



WILLIAM W. GEORGE

AMRAM MIGDAL

What Went Wrong with Boeing's 737 Max? (B)

On November 18, 2020, the United States Federal Aviation Administration (FAA) approved Boeing's 737 Max jet to fly again after 20 months on the ground.¹ The FAA and regulators around the world had banned the 737 Max from flying in the immediate aftermath of the March 10, 2019, crash of Ethiopian Airlines flight 302, *en route* to Nairobi, Kenya. It had been the second of two deadly crashes involving the 737 Max model in just five months, following the October 29, 2018, downing of Lion Air flight 610 as it took off from Jakarta, Indonesia. Flaws in the Max's design, including the maneuvering characteristics augmentation system (MCAS), had led to the deaths of a total of 346 people in the two tragic accidents. Since then, Boeing had been working with regulators to make the fixes necessary to restore the Max to flight, while striving to regain the trust of airline customers and passengers.

As 2020 came to a close, the news of the FAA approval stood in contrast to the pessimistic outlook for Boeing and the broader commercial aviation sector over the short to medium term. In addition to a spate of cancelled Max orders, Boeing's airline customers were suffering due to the COVID-19 pandemic. In 2020, air travel around the globe was decimated, with about half the number of passengers flying compared to 2019—and international travel down 90%.² Nearly 7,000 passenger jets worldwide—just under one-third of the global fleet—were confined to their hangars.³ Boeing expected the pandemic to have long-term negative effects on air-travel trends and had reduced its forecast of global jetliner demand by 2,000 units and \$200 billion in industrywide sales by 2029.⁴

Days after the FAA approval, Boeing received its first new orders for the Max since its grounding.⁵ In addition, the world was celebrating the first phases of distribution of two vaccines that promised to alleviate the pressure of the COVID-19 pandemic. Yet it was unclear whether these developments marked the beginning of a potential rebound. Boeing CEO David Calhoun faced scrutiny from passengers, airlines, regulators, investors, employees, and the media as he sought to recover from the loss of trust in the airplane manufacturer and the financial consequences of the crashes. With the advent of the vaccines, would air travel resume at anything near pre-pandemic rates? How could Calhoun help restore confidence in Boeing and regain its longstanding reputation for high-quality engineering?

Grounded in the Wake of Tragedy

At the time of the Ethiopian Airlines crash, Boeing had delivered 386 737 Max jets to airlines worldwide, with outstanding orders for more than 4,000 more.⁶ Directly after the crash, Ethiopian Airlines ordered all six 737 Max aircraft in its fleet to stop flying.⁷ On March 11, 2019, China and a number of other countries announced all 737 Max models within their borders were grounded.⁸ On

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March 12, Boeing's then-CEO Dennis A. Muilenburg called President Donald Trump to reassure him that the Max was safe and worthy to continue flying.⁹ The same day, the European Union and other authorities suspended all Max flights.¹⁰ On March 13, when most countries had already declared that the 737 Max must not fly, the FAA announced that it too would ground the planes. Within one week of the second crash, all 737 Max units worldwide were indefinitely prohibited from flying.¹¹

Investigations and Revelations

By the end of March, black box data and multiple investigations confirmed that a malfunctioning exterior sensor, called an angle of attack (AoA) sensor, had triggered the MCAS on Ethiopian Airlines flight 302, leading to the crash—just as had occurred on the Lion Air flight five months earlier.¹² Yet a Boeing vice president continued to deliver the company's message that the plane was airworthy, stating on March 27, "The 737 is a safe airplane."¹³ Boeing announced that it would fix the MCAS, and the FAA confirmed that it expected to approve the software patch by the end of March.¹⁴ Within weeks, as Boeing and regulators deepened their investigations, the target date was pushed to April, and then to September.¹⁵ During this time, production of 737 Max units continued, although in April Boeing scaled back the pace of production from 52 to 42 units per month.¹⁶

In July 2019, press reports showed that the FAA had discovered after the Lion Air crash that the agency did not have a thorough understanding of the MCAS and that regulators had never independently conducted a final risk assessment of the software.¹⁷ Nevertheless, in March 2017, the agency had granted the Max so-called amended type certification, which entailed a faster approval process so long as the new model stayed within certain parameters of the original 737 model, certified in 1968. Conforming to those original design specifications had contributed to flaws in the plane's engineering that necessitated the rushed and under-scrutinized addition of the MCAS. Boeing itself had performed the final tests on the MCAS, which was allowed in part because of legislative language, drafted directly by Boeing and its lobbyists, that passed into law in 2018 and that allowed manufacturers to have the final say over regulators when specific safety features were in question.¹⁸

Recommended Changes for Boeing and Regulators

On September 25, 2019, a committee of Boeing's board delivered a report detailing recommended changes to Boeing's organization and processes. The committee had interviewed employees but not directly investigated the Lion Air and Ethiopian Airlines crashes.¹⁹ The report concluded that Boeing should restructure its organization, governance, and processes to focus more on safety. A permanent Aerospace Safety Committee was added to the board, and going forward safety-related experience would be a criterion for new board directors (see **Exhibit 1**).²⁰ The company also committed to establishing a unit devoted specifically to product and services safety. Other recommendations focused on redesigning Boeing aircraft cockpits in order to accommodate "a new generation of pilots, some of whom may have less training," according to press reports.²¹ The focus on pilots echoed Boeing's and its defenders' claims that the crashes would not have occurred if more skilled pilots had been flying.²²

