relatives of the victims of these two air crashes, and thank you for your presence today.

Captain Sullenberger, you, in your testimony, stated essentially that this 737 platform which had been around for 50 years or so was updated with the design of the 737 MAX, which pretty much sits on the same platform as the 737 but the 737 MAX has larger engines. And these larger engines, because of ground clearance, those engines on the MAX were required to be mounted higher and further forward on the wings. Is that correct?

Mr. SULLENBERGER. Yes.

Mr. JOHNSON OF GEORGIA. And because of that design need, the new engines actually reduced the aircraft's aerodynamic stability in certain conditions which, therefore, inspired the folks at Boeing to address that issue with adding a software feature called the Maneuvering Characteristics Augmentation System, also known as MCAS. Is that correct?

Mr. SULLENBERGER. Yes.

Mr. JOHNSON OF GEORGIA. And the MCAS system operated automatically, causing the nose of the plane to be pushed down without pilot input, if conditions warrant it?

Mr. SULLENBERGER. Yes.

Mr. JOHNSON OF GEORGIA. And the condition that warranted it would derive from the operation of one angle-of-attack sensor. That would be something that would happen to the sensor would cause the MCAS system to operate and push the nose down without pilot input.

Mr. SULLENBERGER. Yes.

Mr. JOHNSON OF GEORGIA. And if that angle-of-attack sensor failed in some way, it could result in a problem in the operation of the aircraft. Pushing the nose down, that means the plane is going to go down, correct?

Mr. SULLENBERGER. Yes. And not just once but repeatedly.

Mr. JOHNSON OF GEORGIA. And the MCAS system was not a system that was revealed to the airline industry, and thus to the pilots, prior to the first aircraft disaster in the Philippines.

Mr. SULLENBERGER. My understanding is that it may have been revealed to some airlines, but to my knowledge, no airline pilots around the world knew of its existence before the first crash.

Mr. JOHNSON OF GEORGIA. No pilot around the world knew that the MCAS system could thrust the nose of the plane downward. They did not know that, and so, therefore, they had no training in terms of how to react to a sudden nosedive by the plane. Is that correct?

Mr. SULLENBERGER. I am sorry. Would you say that again?

Mr. JOHNSON OF GEORGIA. A pilot without knowledge of an MCAS system in the plane, flying a 737 MAX, a pilot not knowing of this MCAS system and now the plane is suddenly, the nose of the plane is headed downward, you are not trained or no pilot was trained in how to react to that occurring, prior to the crash in the Philippines of the 737 MAX.

Mr. SULLENBERGER. That is essentially correct. As I understand it, the assumption on the part of Boeing and the designers was that pilots, even though they did not know of the existence of the MCAS feature, the software, that they would somehow interpret this repeated nose-down movement as being a runaway stabilizer procedure, which would be something that they were familiar with. But it is, as I said, demonstrably evident that at least two professional airline crews were unable to do that.

Mr. JOHNSON OF GEORGIA. Was the FAA notified of the MCAS addition to the 737 platform prior to the crashes?

Mr. SULLENBERGER. My understanding is that, at some point, they were made aware of the feature, but that they were not aware of the changes to the operation of the feature prior to the first

crash; that it had been redesigned to activate with greater movement each time it activated, and it would activate until the full range of motion that could be achieved was achieved. In other words, it would act repeatedly until the nose was forced as far down as it could go.

Mr. LARSEN. Thank you, Captain Sullenberger.

Thank you, Mr. Johnson.

Mr. Massie is recognized for 5 minutes.

Mr. MASSIE. Thank you, Mr. Chairman.

I want to thank all the witnesses for coming today.

Captain Sullenberger, do you think that better trained pilots or more experienced pilots should have been able to handle the situation and the malfunctions in the Lion Air and Ethiopian Airlines crashes?

Mr. SULLENBERGER. Congressman, the first thing that we have to remember is that we are all, as humans, subject to hindsight bias, and it makes it very difficult for us to know with certainty what one might have done suddenly facing an unanticipated situation that we now have knowledge of.

I think that it is unlikely that other crews would have had very different experiences or performed very differently than these two crews did on their accident flights, prior to knowledge of the system, certainly in the first case, and not having practiced it in a simulator since then.

Mr. MASSIE. Wasn't there a crew on the same plane on Lion Air that experienced a malfunction—

Mr. SULLENBERGER. Yes.

Mr. MASSIE [continuing]. Prior to the crash?

Mr. SULLENBERGER. Yes.

Mr. MASSIE. And how did they—

Mr. SULLENBERGER. At least one apparently experienced this and was successful, but obviously two were not. I don't know what the probability of success would be, but some—at least one did and at least two did not.

Mr. CAREY. May I comment, sir?

Mr. MASSIE. Sure. Let me ask you a question first, Captain Carey. Are your members trained on runaway trim procedures, U.S. pilots?

Mr. CAREY. It would depend on what aircraft type they have been on and how many years they have been with the airline. The simple answer would be, yes, at some time in their career they were trained on a runaway stabilizer situation, either on the aircraft they are flying or previous model.

What I would like to comment, sir, at your pleasure, the Lion Air airplane that did successfully land after the MCAS experience was fortunate enough to have a third pilot in the jump seat, and that pilot recognized the malfunction and led to the safe landing of that aircraft.

Mr. MASSIE. If the other pilots had had the same training as the third pilot, would they have recognized it?

Mr. CAREY. It may have just been fate that the third pilot was there while the—you have to remember, sir, and members of the panel, this is a sudden, violent, and terrifying event. This airplane is pitching up and down rapidly and violently. There's bells, warn-

ings, and clackers sounding. Communication is difficult. The third pilot in the jump seat, those stab trim wheels are right in front of that observer, and that pilot was fortunate enough to recognize the malfunction.

Mr. MASSIE. Let's talk about your members and colleagues. Would they know how to respond to that situation or how to identify and respond to runaway trim?

Mr. CAREY. I would have to completely concur with Captain Sullenberger's remarks. In this situation, I believe that some crews would have recognized it in time to recover and some would not have.

Mr. MASSIE. Mr. Babbitt, can you tell us about your experience in the simulator in encountering this similar situation? What was that like?

Mr. BABBITT. It was a very educational experience, I will say that. I think I would agree with Captain Sullenberger that, you know, any of these events, all of us up here have experienced different emergencies, and they are very attention getting, and sometimes, you know, you might have been focused over here.

I had the advantage, as did Captain Sullenberger, I knew what was going to happen. I have read, and I knew what the procedures should have been in the old system; I knew what the procedures were in the new system. And so I was able to follow the procedures, but essentially, I had training. I had been briefed as to what the reaction of the airplane was going to be, and nevertheless, it is any emergency. When a fire bell goes off in the aircraft—I have had engine fires—it is quite discerning, and one of the first things you do is stop the noise.

In this case, you can't stop the noise. The stick shaker continues to go, and we figured out—I mean, my experience in Boeing is we had one going and one not. That would tell you you have got an indicator problem. But yes. And then the new software fix was, I think, a very good one. It obviously limits the amount of authority given to the pitch-down, and it only does it once. I mean, you either fix it or you don't, and it is a runaway stabilizer trim.

Mr. MASSIE. I would like to ask one more question—

Mr. BABBITT. Sure.

Mr. MASSIE [continuing]. Real quick of Captain Sullenberger.

I think you are spot on by, in your statement, that we need to—we can no longer define safety solely as the absence of accidents. We need to look at the near misses.

But how do you balance the pilots not wanting somebody looking over their shoulder versus going back and looking at the near misses?

And if he could respond, I am done asking questions.

Mr. LARSEN. You have 15 seconds.

Mr. SULLENBERGER. The key to that is trust. When pilots trust that their professional observations, self-reported, will be de-identified and used only for safety purposes, they are willing to make those kinds of safety reports, that that can only come from them and not from somewhere else.

Mr. MASSIE. Thank you.

Mr. LARSEN. Thank you.

I recognize Representative Titus for 5 minutes, and then our side, Mr. Allred will be after Representative Titus.

Representative Titus, 5 minutes.

Ms. TITUS. Thank you, Mr. Chairman.

As you all have said, this investigation is very important for the future. For the past, maybe it gives some solace to those who have family members or friends who are lost, but it is not going to bring back those lost lives. So as we think about the future, I would wonder if now that you are having greater scrutiny by the FAA, now that you are looking into what caused these problems, now that you are revisiting the ODA, have you discovered any other short-cuts that Boeing or some of the airlines might have taken that we don't know about and haven't caused accidents yet?

Mr. Babbitt.

