Pushing It to the Max

Boeing's Crashes Expose Systemic Failings

The crash of two Boeing 737 Max jets in the course of just months has created an existential crisis for the company. Were the 346 who died in Indonesia and Ethiopia the victims of shortcuts and cutthroat competition in the aviation industry? By DER SPIEGEL Staff

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It took Ethiopian Airlines Flight 302 about six minutes to travel from Addis Ababa to Ejere, a sprawling cluster of small farms on the edge of the Abyssinian highlands. By car, the journey takes around three hours and winds past unfinished buildings in the Ethiopian capital's southeastern suburbs before continuing down the immaculate, six-lane Addis Adama Expressway, which was built by the Chinese and opened in 2014. After the exit, there's a narrow, bumpy gravel road that's barely wide enough for a single car or carriage. It is out here that the scene of the accident can be found -- or the scene of the crime, depending on what investigators find.

In this undulating terrain 2,000 meters (6562 feet) above sea level, the earth seems scorched. The only green comes from eucalyptus trees, which dot the landscape and provide precious shade for goatherds and their animals. Along the paths are head-high stalls that transform into storefronts come market day, when farmers sell their homemade schnapps. It's a barren region.

The crater the airplane made when it slammed into the ground at 8:44 a.m. on March 10 is around 10 meters deep. Its diameter is difficult to determine now that the excavators are done salvaging what they could find, but people standing on the edge of the pit look tiny by comparison. The plane smashed into the ground at a speed of 926 kilometers per hour (575.4 mph) -- and physics did the rest. The aircraft drilled deep into the ground, dislodging earth and stones, hurling them 50 meters into the air, along with parts of what only seconds ago had been an airplane.

The fuselage, landing gear, wings, engines, doors, windows, seats, luggage -- and people -- were brutally crushed, torn into pieces and strewn around. The grotesque contortions displayed by some pieces of metal come in part because in a last ditch, and ultimately futile effort at survival, the plane entered into a steep curve. The kerosene in the tanks didn't explode and nothing burned. The fuel evaporated instantaneously due to the extremely high speed at impact.

Difficult questions began arising almost immediately after the crash. The most difficult of all is whether this misfortune was, in fact, avoidable. Indeed, whether it should have been prevented. It is unbearable to think the 157 victims from Ejere might have died because of an industrial scandal. And if they were, then the crater is indeed a crime scene -- and it's where the search for clues begins.

Immediate Grounding

From here, there's a direct connection to Indonesia, where only five months earlier, on Oct. 29, Lion Air Flight 610 likewise entered a steep dive, slamming into the Java Sea minutes after takeoff. Together, these two crashes plunged the aviation world into turmoil. And all eyes were suddenly trained on an airplane that had only just gone on the market: the Boeing 737 Max.

Within hours of the second crash, China ordered all planes of that model to be grounded. The United States needed three days to follow suit. Since then, 550 of the new planes around the world, with a sticker price of around $135 million, have been paralyzed. If it were up to Boeing, the aircraft would have been back in service long ago, patched up with a software update. But following the failure of the update in question in tests conducted in late June, the crisis has been ongoing. The 737 Max remains grounded and all eyes are still fixed on Boeing.

In recent weeks, DER SPIEGEL dispatched a reporting team to Seattle, New York, Chicago, Washington, D.C., Addis Ababa, Jakarta and Paris to shed light on the events leading up to and including the crashes. They conducted interviews with Boeing executives and airline managers, visited Boeing factories and spoke to experts who explained the technical side of what went wrong. They even stepped into a flight simulator to get a better understanding. In Ethiopia and Indonesia, they tracked down eyewitnesses of the crashes and spoke to the victims' surviving family members around the world along with lawyers and experts.

DER SPIEGEL learned a great deal about the bizarre process of regulatory approval in the U.S. We also learned of a complaint by a whistleblower at Boeing, who approached the European Union Aviation Safety Agency (EASA) in June with serious accusations against the airplane manufacturer.

A best-case scenario is hard to imagine given the dire straits in which Boeing currently finds itself. The only way our standard approach to the risks of flying can possibly remain unchanged is if, at the end of the investigations in Ethiopia and Indonesia, it is determined that both were truly accidents in the conventional sense and their similarities.

But if it is revealed that 346 people died because both a corporation and the regulators tasked with overseeing it were grossly negligent, or even deliberately lax, then it would have far-reaching consequences for the aviation industry, the credibility of supervisory bodies and for normal people's everyday lives.

A Feared Lawyer

It was nighttime in New York when the Boeing 737 fell out of the sky in Ethiopia. Marc Moller heard about it on Sunday morning right after he woke up. An Ethiopian Airlines plane, he learned, had crashed on the way to Nairobi with 157 people on board. His first thought was: Lion Air.