On September 26, 2019, the National Transportation Safety Board (NTSB) issued a report that criticized Boeing for failing to make pilots aware of the MCAS and for neglecting to take into account the chaotic atmosphere in the cockpit during crucial moments when multiple warnings were active (e.g., when the AoA-sensor warnings from malfunctioning exterior vanes erroneously went off, triggering the simultaneous activation of the MCAS, as happened during both doomed flights).²³ The NTSB's nonbinding recommendations also called on the FAA to redesign its risk assessment processes to evaluate how pilots in emergency situations might respond to a cacophony of warnings and alerts.²⁴

A Whistleblower Weighs In

In October 2019, a Boeing systems engineer who worked on the Max filed an internal ethics complaint regarding concerns he had raised during the development process of the 737 Max. Curtis Ewbank alleged that a technical fix he had recommended might have corrected for the inaccurate AoA sensor reports and forestalled the unnecessary and dangerous activation of the MCAS.²⁵ He claimed that his recommended fix was denied for budgetary and scheduling reasons—and because it might have violated Boeing's commitment to airline customers that the new jet not require additional pilot training.²⁶ In a letter to the U.S. Senate, Ewbank stated that, in 2015, "[my] manager argued against the design changes I wanted to make by stating, 'People have to die before Boeing will change things.'" ²⁷

Ewbank also claimed that the FAA's amended type certification was not rigorous enough. He wrote, "The 737 MAX's original certification was accomplished with hand-waving and deception to hide the numerous ways the 1960s-era design of the 737 does not meet current regulatory standards."²⁸ Amended type certification only scrutinized systems that differed from previous generations of the 737, meaning that pilots' familiarity with and reactions to new systems were not considered. Ewbank warned that the Max design contained numerous flaws beyond the problems with the MCAS and that many of these same flaws were present in the airframe design of Boeing's upcoming 777X model.²⁹

Public Accountability

On October 11, 2019, a report issued by the Joint Authorities Technical Review—comprised of investigators from the FAA and NASA of the U.S., along with regulators from Brazil, China, Europe, and other authorities—condemned both Boeing and the FAA for failing to identify the problems with the Max.³⁰ The report cited Boeing for not doing enough safety testing and withholding information from the FAA; it faulted the FAA for entrusting too much of its oversight responsibility to Boeing employees. "To put the fox in charge of the henhouse never made any sense, and now we see the deeply tragic consequences," said Connecticut Senator Richard Blumenthal.³¹

The day the report came out, Boeing stripped Muilenburg of his position as chairman of the board, installing lead independent director David Calhoun in that position, while Muilenburg continued as CEO. On October 22, Boeing fired the head of its commercial aviation division, who had been in charge of Max development.³² On October 23, the Indonesian National Transportation Safety Committee released findings that concurred with the NTSB and Joint Authorities investigations, pointing blame at Boeing and the FAA for flaws in the MCAS and for failing to alert pilots to the addition of the new system; the Indonesian authorities also criticized Lion Air for poor maintenance and pilot training.³³

On October 29 and 30, 2019, Muilenburg testified in Congress before the Transportation Committee of the House of Representatives, admitting, "We know we made mistakes and got some things wrong. We own that, and we are fixing them."³⁴ During the testimony, numerous internal documents from as early as 2015 showed rising concern among Boeing engineers about the Max's design and safety.³⁵ In a 2016 chat conversation with a colleague, Boeing's chief technical pilot for the Max said of the MCAS, "It's running rampant," and that problems during simulation flights were "egregious."³⁶ Eight months prior to the chat, he had requested and received approval from the FAA to remove mention of the MCAS from the 737 Max flight manual, while remaining within the parameters for amended type certification. This pleased airline customers, which insisted on minimal changes to the flight manual in order to avoid the need for costly pilot retraining. The chief technical pilot admitted in the chat that, "I basically lied to the regulators (unknowingly)," about the risk of omitting mention of the MCAS.³⁷

Lawmakers used the chats and other communications as evidence to allege that Boeing had known early on—during development and certainly after the Lion Air crash—that the MCAS made the plane

unsafe to fly. "This is the smoking gun," an Oregon congressman told reporters.³⁸ Blumenthal said, "What these reports indicate is that Boeing's own employees lied and concealed the truth."³⁹ A number of airline customers had already canceled their existing orders for Max units, and, at the time, Boeing estimated that the aftermath of the crashes would cost the aviation industry a total of \$8 billion.⁴⁰ Boeing's share price dropped from a peak of \$440 prior to the second crash to \$346 at the close of trading on Muilenburg's second day of testimony (see **Exhibit 2**).

Working Toward Recertification

In November 2019, early phases of the Max's recertification were underway. The process included an in-depth review of the Max's design, the circumstances of the crashes, and the initial granting of the amended type certification. Following those proceedings, the FAA would mandate any necessary changes to the jet's design and issue directives for steps Boeing and/or airlines would need to take before the Max could carry passengers again, e.g., technical fixes or requiring additional pilot training. Once the technical directives were met, the FAA would conduct test flights and other inspections prior to rescinding its March 13 order to ground the planes, resulting in recertification. Boeing announced that deliveries would resume even before grounding orders were lifted by regulators, and the company expected that commercial flights on the Max would resume by January 2020.⁴¹