Mr. BABBITT. No. The ODA process has been around the since the beginning of time and airplanes. I mean, the only pilots I know that didn't go through it were Orville and Wilbur. Everybody else has had to turn over their designs as they wanted things certified. And, you know, the process works. I mean, you simply don't have the manpower to do all—to absolutely, you know, watch every piece of design. Boeing has over 40,000 engineers. The FAA has 1,400, and you work hand in hand. And the ODA process is the same in the United States as it is at EASA, which is the European.

So I think, you know, what we need to do—one of the things that is incumbent upon us now as we move forward with increasing technology is understanding and training pilots to appreciate more and more of the safety envelope is protected by automation, meaning that this is not the only airplane that will help you recover. Captain Sullenberger flew the A320. If that airplane gets too close to a stall, the airplane pushes up its own power. If you get going too fast, it pulls the nose up for you. It does a lot of things, and these are all things to protect the safety envelope, but the pilots need to have absolute training and understanding of what—

Ms. TITUS. I understand all that, we have been through all that, but that doesn't answer my question. Have you come up—have you discovered any other problems that we just haven't made the news because there hasn't been a crash?

Mr. BABBITT. No. I think—

Ms. TITUS. That is reassuring.

Mr. BABBITT. Obviously, if I knew what those problems might be. I don't anticipate there were any. I think Boeing has done a respectably—they have built wonderful airplanes over the years, and I have put in my testimony, I think they made a bad assumption as to what they needed to tell people. They assumed the system was one everyone was familiar with, based on similar systems in the aircraft, and they were incorrect.

Ms. TITUS. OK. Thank you. I hope you are right.

As you—uh-huh. Thank you.

Mr. CAREY. Ms. Titus, thank you.

I would like to see more FAA oversight of foreign repair stations. This is vital to the future of aviation. More and more aviation maintenance, heavy maintenance is being outsourced overseas to countries like El Salvador, Brazil, China. As much as we would like to keep these jobs in the United States, and that is certainly our

agenda, the economic reality is these maintenance facilities are going overseas, and we would like to see very robust oversight of these facilities.

Mr. SULLENBERGER. May I comment also——

Ms. TITUS. Please.

Mr. SULLENBERGER [continuing]. To clarify something that Captain Babbitt said?

ODA is actually a fairly recent revision of the previous DER system, and one of the major changes in that is that the FAA no longer chooses their designees. They are chosen by the manufacturer. And so, again, the incentives are not aligned as consistently toward public good with those kinds of choices being made and depending upon who their supervisors are.

Ms. TITUS. Uh-huh. Would you like to comment, Ms. Nelson?

Mr. BABBITT. I think the rationale behind that was, if you have 40,000 engineers, you know who the better ones are, you know the ones who should have risen to the management of the projects. The FAA doesn't know these people at all. They have oversight of them and they work in parallel with them. If you have been part of a certification team or service—certification flights, which I have been, you have an FAA pilot in one seat and you have a Boeing pilot in the other putting the airplane through the paces. If you look at the records, the FAA has flown the airplane just about as much as the Boeing pilots have in testing.

Ms. TITUS. I appreciate that, but you say you lack the resources to have adequate oversight. I believe that is true, from all I have heard from FAA over the last several years, and there is going to be a tendency by someone who works for a company reviewing what that company is doing to be more positive than somebody who is objective and outside. I mean, that is just—that is just a fact.

I would ask very quickly, Ms. Pinkerton, some of the airlines are now reconsidering the use of the 787 MAXes. They have ordered thousands of them. Some of them are changing out their whole fleet because they want to keep the same plane, and you understand all the economics of that.

Have you heard any of the airlines addressing some reconsideration of this or how they are taking that into account with the grounding of all these planes?

Ms. PINKERTON. Well, I have certainly seen the reports. Some of those are commercial decisions that each carrier is going to make.

Ms. TITUS. Thank you, Mr. Chairman.

Mr. LARSEN. Thank you.

Mr. Allred for 5 minutes.

Mr. ALLRED. Thank you, Mr. Chairman.

I want to first express my deepest condolences to the families of those lost in these two crashes. I extend my condolences to the families who are here and those that are not. I want to do what we can to make sure that something like this doesn't happen again, not only with the MAX, but with future aircraft and iterations of aircraft.

To that end, I want to begin with you, Captain Carey. At our May 15 hearing, I raised my concerns to Acting Administrator Elwell after reading a report in the Dallas Morning News regard-

ing your meeting with Boeing that the FAA was not made aware of the concerns of your pilots.

Moving forward, what role do you think pilots should play in alerting the FAA of concerns like those that you raised in that meeting?

Mr. CAREY. Thank you, Mr. Allred. First of all, I would like to thank Acting Administrator Elwell. He has been quite progressive in allowing us contact to his office and his professionals.

Going forward, we would like to see our subject matter experts, our 737 pilots in our safety and training program at the Allied Pilots Association invited to future certification proceedings on all future designs. So we have the 777-900 coming down the chute from Boeing shortly. This will be the first commercial aircraft with folding wings. Do we want that to be certified on the original Boeing 777 certificate from 1996 or whenever it was? And this goes back to the timeline or the sunset of a certificate as we are speaking. The 737 is operating on a 1967 certificate.

So we absolutely would like the stakeholders, the flight attendants, the pilots, the engineers, and the maintenance personnel to be involved in future certification with the manufacturer and progressively with the administration as these designs come to commercial use.

Mr. ALLRED. After the designs have already been introduced, are you confident in the processes to raise those concerns now?

Mr. CAREY. I believe we—I am confident in the ability to raise the concerns through the ASAP program, the safety reporting program, the Whistleblower Program, and forums like this, public forums that you so graciously put forward.

I would like to say, to answer a question that was raised earlier, the Allied Pilots Association only endorsed the safety of the American Airlines version of the MAX, because we were one of two airlines in the world to purchase the optional dual AOA system. So we professed our confidence in our version of the airplane. I called the president of Southwest pilots union and said, heads-up, you guys don't have the redundancy that we have.

Mr. ALLRED. Well, you raised a point I wanted to follow up with Captain Sullenberger.

In your written testimony, you state that, quote, "whistleblower protection must be strong and effective, and if it is not strong enough, we must strengthen it."

In your experience, do you believe that current protections are sufficient? And, if not, what can be done to ensure that employees are freely able to come forward with their concerns?

Mr. SULLENBERGER. It is apparent to me it is not sufficient. I think there are those who need to come forward, and they need to feel free of recrimination, in order to make sure that the truth is known.

Mr. ALLRED. Mr. Babbitt, same question to you.

Mr. BABBITT. I can tell you at the FAA, when I was there, whistleblower reports were taken incredibly seriously. I, in fact, established an entire department to ensure that they were heard, that they had the protections that were needed, and the followups were made. It is a very robust system. And to my knowledge, I know of no one who has come forward later after leaving or anything and

said, geez, I tried to be a whistleblower and no one would listen to me. That doesn't happen at the FAA, not at least in my tenure there.

Mr. CAREY. I think there may be a problem within the manufacturing side, the commercial side. For example, Boeing has what they call a Boeing ethics department. So if an engineer or an employee raises a vital concern, if it has economic impact to the corporation, they may be coached or counseled.

Mr. ALLRED. Yeah. That is great. Well, I have about 40 seconds left.

And, Captain Carey, I just want to ask you one more question. From your written testimony, you state that there is only one standard of safety and training and that, quote, "simply put, Boeing does not produce aircraft for U.S. pilots versus pilots from the rest of the world."

Can you elaborate on that?

Mr. CAREY. Absolutely, sir. You know, we have to get away from the days of the American pilot machismo in the "Top Gun" movie. Ethiopian Airlines flies a plane into Washington Dulles every day from Addis Ababa, and they have been doing it for years. They have a proud aviation culture. They were founded by TWA in 1945 and managed through 1975. They are very proud of the fact that Emperor Selassie was the only head of state from Africa to attend JFK's funeral because he had a Boeing aircraft that brought him here.

Mr. ALLRED. Thank you so much.

Mr. LARSEN. Thank you.

I now recognize Representative Johnson of Texas, and followed by Representative Davids from Kansas.

Representative Johnson, 5 minutes.

Ms. JOHNSON OF TEXAS. Thank you very much, Mr. Chairman.

And let me express my appreciation for all of the witnesses being here and especially the family representatives.

We care deeply about airline safety. For one thing, all of us get on a plane every week, going and coming home, and so we are as concerned about American safety as any other safety around the world.

I live in Dallas, Texas, where we have DFW and Love Field, and both airports have airlines very involved in this area. And it does cross my mind often how aboveboard we are with the examination of the planes and the agencies in charge, and wonder sometimes if some laxity might cause a little slip-up.

I know that we have very, very safe aviation activities, but I wonder if each of you could tell me anything that would give us a little bit more assurance that we are headed in the right direction for making sure that safety is the number one concern each time a plane is involved.