Soon, the first TV stations began calling him. CNN and NBC always need experts when the words "Breaking News" scroll across the screen. Producers at the news channels have Moller's number saved for whenever a plane goes down and the 80-year-old lawyer is a legend among his colleagues. When it comes to representing the bereaved, no one can fool him. Airlines, airplane manufacturers, even car rental companies have come to fear him. Should the situation call for it, Moller has no problem disparaging the other side as "mass murderers." When he represented relatives of the victims of the Germanwings crash in 2015, he accused the instructors of the co-pilot, who ultimately killed himself and 149 others in a brutal murder-suicide, of not having noticed how volatile the pilot was.

Lawyer Marc Moller: "There was something seriously flawed and wrong with the 737 Max."
Photography/ DER SPIEGEL

A day after the crash in Ethiopia, Moller met with a senior partner from the law firm Kreindler & Kreindler on Third Avenue in Manhattan. The man's name is Justin Green, who had flown fighter jets for the Marines before becoming an attorney. By the time Moller showed up, Green had already begun analyzing the radar data from Flight 302. Now they compared it with the data from Lion Air 610. "Even before the Lion Air and ET 302 flight data recorder information was available, it was clear to us that the two events shared remarkable similarity," Moller recalls. The two lawyers had no doubt: "There was something seriously flawed and wrong with the 737 Max."

The flight paths of both planes were inexplicably wild, characterized by sharp and sudden gains and losses of altitude, as if the pilots were struggling to maintain control of their aircraft. By the end, the planes had gained so much speed and were descending so steeply that the pilots would have had to possess superhuman strength to counter the pressure on the horizontal stabilizer trim. Moller and Green from the law firm Kreindler & Kreindler, specialists in catastrophes, had a case. And what a case it was.

The two of them related the story of their case during a visit to their office in New York, from which they have a view of the East River. There are pictures on the walls that make it look almost like a museum -- sketches of court proceedings with Moller himself always front and center.

"Here," he says. "That's me during the American Airlines case." That was in 1995, when a Boeing 757 struck a mountainside in Colombia. Another drawing shows Moller before a judge to whom they had just shown a visualization of the crash of an Avianca plane in New York. The judge is looking over Moller's shoulder and into the eyes of the opposing counsel. "When the judge asked the defense counsel whether the video reconstruction was accurate, I knew we had won the case."

Justified in Their Demands

Moller has been doing his job since 1964, his career beginning with one of the worst accidents in the history of civilian aviation: Turkish Airlines Flight 981. Due to a faulty cargo bay hatch, the plane exploded in mid-air, killing 346 people onboard the DC-10 over Paris. And Moller had found his calling, that of representing the families of the victims. And that's what he is still doing today: Helping the families of victims secure significant compensation and using all of the legal resources at his disposal to do so. While the bereaved process their grief, Moller says, they are completely justified in their demands for accountability and financial compensation. "The sad truth," he says, "is that ultimately, the currency of compensation is money."

Unlike Green, Moller's young, athletic partner, the older lawyer is "not the pilot type." Moller is a desk jockey with remarkably large hands that always protrude from the sleeves of a suit. The secret of his success, he says, lies in the fact that he's only as smart as the people on the jury; he's not an expert in aerodynamics or flight control or anything else technical. What's more, over the course of his 55 years in the profession, he's learned that every plane crash can be traced back to a single, simple cause. "With the exercise of common sense, the judge and jury will reach the right result," Moller says.

They've been working on Ethiopian Airlines Flight 302 case since March. It's the firm's most important case in decades. Eight Americans were onboard the plane, 22 United Nations employees, development workers, scientists, men and women from 35 countries. Many of the victims' relatives feel a responsibility to ensure that such an accident never happens again -- that much they owe to their lost loved ones. It's the lawyers' job to make those affected by the tragedy visible, to put a face to the numbers. Indeed, it's easy to say that 157 people died in the crash of Ethiopian Airlines Flight 302. But the scope of the accident only becomes tangible when the people whose lives have been torn apart are placed in the foreground.

Just As He Remembers Her

Sara Gebremichael is dead. She was a stewardess onboard the plane. On the day she died, she left her apartment at around 6 a.m. and was picked up by the airline's chauffeur service. Gebremichael was on the move a lot in the days leading up to her death -- in Brazil, then India, and now Nairobi, Kenya. The upcoming flight was a short one by comparison. Her husband says he had to move after his wife's death. He couldn't handle living as a widower in the apartment they once shared. He erected a small altar near a window in his new apartment with photos of his wife laughing, looking, being -- just as he remembers her.