On December 11, 2019, FAA administrator Stephen Dickson testified before Congress, revealing that FAA findings following the first crash showed that the FAA believed that as many as 15 future crashes were probable over the Max's expected 30- to 40-year lifespan.⁴² But, the FAA did not ground the plane at the time. Dickson also called Boeing's timeline for the Max to return to flight by January 2020 "unrealistic" and implied that the Max would not be in the air again until mid-2020.⁴³ On December 16, 2019, Boeing announced it would suspend production of Max units until at least January.⁴⁴ Boeing did not terminate or furlough the 12,000 employees who worked on the plane—although numerous Boeing suppliers around the world were affected, in some cases laying off thousands of employees or going out of business entirely.⁴⁵

On December 23, 2019, Boeing fired Muilenburg. After the announcement, Boeing shares rose 3%.⁴⁶ Calhoun, who had served on Boeing's board since 2009 and, like several previous Boeing executives, had worked at General Electric and trained under Jack Welch, became CEO. As 2019 drew to a close, Boeing ended the year with net negative aircraft orders due to the number of canceled orders in the wake of the crashes. After posting a \$10.5 billion profit in 2018, Boeing lost \$636 million in 2019, its first full-year loss since 1997.⁴⁷ Boeing increased its estimate of total losses that would eventually be attributable to the groundings to \$18 billion.⁴⁸ U.S. Treasury Secretary Steven Mnuchin claimed that the effects of the 737 Max grounding would contribute to a net reduction of 0.5% of GDP.⁴⁹

In January 2020, additional past internal communications among Boeing employees emerged. During the Max's development process, one Boeing employee wrote, "This airplane is designed by clowns who in turn are supervised by monkeys."⁵⁰ Another employee wrote in 2018, "I still haven't been forgiven by God for the covering up I did last year," in reference to problems with the plane's design that the employee had not reported to regulators.⁵¹ In February 2020, test flights as part of the recertification process commenced, and Boeing projected commercial flights would begin in summer 2020 at the earliest.⁵² Nevertheless, Boeing's three biggest U.S. airline customers—American Airlines, Southwest Airlines, and United Airlines—all announced that they would not include the Max in their respective flight schedules through the summer.⁵³

In March 2020, Calhoun made a number of public comments critical of his predecessor, claiming that Muilenburg had irresponsibly ramped up production timeframes in pursuit of short-term stock

performance. He said, "[Employees] felt like they were being pushed into a timeline," and added, "I'll never be able to judge what motivated Dennis, whether it was a stock price that was going to continue to go up and up, or whether it was just beating the other guy to the next rate increase. [. . .] If anybody ran over the rainbow for the pot of gold on stock, it would have been him."⁵⁴ Calhoun added that the challenge of getting Boeing back on track was "more than I imagined it would be, honestly. [. . .] And it speaks to the weaknesses of our leadership."⁵⁵

COVID Takes Off While the Max Is Down

In the spring of 2020, the COVID-19 pandemic erupted out of China and spread around the world, severely disrupting travel and the global economy. Over the three weeks from February 12 to March 20, Boeing's share price fell from \$347 to \$95.⁵⁶ In April, airline customers canceled orders for 108 Max units, and another 94 cancellations came in May.⁵⁷ The total number of cancellations since the model's grounding was more than 400, with more than 4,000 orders still outstanding.⁵⁸ In June, neither Boeing nor the FAA could confirm the timeline for recertification or when Max flights might resume.⁵⁹

Over the course of 2020, the pandemic devastated global air travel. Of the nearly 7,000 passenger jets grounded across the globe due to COVID-related disruptions, analysts expected that nearly 4,000 would never fly again, while a few hundred might find a second life as cargo planes.⁶⁰ While Boeing hoped that business travel, if not consumer travel, would pick up again, reports stated that executives of Delta and other airlines did not expect business travel to "ever return to pre-pandemic levels."⁶¹

On September 16, 2020, the U.S. House of Representatives Transportation Committee's investigation report concluded that both Boeing and the FAA had "played instrumental and causative roles" in the crashes.⁶² The report stated, "The Max crashes were not the result of a singular failure, technical mistake, or mismanaged event [. . .]. [T]hey were the horrific culmination of a series of faulty technical assumptions by Boeing's engineers, a lack of transparency on the part of Boeing's management, and grossly insufficient oversight by the FAA."⁶³

At the end of September, Dickson took the unusual step of piloting the aircraft during one of the 737 Max recertification test flights.⁶⁴ Despite positive comments from Dickson, it remained unclear when recertification would be granted. In October 2020, Boeing did not sell a single additional plane of any model, and another 37 orders of the Max were either outright canceled or removed from Boeing's official backlog of ordered-but-undelivered planes;^a the company delivered just 13 units (of other models) during the same month.⁶⁵ Through October 2020, the total number of 737 Max cancellations was 448, with another 595 removed from the official backlog, for a total of 1,043 orders off the books (see **Exhibit 3**).⁶⁶ In contrast, Airbus received orders for 11 new aircraft and delivered 72 units during the same month, and the A320NEO had 5,596 orders on backlog, compared to the 737 Max's remaining 3,320.⁶⁷ Zero 737 Max units had been delivered since the March 2019 Ethiopia Airlines crash.⁶⁸

In addition, issues with other models had also slowed Boeing orders and deliveries. The 787 Dreamliner required rework related to quality issues at Boeing manufacturing facilities in Kansas, South Carolina, and Washington in the U.S., as well as plants in Italy and Japan.⁶⁹ Boeing was inspecting each aircraft individually, slowing time to delivery and increasing the manufacturer's backlog of undelivered planes.⁷⁰ In 2020, Boeing had a net negative 1,020 orders for the year, while

^a Planes were removed from the official backlog "when either the credit quality of an airline has lowered to a point where it may no longer be able to pay for the jets, or because the delay in delivering the airplane, under the terms of the contract, makes a cancellation possible," wrote an analyst. Source: Dominic Gates, "Boeing wins zero new orders, delivers few jets and sees 737 MAX backlog shrink," *Seattle Times*, November 10, 2020, <https://bit.ly/2JUw75q>, accessed December 2020.