This kind of accident gets your attention, and we want to be supportive of whatever it takes to ensure more and more safety. We have more and more air traffic and more and more technology involved. Change does come. So I am very concerned. As an old mind who does not move as fast as some young ones, I am basically very concerned about safety and aviation. We see more and more traffic.

So each of you will take some time, if you will, to give me some of your thoughts of what we need to focus on to ensure that.

Ms. PINKERTON. Congresswoman, I think that you can rest assured that our aviation system is the safest in the world. I have been an observer of this industry for 20 years. I worked on the Hill and did oversight of the FAA. I worked at the FAA, and now I represent the airlines. And I can tell you, the dedicated people that are at the FAA and that are in the airline industry, safety is absolutely our top priority. And when accidents like this happen, we take them incredibly seriously. We go back, we look, and we try to be better the next time.

So even though we have had a decade of a perfect safety record, albeit that one terrible fatality, we recognize that we have to be better. And that is why I mentioned in my testimony, the types of programs that we have right now, allow us to predict and prevent. We identify trends.

I can assure you that when the FAA, because—and I will tell you what the good sign is. I think Sara Nelson mentioned she has noticed a chastened attitude and motivation. When something like this happens in the aviation community, we redouble our efforts. We don't rely on our perfect record from the past. We know we have to get better, and we are committed to doing that.

Ms. JOHNSON OF TEXAS. Thank you.

Ms. NELSON. I would like to note that I agree wholeheartedly with Sharon. And I think that there is no doubt that everyone across the industry, whether it is regulators, operators, or the frontline personnel who make the airlines fly, are absolutely committed to safety, and can tell you without a doubt that that is the foremost thought on their minds.

There are some things that we can learn from this, though, and things that we can do better. And one of them is fully funding FAA personnel and making sure that we are competitive with the private sector for the certification engineers who are working at the FAA. And I think that we can also make sure that the reporting systems that Captain Carey was talking about that help us continue to analyze how we are doing, look at near misses, look at potential problems where employees had a distraction with their safety duties, and they are able to do that because they can report these issues without a punitive response.

So that has been under attack in recent years, and in our experience, has been diminished somewhat, and we have had to fight very hard for the continued programs that ensure a nonpunitive reporting system so that all of the employees can identify when they see an issue. And I would say that those two issues especially could be addressed in this time, both the funding and also the continued support of the reporting systems that allow us to continue to analyze the safety—

Mr. LARSEN. All right.

Ms. NELSON [continuing]. Of citizens and keep us safe.

Mr. LARSEN. Thank you, President Nelson.

Thank you, Representative Johnson.

I recognize Representative Davids for 5 minutes.

Ms. DAVIDS. Thank you, Chairman.

And thank you to all the witnesses who are here today to testify, and thank you to the families. My condolences on your loss and condolences to those who are not here today.

The first thing I would like to do is just to acknowledge that all of us—we have heard from you, we have heard in previous testimony and hearings that we have had—that all of us recognize that safety is the underlying most important foundational piece of our aviation system, not just in this country, but around the world. And as leaders in that space, I know that all of the folks here are putting that as a top priority. I can tell from your testimony, not just your verbal, but also your written testimony, and the meetings that I have had with folks who are also part of the FAA.

And I think that one of the pieces that we have to also keep in mind is that pronouncements from anyone, whether it is manufacturers, stakeholders, Members of Congress, or other people who are performing oversight, about what any causes might have been of these accidents are premature until we get the results of the investigations. And I have appreciated all of you bringing that up and continuing to remind folks of that.

One of the things I would like to start off with is actually a followup from the line of questioning that Mr. Balderson was on earlier, which is to ask, Mr. Carey, you mentioned that the invitation for the folks from Allied Pilots made on June 5 simulator training was canceled. I am curious if you could tell us what the reasoning for the cancellation was.

Mr. CAREY. We are still trying to determine that. We initially received an invitation to go down to the Boeing simulator at Miami, 737 MAX full-motion simulator, and Captains Goldberg, behind me, and Captain Tajer, were going to participate in a flight review of the MCAS system at Boeing's invitation. The invitation was withdrawn. We are trying to get some simulator time either at Boeing.

I mentioned earlier Ethiopian has a simulator we are trying to get into to use. And also a correction to my earlier statement, there are also two 737 MAX simulators in Canada. So if Boeing will not renew their invitation, we will certainly go purchase time at one of those other carriers.

Ms. DAVIDS. So at this point, there hasn't been a rescheduling of the invitation?

Mr. CAREY. No. That is somewhat upsetting to us. I mean, we are the largest airline in the world, and we would like a fair take at reviewing this MCAS scenario, in a muscle memory scenario as Captain Sullenberger described earlier.

Ms. DAVIDS. And then I would like to—Mr. Babbitt, I would like to hear your thoughts on the funding question in making sure that we are keeping FAA properly funded, both what was your experience, and then if you can opine on where we are at right now? I am not sure if you feel comfortable doing that because you are not currently the Administrator, but I would like to hear a little bit about that.

Mr. BABBITT. Thank goodness for that. Thank you.

The funding is always an issue. You come in with a robust—we have always an enormous amount of things that people would like the FAA to undertake and do. You simply don't have the funds.

And so prioritizing what you need to do. And obviously, what is at the fulcrum of that prioritizing is safety.

And I think in—I didn't get to answer Ms. Johnson's question, but I think the biggest fear we have is—and funding will help alleviate it, but the biggest fear that I have is complacency. We have a system that is incredibly safe and, therefore, a lot of people say, well, geez, it is running great. Why do we need to do anything else? Well, we need to do anything else because we are always breaking new boundaries, pioneering new areas, understanding new technology, and we have to evaluate those things.

And remember, the FAA's task is not to design the systems; it is to design the safety boundaries that the system has to operate in. We—you know, it is sort of like baseball. You know, the commissioner set the rules. The players have to play by those rules, and that is what we do. That is what the FAA does.

And so prioritizing—and I guess the best thing I could suggest is that we make certain that, when the FAA does, in fact, prioritize, they share those thoughts with the committees, which I know we do.

Ms. DAVIDS. Thank you.

And finally, I would just say that the concept of oversight is something that is our duty under the Constitution. We also have the duty to make sure that we are properly funding all of our safety, especially aviation, but all of our safety mechanisms in this country. So that is on Congress.

Thank you.

Mr. LARSEN. Thank you.

I recognize Representative Craig of Minnesota for 5 minutes.

Ms. CRAIG. Thank you so much, Mr. Chairman.

Again, as all of us, I want to express my sincere condolences to the families and friends of the victims of the Boeing 737 crashes. We take this responsibility in this Congress incredibly seriously. So thank you all for being here with us today.

Before I came to Congress, I worked in a highly regulated space, the medical technology field, where we heeded very strict compliance and reporting requirements to disclose aftermarket or postmarket issues that were encountered by physicians, by hospitals, by many, many stakeholders with our devices. It was a government system, the FDA's Adverse Event Reporting System, sometimes referred to as the MAUDE database.

Ms. Pinkerton, I found the voluntary reporting programs you mentioned to be incredibly interesting. And I wanted your thoughts on whether we should have a more structured approach, rather than a voluntary reporting system, so that, as Captain Sullenberger said, we resolve these risks before we encounter an event. If you would speak to that, and I am going to ask a number of you also to speak to whether you think the postmarket reporting requirements are adequate from an FAA perspective.

Ms. PINKERTON. Thank you for the question. And with respect to the structure of our safety programs, I think the voluntary nature—and it will be great to hear from our union partners on that—the voluntary nature of it is part of the beauty of it, and Congress has passed statutory protections for voluntarily coming

forward and, frankly, that has been a linchpin of our safety management systems and all of these data-sharing programs.

So I would—you know, I think everything—and we certainly welcome any scrutiny of these programs. I think it is always good to ask the questions, but those programs are working remarkably successfully right now.

With respect to the FAA standards on parts, I think—again, I think they are welcomed scrutiny. And that is the beauty of the oversight that you are taking seriously and that you all are performing. The IG, the Secretary has asked for oversight. Again, I think the scrutiny is welcomed. The standards are working very well right now.

Ms. CRAIG. Captain Carey or Sullenberger, do you have anything to add to that?

Mr. CAREY. Well, we are quite proud of the fact that the Allied Pilots Association, in partnership with the FAA and American Airlines, established the first aviation safety reporting program nearly 25 years ago, it is now known as ASAP, and this has been tremendously successful in averting disasters over the last 25 years. And this program started with the pilots at American Airlines, but now it reaches out to the other stakeholder workgroups within the airline industry at every airline in the country.