Airbus had secured 308 net new orders.⁷¹ In October 2020, Boeing reported a Q3 net loss of \$466 million, compared to a profit of \$1.2 billion during the same period in 2019 (see **Exhibit 4**).⁷² Most of the losses were centered in Boeing's commercial airplanes division.⁷³ Free cash flow in Q3 2020 was negative \$5.1 billion, and Boeing had just \$27 billion of liquidity and total debt of \$61 billion.⁷⁴ It now estimated the projected losses from the Max crashes and groundings at \$20.6 billion.⁷⁵

With FAA Approval, What Next?

On November 18, 2020, the FAA rescinded its grounding order, thus recertifying the 737 Max. The conditions of recertification included mandatory fixes to the plane's design and the requirement for additional pilot training. Among the fixes were the ability for pilots to override the MCAS in order to stabilize the plane, along with a number of other technical changes to the plane's design and technology as well as pilots' procedures. Going forward, FAA officials—rather than Boeing employees—would approve these changes as they were carried out. International regulators were expected to follow the FAA's decision in short order. "I can tell you that my family and your family will be safe on this aircraft," Dickson said.⁷⁶ Following the announcement, Boeing shares fell 3.2% to \$203.⁷⁷ Calhoun said, "We will never forget the lives lost in the two tragic accidents that led to the decision to suspend operations. [. . .] These events and the lessons we have learned as a result have reshaped our company and further focused our attention on our core values of safety, quality and integrity."⁷⁸

Airlines' responses to the news varied. American Airlines indicated it would resume use of the Max model by the end of the year, while United Airlines said it would wait until early 2021, after it thoroughly inspected each of its Max planes; Southwest Airlines stated it would not resume flying the Max until the spring of 2021, at the earliest.⁷⁹ Of the 450 built-but-undelivered 737 Max units, Boeing would need to find new customers to take on about half of them, since their original airline customers had canceled orders.⁸⁰ On December 3, 2020, Ryanair became the first airline to place new orders, agreeing to purchase an additional 75 Max units on top of its existing order of 135.

Meanwhile, Boeing announced that it would undertake layoffs and begin 2021 with a workforce of 130,000, about 19% lower than at the start of 2020.⁸¹ The company would also downsize its physical footprint, reducing office spaces by 30% across the company and combining all 787 production in its South Carolina manufacturing facilities.⁸² In 2021, it would continue with plans to halt production of the 747 model, leaving its large Everett, Washington, factory empty, with no immediate plans to move any other aircraft to that space.⁸³ Meanwhile, the already-delayed 2022 launch of Boeing's upcoming new 777X model was projected to be pushed back even further.⁸⁴ "There's no doubt that this moment is among the most difficult in our more than 100-year history," said Calhoun. "The COVID-19 impacts on our commercial customers continue to be devastating."⁸⁵ The 737 Max was ready to fly again, but it was far less certain how Boeing's commercial aviation business would get back off the ground.

Exhibit 1 Boeing Board of Directors, 2020

Robert Bradway, director since 2016, chairman and CEO, Amgen. Member of the Audit and Finance committees.

David Calhoun, director since 2009, president and CEO, Boeing. Calhoun previously served as an executive of The Blackstone Group and on the board and as an executive of Nielsen Holdings plc/The Nielsen Company B.V., following a 26-year tenure at GE. Calhoun also serves on the board of Caterpillar Inc.

Arthur Collins Jr., director since 2007, former CEO, Medtronic. Collins previously was senior advisor to Oak Hill Capital Partners and executive at Abbott Laboratories. Collins serves on the board of U.S. Bancorp. He is chair of Boeing's Compensation committee and a member of the Governance, Organization and Nominating committee.

Admiral Edmund Giambastiani Jr., director since 2009, seventh vice chairman of the U.S. Joint Chiefs of Staff; former Supreme Allied Commander Transformation, NATO; former Commander, U.S. Joint Forces Command; president of the Giambastiani Group. Since retiring as a nuclear trained submarine officer, he has served on advisory boards, investigations, and task forces for the Secretaries of Defense, State, and Interior and the Director of the Central Intelligence Agency. Giambastiani serves on the boards of the Invesco Exchange Traded Fund Trusts and THL Credit. He is chair of Boeing's Aerospace Safety committee and a member of the Governance, Organization and Nominating and Special Programs committees.

Lynn Good, director since 2015, chairman and CEO, Duke Energy. Good also serves as the chair of the Institute of Nuclear Power Operations and as a member of the board of the Edison Electric Institute and the World Association of Nuclear Operators. She is chair of Boeing's Audit committee and a member of the Compensation committee.

Akhil Johri, director since 2020, former executive vice president and CFO, United Technologies Corporation. Previously, Johri was CFO at Pall Corporation. He also serves on the board of Cardinal Health Inc. Johri is a member of Boeing's Audit and Finance committees.

Lawrence Kellner, director since 2011, non-executive chairman of the board, Boeing; former chairman and CEO, Continental Airlines. Kellner is president of Emerald Creek Group and serves on the board of Marriott International. He is chair of Boeing's Governance, Organization and Nominating committee and a member of the Aerospace Safety committee.

Ambassador Caroline Kennedy, director since 2017, former U.S. Ambassador to Japan. Kennedy was previously with the Office of Strategic Partnerships of the NYC Department of Education and The Fund for Public Schools as well as a lawyer, author, and editor. She serves on the board of trustees of the United States-Japan Foundation. She is a member of Boeing's Compensation and Governance, Organization and Nominating committees.

Steven Mollenkopf, director since 2020, CEO, Qualcomm Incorporated. Mollenkopf is a member of the Aerospace Safety and Compensation committees.

Admiral John Richardson, director since 2019, 31st Chief of U.S. Naval Operations; former director of the Naval Nuclear Propulsion Program. Previously, he served in four nuclear submarines and evaluated and taught submarine commanding officers. He had roles at the Chief of Naval Operations staff, as naval aide to the President of the United States, and at U.S. Joint Forces Command. He serves on the board of Exelon Corporation. Richardson is chair of Boeing's Special Programs committee and a member of the Aerospace Safety and Finance committees.

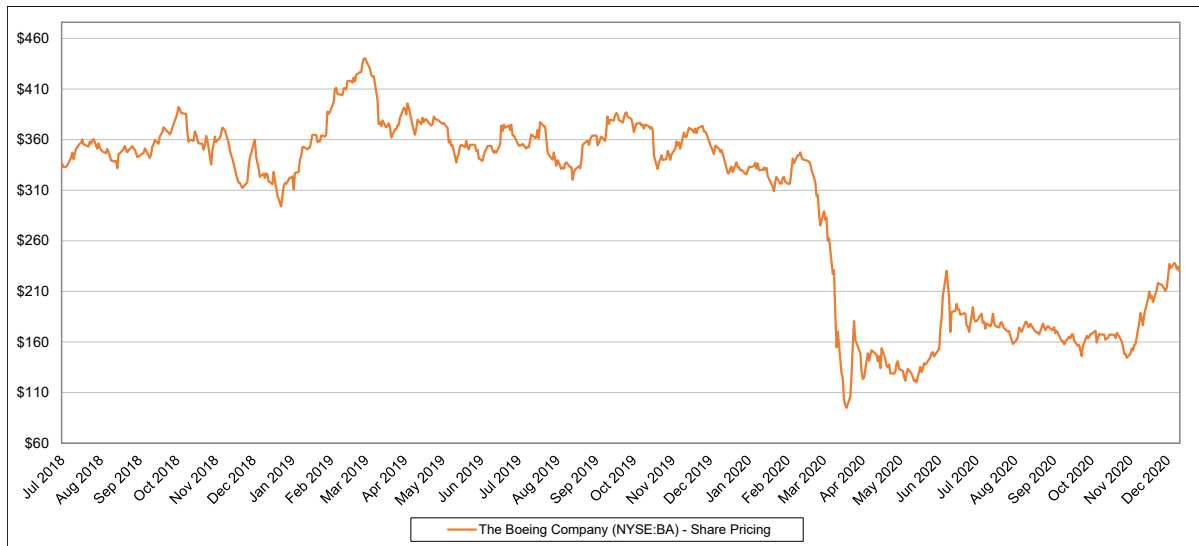
Ambassador Susan Schwab, director since 2010, former U.S. Trade Representative. Schwab is a strategic advisor to Mayer Brown LLP and previously served as CEO of the University System of Maryland Foundation, as consultant for the U.S. Department of Treasury, and as dean of the University of Maryland School of Public Policy. Schwab serves on the boards of Caterpillar Inc., FedEx, and Marriott International and is a member of Boeing's Compensation, Governance, Organization and Nominating, and Special Programs committees.

Ronald Williams, director since 2010, former chairman, president, and CEO, Aetna. Williams is chairman and CEO of RW2 Enterprises, LLC and also serves on the boards of American Express Company and Johnson & Johnson. He is chair of Boeing's Finance committee and a member of the Audit committee.

Source: Corporate Governance, Boeing website, <http://bit.ly/38d41vt>, accessed January 2021.

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Exhibit 2 Boeing Share Price, July 2, 2018 to December 11, 2020

Source: The Boeing Company Share Pricing, Capital IQ, Inc., a division of Standard & Poor's, accessed December 2020.

Exhibit 3 Boeing 737 Max Cancellations and Orders in Jeopardy due to Airline Customers' Financial Turmoil, January to October 2020

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Total
Cancellations	0	41	150	108	14	60	43	17	3	12	448
Orders in Jeopardy	0	2	139	99	80	119	9	74	48	25	595

Source: Adapted by casewriter from Boeing company records cited in Andrew Tangel and Andy Pasztor, "Boeing 737 MAX Cleared to Fly Again, but Covid-19 Has Sapped Demand," Wall Street Journal, November 18, 2020, https://www.wsj.com/articles/boeing-737-max-to-fly-again-but-now-coronavirus-has-sapped-demand-11605695402?st=yft13i7lfhonjyk&reflink=article_email_share, accessed December 2020.