Mr. SULLENBERGER. Let me just add that I agree with Captain Carey. And as mentioned earlier about some of the maintenance issues with foreign repair stations and their oversight, those in particular are troubling. More and more, over time, airlines, for economic reasons, have outsourced much of their heavy maintenance that used to be done in-house by their own employees, supervised by their own employees, often there was an FAA overseer on the site, now to overseas locations where a—if the FAA even has the budget and the staff to make a foreign visit, it is virtually impossible for them to arrive unannounced.

There is also a continuing problem within the industry of counterfeit parts, people trying to reuse parts or use parts without a proper provenance where you know with certainty its history from the manufacturer to its delivery onsite and to use in an airplane.

So there still are some ongoing systemic issues that have never been resolved.

Ms. CRAIG. Ms. Nelson, you mentioned in your testimony the 2006 NTSB results of a study, “Safety Report on the Treatment of Safety-Critical Systems in Transport Airplanes.” The NTSB concluded that existing decisions made during design and certification process practices were not subject to ongoing risk assessment and consideration of new information from aftermarket operations and maintenance of aircraft.

Do you believe that this 2006 NTSB recommendation has been addressed and implemented by the FAA?

Ms. NELSON. This has been addressed, I would say, yes. It has not been fully implemented. And my assumption for the biggest reason that it has not been fully implemented is the funding to carry out those recommendations.

Ms. CRAIG. It comes back to funding. Thank you so much.

Mr. Chair, I yield the remainder of my time.

Mr. LARSEN. Thank you.

I recognize Representative Stanton for 5 minutes.

Mr. STANTON. Thank you very much, Chair Larsen. I appreciate it.

Thanks for the witnesses for being here and being patient with this committee. Sorry we are coming in and out. Obviously, we serve on multiple committees.

My first questions are for former FAA Administrator Babbitt. Mr. Babbitt, Captain Carey has questioned whether a sunset or termination date for FAA aircraft certification, particularly for those like the 737 designation from 1967, should be incorporated into the FAA certification process.

As this committee examines the certification process, with your decades of FAA experience and as a pilot yourself, do you think this is an idea worth considering?

Mr. BABBITT. Well, they actually do. Those certifications, the original certification in 1967, applied to that airplane obviously. And what you look at as, maybe 2 years later, we have a new engine we put on that airplane. Do we recertify it? Not really. It has maybe the same thrust, and so—and the parties work together. The airline, the manufacturer. They say this doesn't significantly operate the aircraft differently. It doesn't feel any differently. The pilots do need to understand what the new engine limitations might be, but that's that. Those are—every time there is a significant change made, it is evaluated by the FAA.

I guess the point we should get to for this one is, were the changes made to this aircraft substantial enough that it should have dictated, wait a minute. It has got a different wing. It has got this. It has got that. Maybe we should have another type certificate for this airplane.

And that is a valuable or, you know, something worth considering.

Mr. STANTON. Thank you very much. As you know, Boeing advanced the 737 MAX as a fourth generation of the 737. This had several benefits for Boeing saving money. It gave them a jumpstart on their design and engineering work and required less pilot training. But most importantly for Boeing, it allowed the company to apply for the same common type certification, saving considerable time in getting the aircraft off the ground.

In your opinion, should the FAA have considered—under these circumstances, should the FAA have considered this a new aircraft model rather than a variation of an existing one?

Mr. BABBITT. They did consider. I am certain that they looked at it, and there is an entire matrix of changes that you go through, and these are typically shared. I know in the past, most of the pilot unions involved get to look at that matrix, whether it is certification, minimum equipment, things like that. But what is important to remember, I have heard several times that if this was a new type certificate, it would be very expensive. Not necessarily. If the old airplane simply has one new feature and we say, well, we are going to have to give a different type rating for this, all you are going to have to train in is that difference.

A great example is in the Airbus aircraft to transition from an A320 to an A330, which is a dramatically different airplane, it is

4 days of difference in training. If you had never flown an A320, it would be a 3- or 4-week course.

Mr. STANTON. To your knowledge, has the FAA ever denied a manufacturer's application to treat an aircraft like a variation of an existing aircraft?

Mr. BABBITT. Yes.

Mr. STANTON. Thank you. My question is now for Captain Sullenberger. Captain, thank you for being here. I want to explore with you a question raised in Captain Carey's testimony on pilot training. As aircraft become more and technologically advanced, is the FAA equipped to make sure that pilot training is sufficiently rigorous to handle the potential scenarios that could arise?

Mr. SULLENBERGER. I have concerns, Congressman, because over many years, pilots have been given less and less detailed information, especially in the documentation, the manuals that we have access to, even online. So it becomes harder and harder for those of us who really want to understand in a deep way exactly how these machines operate, where the surprises are, where the dark corners are, where the counterintuitive features are that we have that might bite us, it is a trap for us if we are unwary.

And going back to the certification issue for a moment.

Mr. STANTON. Please.

Mr. SULLENBERGER. I want to address quickly one more, I think, unappreciated change that occurred with the MAX, having stretched this airplane even more than the previous version. The result of that, because of the legacy short landing gear, and the geometry that that affords for the nose angle on takeoff and landing, the speeds for takeoff and for landing have been increased significantly over previous versions, about 20 knots, I understand, that is 23 miles an hour, which slightly increases the risk of a runway overrun.

And when you are operating at airports like Burbank, like Chicago Midway, like LaGuardia that are short runways constrained by obstacles, in some cases by water, that becomes even more of a consideration, especially if the runways are wet or contaminated by snow and ice. And that is yet one more compromise that has been made in this latest stretch to the original design.

Mr. STANTON. I thank you, Captain. I have more questions, but my time is short, so I will yield back. Thank you.

Mr. LARSEN. Thank you.

Mr. Carbajal, you are recognized for 5 minutes. And I ask that you apologize to Mr. Brown.

Mr. CARBAJAL. I apologize to whoever I need to apologize to.

Thank you all for being here, for giving us your time and to share your thoughts and testimony with us.

Captain Carey, thank you for your time again. I know you have a very distinguished career as a 35-year captain with American Airlines and spent time in Africa training African pilots.

Based on your experience training non-U.S. pilots, why is it important for a company like Boeing to create an aircraft for pilots around the world and not just U.S. pilots? Are there any improvements you think the FAA can make to evaluate pilot training?

Mr. CAREY. Boeing is a national treasure. I worked as a kid in the machine shop on Long Island making parts for the aircraft in-

dustry. That is how I paid my way through flight training. The pilots in Africa or Europe—America—we are lucky here in the United States because we have a robust military, and we have a pool of well-trained military pilots. We also have a thriving corporate and commuter regional airline industry. So, again, we have a constant assembly line of well-trained experienced pilots. That doesn't exist in small nations around the world, like Greece or Portugal or Ireland or even the United Kingdom. They have to use ab initio trainings, programs.

Ethiopia. When I was in Africa in 2012 and 2013, I was training the Presidential pilots for the President of Equatorial Guinea on their new Boeing 777 aircraft. And I spent a year there. And we maintained a relationship to use the training and maintenance facilities at Ethiopian. Ethiopian has a world-class maintenance and training facility. They can do overhauls on Boeing aircraft, just like we do at Tulsa Tech, American Airlines' largest maintenance facility in the world.

Going forward, I would like to see more training. When I was hired 35 years ago, we trained every 6 months, recurrent training. Captain Sullenberger can attest to that. Now, the FAA has given what they call a single visit exemption, where airlines can retrain their pilots every 12 months. American Airlines happens to do 9-month cycles. I think we should go back to more training. More training leads to a safer sky.

One fatality in seven billion is one more than we need. As Captain Sullenberger said earlier, we need to prevent accidents from the factory floor to the sky, and we can do it.

Mr. CARBAJAL. Thank you. Mr. Babbitt, you oversaw the FAA after the crash of the Air France flight 447, and the Colgan Air flight 3407. In your testimony, you mention our Nation's system of aircraft certification has been evolving for over 60 years and must continue to evolve to improve.

What are some of the improvements that FAA can make to the current certification process and, two, from your experience, are there any lessons learned that we should keep in mind as we work through the issues facing the 737 MAX?

Mr. BABBITT. Thank you for the question. I think that what the FAA could do has been mentioned by several people here. You are certainly going to need experts in the various areas of new technology that we are seeing. You know, we are now seeing artificial intelligence induced into decisionmaking an aircraft. And the data behind those needs to continue to expand, all of that takes money.

So, you know, in terms of subject matter experts, increasing, you know, where we need them, and anticipating that is going to be very important. As I said in my testimony, data is our friend. You know, what we did coming out of 3407 or the Air France, we took that data and made changes based on it. Unfortunately, we don't have much data, as of today, for either the Lion Air or the Ethiopian accidents. We know the basics of what happened, but we don't know, and our own NTSB will eventually look at that data and give us more information, which will provide a roadmap for us to, OK, we need to expand and do a better job in these areas if we are going to take the lessons learned from that data.

Mr. CARBAJAL. Thank you very much. Thank you both.

Mr. Chair, I yield back.

Mr. LARSEN. Thank you.

I recognize Representative Brown for 5 minutes.

Mr. BROWN. Thank you, Mr. Chairman.

I too want to offer my condolences to the family and friends of those who died in the two crashes involving the Boeing 737 and MAX 8.

I want to thank the panel, not only for being here today and your testimony, but your work as aviation safety advocates.

A lot of your testimony, a lot of the questions have focused on training, and I don't want to be redundant, so I have been able to check off a lot of my questions. I just want to clarify a few things.

The simulators, Captain Sullenberger, you mentioned a level D, I think you categorize it as a full feel simulator. I understand there is one in the United States, two in Canada, one in Ethiopia. Is that accurate?

Mr. SULLENBERGER. That is my understanding.

Mr. BROWN. Are there other simulators that either—you know, that may not provide full feel, but allow for ample training on emergency procedures, system failures, mechanical failures—

Mr. SULLENBERGER. Captain Carey would know better than I, but there are, of course, simulators for previous versions, including the 737 NG, the immediate predecessor to the MAX. But that, of course, wouldn't be able to replicate the activation of MCAS.

Mr. CAREY. That is correct.

Mr. BROWN. Let me—the cockpit is a busy place, even in normal flight conditions. And when there is a flight condition that triggers an emergency indicated in an instrument or some other indicator, it gets really, really busy. I just want to sort of explore. I come out of the Army aviation community where, you know, I flew back in the 1980s, so we still had sort of steam gauges in the OH-58, and I know we have advanced considerably in every airframe, rotary wing, and fixed wing, but can you give us a sense of—for the 737—how many emergency procedures are in the documentation, either a pilot's manual, an operator's manual for mechanical or system failures? Give us a rough estimate.

Mr. CAREY. I have my 737 subject matter experts behind me. They inform me there are hundreds, sir.

Mr. BROWN. There are hundreds. And of those hundreds, is there sufficient simulator time to train on those hundreds?

Mr. CAREY. We train—at American, we train every 9 months, and we go through the major ones, the ones that would be most difficult for a pilot to handle.

Mr. BROWN. And now, of course, the training challenge with the MCAS is that we didn't, as Captain Sullenberger mentioned, we lacked the information that it was on board. But are there other automated systems? And I think this is a followup to a question that was asked by Representative Titus. Are there other systems that create automated systems—

Mr. LARSEN. Mr. Brown, make sure you are getting in the microphone there.

Mr. BROWN. Yeah, I just couldn't see the witnesses beyond Mrs. Napolitano. Sorry, Mr. Chairman.

Are there other automated—it is the design flaw of the room, don't worry. No, you are fine.

Are there other automated systems that present similar challenges in terms of—and I am focusing on the simulator—that there is adequate simulator time to train on?

Mr. CAREY. Well, as far as the 737 MAX goes, the MCAS is the only federated system, which is not integrated into the flight control laws and logic. So this would be one that is unique in itself. As we talk about this in a static matter, you are an aviator yourself, we have to remember that as the pilots are trying to regain control of this aircraft, they experience +2 positive G forces and -.7 negative G forces. As you know, sir, those are extreme forces on the human body while you are trying to read a checklist, perform duties, move switches, move controls, not to mention the human suffering that was obviously heard behind the cockpit door. So this was a terrible situation to put an aircrew in.

Mr. BROWN. So, Captain Sullenberger, you mentioned that, you know, on the level D, there need to be more simulators or certainly more simulator time. Are there any other missing components in the training programs? This is a—you know, you mentioned simulators. Are there any other missing components?

Mr. SULLENBERGER. Yes. And some things we are doing to some extent already, but we need to do much more. I have seen in my career a huge tsunami of change in technology and in training, and I have seen certain trims. One we mentioned already, the reduction in the information about their systems and their airplanes that is now available to pilots compared to years ago.

Mr. BROWN. Let me just jump in because I got 10 seconds. Does Congress need to legislate this or is this something that it can self-correct in the market or with the FAA?

Mr. SULLENBERGER. I think it needs FAA direction. I think it needs—the airlines need incentives to do more training, not just in what we consider batting practice of one-off events, but really in an operational flying scenario. Give them multiple challenges that they have never seen before where they must have a creative reserve to use what they know, adapt it, and apply it in a new way to solve a new problem.

Mr. BROWN. Thank you, Mr. Chairman. I yield back.

Mr. CAREY. I concur.

Mr. LARSEN. Thank you.

Just so we know, in order of the Members that are here, I will begin with Norton next, then Lynch, then Napolitano, and then Payne. That is the order that we have right now.

Representative Norton, 5 minutes.

Ms. NORTON. I appreciate this hearing, but I particularly appreciate the families who are here. The least we owe you are our condolences.

Actually, sometimes the committee learns more from the newspapers than from anyplace else. And I am looking at a—perhaps this is best for the pilots. I am looking at a New York Times piece that indicates—I am sorry, it is a Wall Street Journal piece, that 25 percent of people who fly airplanes want to avoid the MAX, 38 percent said they weren't sure. The flying public doesn't know what to do, in other words.

But the FAA has signaled that it is preparing for flight trials for the proposed 737 MAX enhancement as early as this week and preparing to take an important step toward returning the 737 MAX service by late summer. Now, we know it will require the FAA endorsement and, indeed, foreign regulators as well. But I need to ask you, is this the pace that you would expect, given what Boeing has gone through in the last several months? Is this the pace to get back into service?

Mr. CAREY. Thank you, Congresswoman Norton. I would expect that Boeing and the FAA have this as their top priority, as do the air carriers who have these airplanes on order. We have 24 MAXes—we had 24 MAXes in service at American Airlines, and now I believe there are 6 more that are already off the assembly line, and that is just 1 airline. These aircraft are needed. They are needed for passenger service. We want them back in service.

Ms. NORTON. But you think that this pace is to be expected?

Mr. CAREY. I think that the Boeing Corporation and the FAA is capable of getting this airplane back in the sky by the end of the summer.

Ms. NORTON. I think the flying public would be very pleased, given your expertise, to hear that. But I am now interested, I have become more interested again from what I read in the press and what happens in the factory.

Now, the information I have is from the North Charleston plant. Now, the 737 MAX was designed and assembled there, but the information we have really bewilders me because it is on the 737 Dreamers. So the verdict seems to be in on that. And that the employees from the plants were whistleblowers, and as—5 years ago, the agency did not allow the employees from the plants to certify the aircraft to FAA. That is 5 years ago for the Dreamers—I am sorry. Yeah, the Dreamers.

And it bothers me because the MAX is also manufactured there. The employees, the whistleblowers, said that they believed the strong demand for this other plane, on which the information is in, the 787, had pushed Boeing to quickly turn out jets as it raced to meet deadlines.

So I am trying to find whether there is something endemic in the culture that we ought to watch out for, given what we already know now about the 787 Dreamers. And what do you think, therefore, of the pace in light of what we know about the Dreamers, which were also manufactured at the south—at the south Charleston factory?

Ms. PINKERTON. Congresswoman, if I can respond. From the airline perspective, we have no interest in a rapid pace. We want—

Ms. NORTON. Well, you sort of have some interest in it. Obviously, Boeing is losing money, it needs to get these planes up in the air.

Ms. PINKERTON. We have much—a much stronger interest in the FAA and Boeing working with our pilots union in getting—

Ms. NORTON. I am asking about this plant, which also is a plant that produced the MAX. Does anyone have any misgivings about that?

Mr. SULLENBERGER. Congresswoman, I have seen those same reports, and it gives me great concern that with both the 787 manu-

facturer and the manufacturer of the Air Force tanker, the KC-46, there was some debris left in some bays of the interior of the aircraft that could possibly chafe wiring and cause future issues, and that Boeing has become aware of this and is aggressively trying to get to the root of the problems with the manufacturing process so that no foreign objects remain in manufactured aircraft.

Mr. LARSEN. Thank you very much.

I recognize Mr. Lynch for 5 minutes.

Mr. LYNCH. Thank you, Mr. Chairman.

I want to thank the witnesses for their help this morning. And I certainly want to join my colleagues in offering my condolences to the families of the victims, and thank you for your presence here today.

Earlier in the hearing, the ranking member mentioned that we should avoid politicizing this issue. And I do agree that over a long period of time, our aviation system had been extremely safe, a stellar record. And as someone who gets on a commercial airliner at least a couple of times a week, and as someone who has very warm relations with many of the pilots—I have been doing this for 20 years, so I have come to know a lot of the pilots, flight attendants, machinists, and people who work at the airport. My brother-in-law works on the runway at Logan Airport in my district. They all take enormous pride in that long and stellar safety record.