Exhibit 4 Boeing Q3 Selected Summary Financial Results, \$US millions, Q3 2019 and Q3 2020

	Third Quarter			Nine Months		
	2020	2019	Change	2020	2019	Change
Revenues	14,139	19,980	(29)%	42,854	58,648	(27)%
GAAP						
(Loss)/Earnings from Operations	(401)	1,259	NR	(4,718)	229	NR
Operating Margin	(2.8)%	6.3%	NR	(11.0)%	0.4%	NR
Net (Loss)/Earnings	(466)	1,167	NR	3,502	374	NR
(Loss)/Earnings Per Share (\$US)	(\$0.79)	\$2.05	NR	(\$6.10)	\$0.66	NR
Operating Cash Flow	(4,819)	(\$2,424)	NR	(14,401)	(226)	NR
Free Cash Flow	(5,081)	(\$2,889)	NR	(15,439)	(1,613)	NR
Total Consolidated Debt (\$US billions, quarter end)	NR	NR	NR	61.0	61.4	NR
Segment Results						
Commercial Airplanes						
Revenues	3,596	8,249	(56)%	11,434	24,793	(54)%
Loss from Operations	(1,369)	(40)	NR	(6,199)	(3,813)	NR
Operating Margin	(38.1)%	(0.5)%	NR	(54.2)%	(15.4)%	NR
Defense, Space, and Security						
Revenues	6,848	7,002	(2)%	19,478	20,168	(3)%
Earnings from Operations	628	754	(17)%	1,037	2,581	(60)%
Operating Margin	9.2%	10.8%	NR	5.3%	12.8%	NR
Global Services						
Revenues	3,694	4,658	(21)%	11,810	13,820	(15)%
Earnings from Operations	271	673	(60)%	307	2,013	(85)%
Operating Margin	7.3%	14.4%	NR	2.6%	14.6%	NR

Source: Adapted by casewriter from Boeing, "Boeing Reports Third-Quarter Results," press release, October 28, 2020, <https://investors.boeing.com/investors/investor-news/press-release-details/2020/Boeing-Reports-Third-Quarter-Results/default.aspx>, accessed December 2020.

Note: NR = Not reported or reported as not meaningful by the company.

Endnotes

- ¹ Niraj Chokshi, "Boeing 737 Max Is Cleared by F.A.A. to Fly Again," *New York Times*, November 18, 2020, <http://nyti.ms/3ahUKUn>, accessed December 2020.
- ² Doug Cameron, "Boeing Expects Pandemic to Put Big Dent in Jet Demand," *Wall Street Journal*, October 6, 2020, <http://on.wsj.com/3apH6ye>, accessed December 2020.
- ³ Dominic Gates, "Boeing to cut thousands more employees as losses mount," *Seattle Times*, October 28, 2020, <http://bit.ly/3gRnmVJ> and E. Mazareanu, "Size of aircraft fleets by region worldwide: projection 2019-2039," Statista, October 21, 2020, <http://bit.ly/387pSTS>, both accessed December 2020.
- ⁴ Cameron, "Boeing Expects Pandemic to Put Big Dent in Jet Demand."
- ⁵ Dominic Gates, "In a boost for Boeing, Ryanair orders 75 additional 737 Max planes," *Seattle Times*, December 3, 2020, updated December 4, 2020, <https://bit.ly/2LHNuXA>, accessed December 2020.
- ⁶ David Slotnick, "Boeing CEO Dennis Muilenburg is out as the 737 Max crisis drags on. Here's the complete history of the plane that's been grounded since 2 crashes killed 346 people 5 months apart," *Business Insider*, December 23, 2019, <https://www.businessinsider.com/boeing-737-max-timeline-history-full-details-2019-9>, accessed February 2020.
- ⁷ Abdi Latif Dahir, "Ethiopian Airlines has grounded all its 737 Max 8 planes after a deadly crash," *Quartz Africa*, March 11, 2019, <https://qz.com/africa/1570074/ethiopian-airlines-has-ground-its-boeing-737-max-8-planes/>, accessed April 2020.
- ⁸ Slotnick, "Boeing CEO Dennis Muilenburg is out as the 737 Max crisis drags on. [. . .]."
- ⁹ David Gelles, Thomas Kaplan, Kenneth P. Vogel, and Natalie Kitroeff, "U.S. Under Pressure to Cease Flights of Troubled Boeing Jet," *New York Times*, March 12, 2019, <https://nyti.ms/2AbaoBe>, accessed June 2020.
- ¹⁰ Gelles, Kaplan, Vogel, and Kitroeff, "U.S. Under Pressure to Cease Flights of Troubled Boeing Jet."
- ¹¹ William Langewiesche, "What Really Brought Down the Boeing 737 Max?" *New York Times Magazine*, September 18, 2019, updated January 21, 2020, <https://nyti.ms/2zWGLTE>, accessed April 2020.
- ¹² James Glanz, Thomas Kaplan, and Jack Nicas, "In Ethiopia Crash, Faulty Sensor on Boeing 737 Max Is Suspected," *New York Times*, March 29, 2019, <https://www.nytimes.com/2019/03/29/business/boeing-737-max-crash.html>, accessed June 2020.
- ¹³ Glanz, Kaplan, and Nicas, "In Ethiopia Crash, Faulty Sensor on Boeing 737 Max Is Suspected."
- ¹⁴ David Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. Here's the complete history of the plane that's been grounded since 2 crashes killed 346 people 5 months apart," *Business Insider*, March 5, 2020, <https://bit.ly/31iPjq0>, accessed June 2020.
- ¹⁵ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ¹⁶ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ¹⁷ Natalie Kitroeff, David Gelles and Jack Nicas, "The Roots of Boeing's 737 Max Crisis: A Regulator Relaxes Its Oversight," *New York Times*, July 27, 2019, <https://nyti.ms/3eG9X0A>, accessed June 2020.
- ¹⁸ Natalie Kitroeff and David Gelles, "Before Deadly Crashes, Boeing Pushed for Law that Undercut Oversight," *New York Times*, October 27, 2019, updated January 6, 2020, <https://nyti.ms/2ZdaCQD>, accessed June 2020.
- ¹⁹ David Gelles and Natalie Kitroeff, "Boeing Board to Call for Safety Changes After 737 Max Crashes," *New York Times*, September 15, 2019, updated October 2, 2019, <https://nyti.ms/383G08t>, accessed June 2020.
- ²⁰ Phil LeBeau, "Boeing adds safety committee, considers changes to airplane development," *CNBC*, September 25, 2019, <https://cnb.cx/2ZhmJ44>, accessed June 2020.
- ²¹ Gelles and Kitroeff, "Boeing Board to Call for Safety Changes After 737 Max Crashes."
- ²² Dominic Gates, "How much was pilot error a factor in the Boeing 737 MAX crashes?" *Seattle Times*, May 15, 2019, <https://bit.ly/2YBZOws>, accessed June 2020.
- ²³ Natalie Kitroeff, "Boeing Underestimated Cockpit Chaos on 737 Max, N.T.S.B. Says," *New York Times*, September 26, 2019, updated October 29, 2019, <https://nyti.ms/2NBTAps>, accessed June 2020.
- ²⁴ Kitroeff, "Boeing Underestimated Cockpit Chaos on 737 Max, N.T.S.B. Says."

- ²⁵ Dominic Gates, "Boeing whistleblower alleges systemic problems with 737 MAX," *Seattle Times*, June 18, 2020, <https://bit.ly/2BdVmet>, accessed June 2020.
- ²⁶ Gates, "Boeing whistleblower alleges systemic problems with 737 MAX."
- ²⁷ Gates, "Boeing whistleblower alleges systemic problems with 737 MAX."
- ²⁸ Gates, "Boeing whistleblower alleges systemic problems with 737 MAX."
- ²⁹ Gates, "Boeing whistleblower alleges systemic problems with 737 MAX."
- ³⁰ David Gelles and Natalie Kitroeff, "Boeing and F.A.A. Faulted in Damning Report on 737 Max Certification," *New York Times*, October 11, 2019, updated January 7, 2020, <https://nyti.ms/2NwGL02>, accessed June 2020.
- ³¹ Gelles and Kitroeff, "Boeing and F.A.A. Faulted in Damning Report on 737 Max Certification."
- ³² David Gelles and Natalie Kitroeff, "Boeing Ousts Top Executive as 737 Max Crisis Swells," *New York Times*, October 22, 2019, <https://www.nytimes.com/2019/10/22/business/boeing-kevin-mcallister.html>, accessed June 2020.
- ³³ Muktita Suhartono and Hannah Beech, "In Boeing Lion Air Crash, Indonesians Learn What Took Their Loved Ones," *New York Times*, October 23, 2019, updated October 25, 2019, <https://nyti.ms/3i2LLaW>, accessed June 2020.
- ³⁴ Dennis Muilenburg, quoted in David Slotnick, "Boeing CEO Dennis Muilenburg will admit to 'mistakes' when he faces Congress over the grounded 737 Max plane. Read his full opening statement," *Business Insider*, October 28, 2019, <https://www.businessinsider.com/boeing-ceo-senate-737-max-testimony-opening-statement-2019-10>, accessed June 2020.
- ³⁵ Gelles, Kaplan, Vogel, and Kitroeff, "U.S. Under Pressure to Cease Flights of Troubled Boeing Jet."
- ³⁶ David Gelles and Natalie Kitroeff, "Boeing Pilot Complained of 'Egregious' Issue With 737 Max in 2016," *New York Times*, October 18, 2019, updated October 23, 2019, <https://nyti.ms/3i9A4PF>, accessed June 2020.
- ³⁷ Gelles and Kitroeff, "Boeing Pilot Complained of 'Egregious' Issue With 737 Max in 2016."
- ³⁸ Gelles and Kitroeff, "Boeing Pilot Complained of 'Egregious' Issue With 737 Max in 2016."
- ³⁹ Gelles and Kitroeff, "Boeing Pilot Complained of 'Egregious' Issue With 737 Max in 2016."
- ⁴⁰ Gelles, Kaplan, Vogel, and Kitroeff, "U.S. Under Pressure to Cease Flights of Troubled Boeing Jet"; The Boeing Company (NYSE:BA) Share Pricing, Capital IQ, Inc., a division of Standard & Poor's, both accessed June 2020.
- ⁴¹ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁴² Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁴³ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁴⁴ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁴⁵ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁴⁶ Will Martin and Graham Rapiere, "Boeing's CEO Dennis Muilenburg has been fired as the company continues to battle fallout from its 737 Max crisis," *Business Insider*, December 23, 2019, <https://bit.ly/31kZu6V>, accessed June 2020.
- ⁴⁷ Will Martin and David Slotnick, "Boeing posted its first full-year loss in more than 20 years, as the 737 Max crisis continues," *Business Insider*, January 29, 2020, <https://bit.ly/3i6riSM>, accessed June 2020.
- ⁴⁸ Martin and Slotnick, "Boeing posted its first full-year loss in more than 20 years, as the 737 Max crisis continues."
- ⁴⁹ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁵⁰ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁵¹ Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁵² Slotnick, "Nearly a year after it began, the Boeing 737 Max crisis still drags on. [. . .]."
- ⁵³ Chokshi, "Boeing 737 Max Is Cleared by F.A.A. to Fly Again."
- ⁵⁴ Natalie Kitroeff and David Gelles, "'It's More Than I Imagined': Boeing's New C.E.O. Confronts Its Challenges," *New York Times*, March 5, 2020, updated March 6, 2020, <https://nyti.ms/2YAcnZ2>, accessed June 2020.
- ⁵⁵ Kitroeff and Gelles, "'It's More Than I Imagined': Boeing's New C.E.O. Confronts Its Challenges."