On October 29, 2018, that long excellent record was severely damaged when Lion Air flight 610, a Boeing 737 MAX, crashed into the Java Sea at about 450 miles an hour, killing 184 passengers and 5 crewmembers on board. That long record of excellent safety operations was again damaged 4 months later on March 10 of this year when Ethiopian Airlines flight 302, again, a Boeing 737 MAX, crashed 6 minutes after takeoff. That crash resulted in the deaths of all on board, 149 passengers and 8 crewmembers.

After that crash, I, along with many of my colleagues on this committee, signed a letter asking that the 737 MAX be grounded. That decision was not political. That decision was based on the tragic facts, on the tremendous loss of life. We supported the grounding of the 737 MAX because we felt it was the right thing to do. It was the right thing to do for the pilots. It was the right thing to do for the crew. It was the right thing to do for the flight attendants, for the passengers, and for the public.

I represent an area that surrounds Logan Airport. The main runways out of Logan take the majority of flights over my district, over the homes and schools and neighborhoods of the people who live in my district and who I represent. An air disaster like Lion Air or Ethiopian Air 302, coming out of Logan Airport, crashing minutes after takeoff in a densely populated area would be a mass casualty event on the ground in my district.

So it wasn't a political decision to ground the 737 MAX after those accidents, and it won't be a political decision to put those planes back in the air. It will be based on the assurances that we have because of the experts that we have here today and the diligence that we will apply to the testing of this system that will rule the day on that decision.

I do want to ask Captain Sullenberger, you know, the descriptions of the Lion Air disaster report that because of the faulty data

on that angle of attack—the angle-of-attack data, the MCAS system, forced the nose of the aircraft downward, quote, “more than two dozen times during an 11-minute span.” And there were reports from other pilots who have had similar problems that the plane acted like a bucking bronco.

I am just wondering, you know, some people are trying to blame the pilots here, and I am just wondering whether with an aircraft behaving like that, is it fair to blame—is it fair to blame these pilots? Because you would think that if we could get the software right, they wouldn’t have to deal with an aircraft that is acting like a bucking bronco. I just don’t want to take the easy path and blame the pilots.

Mr. SULLENBERGER. I think asking—well, first, we shouldn’t be blaming dead pilots. We need to do much more than that. But asking whether this was a pilot error or design error doesn’t really address the right question, because human performance is a variable and it is situation dependent, and we must make accurate assumptions about what is possible in extreme emergencies, given the distractions, the workload, the task saturation.

You are right, we shouldn’t expect pilots to have to compensate for flawed designs. But we have to realize that everything we do, our entire system, the aircraft designs, the way we train pilots, the culture we have, the knowledge we give them, the information we give them or withhold from them determines three important things. How many errors—

Mr. LARSEN. Captain Sullenberger, I am sorry. You are going to have to get it in writing. Those three issues will have to be in writing to the committee.

Mr. SULLENBERGER. I am sorry, what was that?

Mr. LARSEN. I am moving on to Mr. Payne. We will have to take it for the record.

Mr. SULLENBERGER. I am sorry.

Mr. LARSEN. Thank you.

Representative Payne for 5 minutes.

Mr. PAYNE. Thank you, Mr. Chairman.

And I too want to express my condolences to the family and friends who have suffered from this tragic event.

But, Captain Carey, based on your experiences, what, if any, improvements can be made by the process that the FAA uses to evaluate what pilot training is required on new aircraft?

Mr. CAREY. Well, I would like the Administration to look into future designs. For example, the Boeing 777–900 will be in production in the near future. I would like to see pilot involvement, just like they do in the shipping industry or the United States Navy, where the crews are involved in the development of the airplane or the ship from when they lay the keel.

I think that we have the subject matter experts at American Airlines management aviation side and the aviation side of the Allied Pilots Association to put significant input into the design and development of modern jet aircraft. I believe that if any of our pilots would have seen the MCAS system early on, that it would not have slipped through the cracks and not have entered service without robust training.

Mr. PAYNE. Thank you. And that doesn't happen at this point now?

Mr. CAREY. No, sir.

Mr. PAYNE. Thank you. Ms. Pinkerton, as you are aware, many airlines have canceled flights because of the grounding of the 737 MAX causing immediate operational challenges and other issues. What are the long-term effects of a continued grounding on your carriers and the flying public?

Ms. PINKERTON. Congressman, as I mentioned in my opening statement, carriers have been able to adapt. They are doing things like utilizing spare planes. They are postponing doing optional things like painting planes or putting on Wi-Fi. So they are taking a number of steps to ensure that we have the needed capacity in the system. And in fact, for the busy travel season, we are going to be up as an industry, up an overall 3-percent increase in capacity. So these are challenges. I don't mean to make it sound easy, but we are managing it to really mitigate the impact on passengers.

Mr. PAYNE. OK. And, Mr. Chairman, I will be kind and yield back.

Mr. LARSEN. You are my favorite Member today.

So that covers committee members, and I will now recognize Representative DeSaulnier for 5 minutes.

Mr. DESAULNIER. Thank you, Mr. Chairman. I always wanted to be on this subcommittee, so I will try to be your second favorite. That will be a challenge.

To the family members here, I couldn't help but think—search my memory from high school, the Arthur Miller play “All My Sons,” if you remember that, about people who built military aircraft in World War II and cut corners. And the ending of the play was by the person who was involved in cutting corners, and I am not saying that this was the case in this instance, said, I should have thought of all of those pilots as my children. And I think there is a good analogy here that we all should think of any loss of life should—although they weren't our children, we should think of it that way.

Captain Sullenberger, nice to see you.

Mr. SULLENBERGER. Good to see you, Congressman.

Mr. DESAULNIER. For the chair and others, Captain Sullenberger has had the good wisdom to live in my district from time to time, so we have gotten to be friends, and I have great respect. We are working on a bill on safe landings, as a consequence of the Air Canada near miss at SFO. And I want to thank the committee staff and the chair for helping with that.

We spent a lot of time, you and I, talking about human factors, and you talked about it in your comments, and, Captain Carey, maybe you can jump in here, and your comment that we can no longer define safety as the absence of accidents I think was very well put.

So I look at the aviation industry. My perspective is you have got these issues on technology and human factors that we see in the chemical industry, the refining industry, the healthcare industry, and we are learning more and more about neuroscience and how we can help with that.

So being able to do that is important, but you also have, in my view, the coming consequences for the aviation industry on climate change, how we are going to deal with that. I have an amendment put in Appropriations that the Academy of Sciences would look at that and look at all transportation, because we are going to have more disruptions, and pilots are going to have—and aircraft controllers, more challenges, and I anecdotally can see that.

And then lastly is, what is a reasonable rate of return for the shareholders, knowing that you want private investors, but when they can move their investments around, there is pressure sometimes to cut corners. And sometimes to some people that is a euphemism for efficiency.

So when it comes to human factors in the blending particularly of new technology, both of you have been eloquent, but could you add a little bit more to that that we could institutionalize it? Because I am afraid we are becoming complacent in this field because of our great safety record.

Mr. SULLENBERGER. Well, first of all, I want to congratulate you for including in your bill much more emphasis on and funding for study of human factors. And as we use more and more technology, that human machine interface is going to become even more important.

I would say that, talking about the federated versus integrated system where Boeing as a fix for this lately discovered instability issue with the MAX, they have appended to a conventional airplane a computer control system but without giving it the integrity, the reliability, the redundancy that it should have had.

And so that needs to be part and parcel of everything that we do going forward, making sure that when we have any device or feature in an airplane that can autonomously move flight controls, in this case, a secondary flight control or a change engine thrust, it needs to be built to those highest standards and certified to those high standards.

Mr. DESAULNIER. Captain Carey, do you have anything to add before I yield the balance of my time?

Mr. CAREY. I will leave you some time left, sir. I just have a quick comment about the near miss at San Francisco. And we talk about one level of safety all the time. The Canadian pilots have much more liberal flight time, duty time regulations than the U.S. pilots have. And I think maybe future panels should look into requiring overseas carriers to operate into our country under our rules and regulations.

Mr. DESAULNIER. I am going to yield back the balance of my time, and thank the chairman for letting me sit on this hearing.

Mr. LARSEN. That is fine. Thank you, Representative DeSaulnier.

So I understand there are no other questions from other Members. I do have one set of questions for the full panel.

First off, for Captain Sullenberger, those three elements that you were going to cover for Mr. Lynch, what are they?

Mr. SULLENBERGER. The design of our systems in which we operate determine how many errors will be made, what kinds of errors will be made, and how consequential those errors will be. And the safer we make our system, the fewer errors there will be, the less

serious they will be, and the better the consequences of the inevitable human errors that are made.