- ⁵⁶ The Boeing Company, Capital IQ, Inc., a division of Standard and Poor's, accessed December 2020.
- ⁵⁷ Al Root, "Boeing Sees 108 737 MAX Orders Canceled in April," *Barron's*, May 12, 2020, <https://bit.ly/3fWnfX4>; Dominic Gates, "Boeing in May: More 737 MAXs canceled and no passenger jets delivered," *Seattle Times*, updated June 10, 2020, <https://bit.ly/2ZaY3FK>, both accessed June 2020.
- ⁵⁸ Root, "Boeing Sees 108 737 MAX Orders Canceled in April"; Gates, "Boeing in May [. .]."
- ⁵⁹ Phil LeBeau, "Boeing aims for 737 Max recertification flight by the end of June," *CNBC*, June 10, 2020, <https://cnb.cx/3dJWeF3>, accessed June 2020.
- ⁶⁰ Dominic Gates, "Boeing to cut thousands more employees as losses mount," *Seattle Times*, October 28, 2020, <http://bit.ly/3gRnmVJ>, accessed December 2020.
- ⁶¹ Doug Cameron, "Boeing Expects Pandemic to Put Big Dent in Jet Demand," *Wall Street Journal*, October 6, 2020, <http://on.wsj.com/3apH6ye>, accessed December 2020.
- ⁶² David Schaper, "Congressional Inquiry Faults Boeing And FAA Failures For Deadly 737 Max Plane Crashes," September 16, 2020, <http://n.pr/3aikksf>, accessed December 2020.
- ⁶³ Schaper, "Congressional Inquiry Faults Boeing And FAA Failures For Deadly 737 Max Plane Crashes."
- ⁶⁴ Pete Muntean and Gregory Wallace, "In unusual move, FAA chief test flies 737 Max; says more fixes needed," *CNN*, September 30, 2020, <http://cnn.it/3nwATEM>, accessed December 2020.
- ⁶⁵ Dominic Gates, "Boeing wins zero new orders, delivers few jets and sees 737 MAX backlog shrink," *Seattle Times*, November 10, 2020, <https://bit.ly/2JUw75q>, accessed December 2020.
- ⁶⁶ Gates, "Boeing wins zero new orders, delivers few jets and sees 737 MAX backlog shrink."
- ⁶⁷ Gates, "Boeing wins zero new orders, delivers few jets and sees 737 MAX backlog shrink."
- ⁶⁸ Gates, "Boeing wins zero new orders, delivers few jets and sees 737 MAX backlog shrink."
- ⁶⁹ Dominic Gates, "Boeing finds more 787 quality defects, broadens inspections," *Seattle Times*, December 14, 2020, <http://bit.ly/3bbbvRp>, accessed January 2021.
- ⁷⁰ Dominic Gates, "Boeing to cut thousands more employees as losses mount," *Seattle Times*, October 28, 2020, <http://bit.ly/3gRnmVJ>, accessed December 2020.
- ⁷¹ Gates, "Boeing wins zero new orders, delivers few jets and sees 737 MAX backlog shrink."
- ⁷² Gates, "Boeing to cut thousands more employees as losses mount."
- ⁷³ Gates, "Boeing to cut thousands more employees as losses mount."
- ⁷⁴ Gates, "Boeing to cut thousands more employees as losses mount."
- ⁷⁵ Gates, "Boeing to cut thousands more employees as losses mount."
- ⁷⁶ Andrew Tangel and Andy Pasztor, "Boeing 737 MAX Cleared to Fly Again, but Covid-19 Has Sapped Demand," *Wall Street Journal*, November 18, 2020, <http://on.wsj.com/2KxeJTU>, accessed December 2020.
- ⁷⁷ Tangel and Pasztor, "Boeing 737 MAX Cleared to Fly Again, but Covid-19 Has Sapped Demand."
- ⁷⁸ Boeing, "Boeing Responds to FAA Approval to Resume 737 MAX Operations," press release, November 18, 2020, <http://bit.ly/3r564Je>, accessed December 2020.
- ⁷⁹ Chokshi, "Boeing 737 Max Is Cleared by F.A.A. to Fly Again."
- ⁸⁰ Gates, "Boeing to cut thousands more employees as losses mount."
- ⁸¹ Chokshi, "Boeing 737 Max Is Cleared by F.A.A. to Fly Again."
- ⁸² Gates, "Boeing to cut thousands more employees as losses mount."
- ⁸³ Gates, "Boeing to cut thousands more employees as losses mount."
- ⁸⁴ Gates, "Boeing to cut thousands more employees as losses mount."
- ⁸⁵ Gates, "Boeing to cut thousands more employees as losses mount."