Mr. LARSEN. Thank you.

For all the members of the panel, is there one area of inquiry that you think this subcommittee should pursue? What would, in your view, the next step for the subcommittee be?

Start here. If you have one now, then we will take it. If not, we will take it for the record.

Ms. PINKERTON. I will think on that and provide you something for the record.

Mr. LARSEN. Thank you very much.

Captain Carey?

Mr. CAREY. A critical checklist. For example, the MCAS—the airworthiness directive after the Lion Air crash that came out on the MCAS system. The manual trim, we learned after Ethiopian, that it was almost humanly not possible later stages in the event for a person to move the manual trim wheel. So we not only have to devise checklists, we have to make sure those checklists are able to be performed by a flight crew in that situation.

Mr. LARSEN. Thanks.

Captain Sullenberger?

Mr. SULLENBERGER. I would love to add two thoughts. First, that each aircraft manufacturer must have a systemic, a comprehensive way of safety risk assessment that can review holistically entire aircraft designs looking for risks, not singly, but in combination. And the second thought I would have is that leadership starts at the top, quality and safety start at the top, and it starts with governance at the board level of our aviation manufacturing companies.

I would love to see more people with—men and women—with subject matter expertise and who understand the science of safety, and that means engineering expertise, someone needs to be a pilot on the board who understands the implication of design choices.

Mr. LARSEN. Interesting. Thank you.

President Nelson?

Ms. NELSON. In terms of getting the MAX back up in the air, there just simply needs to be transparency in the process and a full explanation to all the stakeholders and continued involvement. But what I think that this committee needs to really look at is the relationship between the FAA and the manufacturers and the airlines and this issue of client and customer relationship as opposed to governance and oversight from the FAA and proper funding to get that done.

Mr. LARSEN. Thank you.

Mr. Babbitt?

Mr. BABBITT. Yes, sir. I think the FAA, with committee oversight, and manufacturers as well need to devote a little more energy to understanding what is coming in the future with this relationship between the man and the machine and the interface. I have quoted in my written testimony, I didn't give it here, but in my written testimony, I quoted Chris Hart, former Chairman of the NTSB, who said, you know, automation does a wonderful job of masking weaknesses in human performance. But it is amplified

when that automation fails, and I think we need to understand better what we could do to protect that from happening.

Mr. LARSEN. Thank you.

Well, I want to thank the panel of witnesses for coming today, for responding to our request to be here, for helping the subcommittee understand better what the flying public thinks we ought to be doing, as opposed to what the FAA thinks or the industry thinks, and it is very helpful and appreciated.

And before I gavel out, I do as well want to recognize the families, relatives, and friends of the men and women who were the victims of the two crashes. Thank you for coming, again, for being vocal in your efforts to ensure that this subcommittee stays accountable to the families and relatives and to the flying public here in the U.S.

With that, there are no further questions. I ask unanimous consent the record of today's hearing remain open until such time as our witnesses have provided answers to any questions that may 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, so ordered.

And if no other Members have anything to add, the subcommittee stands adjourned.

[Whereupon, at 12:48 p.m., the subcommittee was adjourned.]

SUBMISSIONS FOR THE RECORD

Prepared Statement of Paul Hudson, President, FlyersRights.org, Submitted for the Record by Hon. Larsen

FlyersRights.org is the largest airline passenger organization with 60,000 member/supporters and represents airline passengers on the FAA Aviation Rulemaking Advisory Committee (ARAC) on air safety issues. Paul Hudson has represented airline passengers and the general public on ARAC since 1993.

As such we are a stakeholder with an abiding interest in the safety of the now grounded Boeing 737 MAX after two crashes in six months ended the lives of 346 passengers, crew, devastated several thousand family members and shocked the world aviation community and the general public.

This is not the first time, FlyersRights.org has called for the grounding or limiting routes of Boeing airliners for safety reasons. In 2013, we filed a petition for intervention with the NTSB with the support of three battery experts after battery fires caused the grounding of the Boeing 787 Dreamliner for six weeks. We have also criticized the safe use of this two engine aircraft by the FAA authorizing flights of five hours or more from the nearest emergency landing facility.

We have also expressed concerns about the use of the two engine 737 MAX for long distance over ocean flights to Hawaii and the North Atlantic, without several years of trouble-free operations which has been the traditional under FAA ETOPS certification standards.

In early December 2018 we directly asked Boeing why it had not grounded the MAX based on the preliminary report of the Lion Air disaster and concerns by a pilot member familiar with Lion Air.

The subject hearing has now exposed a slew of new and existing safety problems, plus a damning review of the MAX and its FAA certification in testimony by Captains Sullenberger, Carey and Babbitt, three of the most experienced commercial pilots and air safety experts in the US and the world.

In our view this requires that the Boeing 737 MAX certainly not be ungrounded in the next 6-9 months, and that serious consideration be given to permanent revocation of its certification to offer air travel services to the general public. Some mistakes in its design are unfixable without a complete redesign to produce new aircraft that is inherently stable and safe for the public to fly.

These likely unfixable safety problems include a design that is inherently unstable unlike any other airliner currently in service in US airspace, an MCAS automation system that is both needed to keep the plane from being unflyable or even crashing but that is subject to multiple failures requiring heroic efforts by pilots at best, to impossible ones at worst. Pilots must deal with about 100 emergency conditions already documented in flight manuals.

On top of unfixable safety problems, the flying public, most aviation authorities and many pilots and flight attendants have lost confidence in both the MAX and its primary safety regulator the FAA. In a recent survey of our members, 70% said that they would not fly the MAX if it is ungrounded, 20% said they would and 10% responded other. Other surveys have shown before many of the revelations the past two months that 20-50% would not fly the MAX.

Ultimately it is the flying public that will have the last word on whether this aircraft is commercially viable. Any airline that makes the current version of the 737 a major part of its fleet will be operating at a competitive disadvantage. And should a third crash occur it would threaten the viability of the Boeing Corporation, and the international leadership of the US commercial aviation industry with its 2 million jobs and the number one US goods export.

History tells us that the public has little tolerance for mass fatality transportation disasters, be it the British "unsinkable" Titanic, the German dirigible Hindenburg, the UK Comet as first jetliner (3 crashes in one year). In each case the public lost

confidence and the companies failed, and the sponsoring nations lost their leadership in that form of mass transportation.

**Photos of 89 of the 157 Victims of the Ethiopian Airlines Flight 302 Crash,
Submitted for the Record by Hon. Larsen**



APPENDIX

QUESTIONS FROM HON. GARRET GRAVES FOR SHARON PINKERTON, SENIOR VICE
PRESIDENT, LEGISLATIVE AND REGULATORY POLICY, AIRLINES FOR AMERICA

Question 1. There has been substantial focus on the quality and methodology of training at the major U.S. carriers. What training do U.S. carriers conduct to prevent an inflight loss of control accident?

ANSWER. The FAA is extensively involved in virtually all aspects of Part 121 Carrier training of Pilots, Flight Attendants, and Mechanics. This includes not only the actual substance of the required training, but nearly every aspect of a Part 121 Carrier's training program, ranging from the adequacy of its facilities to the qualifications of its instructors.

Requirements focused on preventing loss of control accidents—specifically the manual handling maneuvers most critical to stall and upset prevention—are mandated within the “extended envelope” provisions of 24 CFR 121.423. This training consists of Extended Envelope Training (EET) and Upset Prevention and Recovery Training (UPRT), and as of March 12, 2019, is required of each pilot to be qualified to serve as either pilot in command or second in command for a Part 121 Air Carrier. Recurrent training follows on an annual basis. These two programs are typically required to be delivered in a Level C or higher full flight simulator and are intended to assure pilots gain confidence in their abilities and the capabilities of their aircraft in very dynamic conditions (ex. aircraft stall, upset, bounced landing). Both of these FAA mandated programs help ensure our Part 121 carriers are among the best trained aircrews in the world.

Question 2. We heard comments/criticism that the B737 has been modified many times, yet pilots have been allowed to fly the various versions with little to no training. Can you comment on the role of the FAA regarding their oversight of Part 121 carriers and the operation of multiple models of the same aircraft type?

ANSWER. As a routine part of the certification process, the FAA, in collaboration with the manufacturer, and operators, directs manual construction, training tables, and even limitations on the number of distinct models of an aircraft type an individual pilot can be deemed qualified to operate. For instance, when one U.S. airline began operating the B737 MAX aircraft, per FAA-imposed limitations, a pilot could maintain currency and qualification on only two variants of the B737. The FAA gave the airline a choice: its pilots could fly the B737 Classic and the B737 Next Gen, or its pilots could fly the B737 Next Gen and the B737 MAX—but no pilot would be allowed to operate all three variants of the B737.

Question 3. We have heard the term “Advanced Qualification Program” or AQP used regarding air carrier training. What does AQP refer to?

ANSWER. An AQP is a training syllabus that seeks to integrate training and evaluation at each stage of a curriculum. For pass/fail purposes, pilots must demonstrate proficiency in scenarios that test both technical and crew resource management skills together. Air carriers participating in the AQP must design and implement data collection strategies which are diagnostic of cognitive and technical skills critical to their operations. In addition, they must implement procedures for refining curricula content based on quality control data. Thus, air carriers have a data informed, individual job task-centered training program. The items that are trained change as the carrier uses assurance data gathered through its Safety Management System (SMS) to identify areas within the operation where performance can be improved.

Question 4. Recent statements by a number of aviation professionals seem to call into question the value of training materials on an iPad. Do you care to comment on these statements?

ANSWER. Our member carriers training curricula includes, but is not limited to, simulator training in the areas of; Extended Envelope Training (FAR 121.423, AC

120-109A), Upset Prevention and Recovery Training (AC 120-111), Unreliable Airspeed Training, Manual Flight (to include Pitch, Power and Trim), and Automation Management. As mentioned earlier, an AQP uses data to inform a carrier of particular areas it needs to train. AQP actually incorporates a taxonomy to determine the appropriate medium for training for the tasks that need emphasis.

Utilizing computer based training for items that require specific understanding or items that need emphasis has become a much-relied upon method for training delivery across all industry and has proven not only efficient but extremely effective, especially given an individual's relative ease of access to computer delivery. Tablets (i.e. Ipad) allow a pilot to effectively focus their attention on a specific area of emphasis, not only when required, but additionally, whenever and wherever they choose.

QUESTION FROM HON. GARRET GRAVES FOR CAPTAIN CHESLEY B. "SULLY"
SULLENBERGER III, PILOT, US AIRWAYS (RETIRED)

Question 1. Having had the opportunity to participate in flight simulations of both the Lion Air and Ethiopian Airlines accidents, can you comment on your observations and experience?

ANSWER. Within seconds, the crews of the Lion Air and Ethiopian flights would have been fighting for their lives in the fight of their lives.

These two accidents, as well as Air France 447 which crashed in the South Atlantic in June 2009, are also vivid illustrations of the growing level of interconnectedness of devices in aircraft. Previously, with older aircraft designs, there were mostly stand-alone devices, in which a fault or failure was limited to a single device that could quickly be determined to be faulty and the fault remain isolated. But with integrated cockpits and data being shared and used by many devices, a single fault or failure can now have rapidly cascading effects through multiple systems, causing multiple cockpit alarms, cautions and warnings, which can cause distraction and increase workload, creating a situation that can quickly become ambiguous, confusing and overwhelming, making it much harder to analyze and solve the problem.

MCAS was software that was designed to autonomously move flight controls (in this case a secondary flight control) and that was essentially a fly-by-wire system, but it was not designed with the integrity, reliability and redundancy that a fly-by-wire system requires.

And the fact that MCAS was appended to a conventionally controlled airplane meant that it was federated and not integrated into it, thus it lacked appropriate protections.

In both 737 MAX accidents, the failure of an AOA sensor quickly caused multiple instrument indication anomalies and cockpit warnings. And because in this airplane type the AOA sensors provide information to airspeed and altitude displays, the failure triggered warnings simultaneously of speed falsely being too low and also of speed being too high. The false too slow warning was a 'stick-shaker' rapidly and loudly shaking the pilot's control wheel. The too fast warning was a 'clacker', another loud repetitive noise signaling overspeed. These sudden loud warnings would have created major distractions and would have masked the cause and made it even harder to quickly analyze the situation and take effective corrective action.

I recently experienced all these warnings and indications and more in a full motion Level D Boeing 737 MAX flight simulator during recreations of the accident flights. Even knowing what was going to happen, I could see how crews could have run out of time and altitude before they could have solved the problems.

First, the startle factor of a sudden confusing emergency is real and huge. I know from personal experience on US Airways 1549 that it absolutely interferes with one's ability to respond effectively. One's pulse and blood pressure suddenly increase, and one can feel it happening. The sudden stress of a life-threatening crisis causes tunnel vision, a severe narrowing of focus.

The fact that with MCAS active, simply pulling back on the controls would NOT stop MCAS from running the pitch trim nose down robbed the pilots of the single most effective and intuitive tool that pilots have in a situation like this, because MCAS inhibits the control column trim cutout switches. And the most insidious aspect of MCAS was that it kept repeatedly lowering the nose very rapidly. It was maniacal.

The many loud, and in some cases, false warnings would have created a high workload, leading to task saturation, as the pilots tried to keep the nose of the aircraft from repeatedly being lowered by MCAS, and completely explain how it was that crews were not able to realize that thrust was causing rapid acceleration.

And the fact that MCAS kept running the trim nose down in intermittent spurts made it much harder for these crews to recognize the emergency as a traditional runaway trim scenario.

And I also experienced firsthand how difficult it was to move the pitch trim wheels manually, at high airspeeds requiring both hands or the efforts of both pilots, and at very high airspeeds, it may not be possible to move the trim manually until the control wheel is moved forward, further lowering the nose to reduce the very high airloads on the horizontal stabilizer.

QUESTIONS FROM HON. GARRET GRAVES FOR HON. J. RANDOLPH BABBITT, FORMER ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION

Question 1. Mr. Babbitt, when an aircraft like the 737 MAX receives an amended type certificate, is it certified based on current certification standards or under the standards the original type certificate was issued? Is there something inherently unsafe in using an amended type certificate to certify an aircraft?

ANSWER. Before issuing an amended type certificate, the FAA reviews the new design to determine which design standards must be met. When the design changes are significant, the new design will be required to meet the latest standards. For some elements of the design where the safety of that design has been well established, changes to the standard may not be required. If the design includes new or novel design features for which there is no current design standard, a new standard will be established. The process for establishing the safety standards for the new design is a thorough and time-consuming review for the FAA and the manufacturer. These processes assure that the newly amended type certificate meets the appropriate safety standards.

Question 2. One of your key safety initiatives was making sure pilots did not fall too reliant on automotive systems. How can we better train pilots to not become reliant on automation and equip them with the skills necessary to deal with system malfunction?

ANSWER. Pilots in today's airspace system need to continue receiving advanced training to operate in today's operational environment. We should utilize the new technology available today to expand training with the use of visual reality and high-fidelity simulation so that no pilot should ever be surprised by events that take place in an aircraft in which they are certified. That includes exposure to all phases of the operational envelope and environment as well as the built-in safety protections and automation that is designed to protect the operating envelope from excursions. Pilot training should also require a full understanding of all possible control inputs produced by automation as well as the logic driving the automation actions.

Additionally, training and line operation should include requirements and demonstrations of manually flying aircraft to confirm pilot skills are being maintained to guarantee safe operations when automation is not available or has failed for any reason.

Question 3. Having had the opportunity to participate in flight simulations of both the Lion Air and Ethiopian Airlines accidents, can you comment on your observations and experience?

ANSWER. The simulator session which I operated from the left seat as the pilot in command included both versions of the Max 8 software and both scenarios were flown with the Captain's Angle of Attack ("AOA") sensor failed. On take-off, at rotation, the "Stick Shaker" warning went off, so I used the "Failed Airspeed Indication" procedures and proceeded to retract the flaps to "clean".

Once the flaps retracted the MCAS became armed and began to trim the aircraft to a nose down ("AND") attitude and I instinctively trimmed the nose back up to a neutral control column position and turned off the trim system, which is both instinctive and standard procedure in all Boeing Aircraft for a "runaway stabilizer trim emergency".

The Boeing pilot asked me to repeat the same event but asked that I not turn off the trim switches nor trim the aircraft. The control column forces got fairly heavy as the MCAS trimmed and when back pressure on the control column was relaxed, MCAS again trimmed the nose down further. I allowed the MCAS to trim a third time and then electrically trimmed the aircraft back to "neutral control column pressure", turned the Stabilizer Trim Switches off and flew the aircraft to a normal landing using manual trim.

Repeating with the upgraded software change the main difference was that MCAS only trimmed once and even without nose up trimming to neutral, the control column pressure to maintain level flight was very manageable and then later, by turn-

ing off the Stabilizer Trim switches, we returned to a normal landing again using manual trim.

My overall impression was the original software was a bit aggressive and in retrospect could have had more background information for pilots in their initial training. Seeing the new software and the requirement for dual input from angle of attack indications for all practical purposes eliminates the potential for an accidental triggering of the MCAS system. Additionally, when the system does call for MCAS input, it is less aggressive and restricted to only one input occurrence.