Getnet Alemayehu is dead. He was the chief logistics officer for aid supplies at Christian Relief Services (CRS), a Catholic relief organization based in the U.S. He had been married for 17 years to his wife, Rahel, a programmer. She had just come back from a business trip to London before the accident. Their daughter, Naomi, is 16 and she spent a lot of time with her father in the week before his death. The day before the accident, the family had gone to a cafe where, instead of cake -- since it was still Lent -- they drank black coffee with lots of sugar. His wife heard about the crash on CNN but was in no shape to share the news with her daughter until the next day. The widow didn't sue Boeing. Her only hope, she says, is that she'll be able to get back a piece of her husband. A finger, a toe -- anything she can bury.

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Yared Getachev is dead. He was the captain of Ethiopian Airlines Flight 302. Roughly four hours before he lost control of his plane, he made his way to the airport. His neighbor, Fasika, who had just gotten home from early mass, saw him before he left. He was wearing his pilot's uniform with four golden stripes, was traveling lightly and was planning on being back home in Addis that evening. Fasika had known the pilot for eight years. That's how long they'd lived alongside one another in a block of apartments in the northeast of the city.

The apartments here are small, their hallways narrow. One enters the apartments via exterior staircases, like at a cheap American motel. Fasika says that she and Getachev were friends. "He missed his family, who lived in Kenya," she says. "And I miss my son, who's studying in the U.S." They were there for each other when they felt lonely. Yared Getachev left his family at the age of 19 to fulfill his dream of becoming a pilot in Addis Ababa.

He was an ambitious young man, slender, almost gaunt, and an extremely sociable person. He was the youngest graduate of the Ethiopian Airlines flight school, a pilot who had spent more than 8,000 hours in the cockpit despite being just 29 years of age. He was a model student. Boeing's lobbyists will likely attempt to make the pilots of the crashed planes, including Getachev, seem incompetent and will try to pin the blame on them. But that is very clearly not true in this case. Patrick Smith, a pilot and well-known author in the U.S., quotes an American flight instructor who trained Getachev. The instructor spoke highly of the young aviator, describing him as an "excellent pilot" who always went to work "well prepared."

Jackson Musoni is dead. The Rwandan worked for the UN Refugee Agency in Sudan, in eastern Darfur. He left behind a wife and three small children.

Jonathan Dubois-Seex is dead. Born in Kenya, he grew up in Sweden, married a French woman, had three children and was on a business trip for the Tamarind Group, which owns and operates restaurants in Africa.

Sebastiano Tusa is dead. He was a marine archaeologist from Italy on his way to a UNESCO conference.

Stephanie Lacroix from Canada is dead. She was accompanying a group of young Canadians to an environmental protection conference.

The site of the crash in Ejere, Ethiopia: The Ethiopian Airlines 737 Max impacted at a speed of 926 kilomters per hour. Eduardo Soteras Jalil/ DER SPIEGEL

In all, 157 people are dead. Initially, their remains were stored in an outbuilding at the Addis Ababa airport, in refrigerated containers that usually hold roses before they are exported. Later, the body parts were taken to St. Paul's Hospital. It will likely take months for them all to be identified. Inside the coffins that were laid out during the funeral ceremony at the Cathedral of the Holy Trinity in Addis, there was only soil from the scene of the accident.

Colorful, Jagged Lines

Half a world away, New York attorneys Moller and Green spread out documents showing the plane's flight path, angle of attack and speed at various points in time. The data has been entered into a coordinate system and are represented as colorful, jagged lines that only experts can interpret. For this, Moller relies on his colleague Green, though he has his own opinion of what went wrong: "We believe that the facts that emerge through litigation will demonstrate that commercial pressure, the Boeing/Airbus competition and the drive to make money and save money resulted in the 737 Max, as initially designed and sold, being an unreasonably dangerous airplane," says Moller.

The competition between Boeing and Airbus does, in fact, appear to be a key element in these two crashes. The profitability of both companies depends on but a few products, and when it comes to the most important aircraft of all, the short- and medium-haul planes, Boeing has fallen behind Airbus, Moller says, and suddenly, once-loyal Boeing customers were buying jets from Airbus, preferring the new A320 to the outdated 737. Boeing had to act quickly. But instead of designing an altogether new aircraft, Moller says, engineers continued to make changes to the old 737 design and, in the end, came up with an aircraft that was dangerously designed.

When he talks, Moller sounds like he already has the jury in front of him. He asks rhetorical questions, which he immediately answers himself, and develops an image for his audience of a plane, wobbling and shaking from faulty software run amok, with an overwhelmed crew, at far too low an altitude, much too close to the ground -- all because the aircraft was designed and built in such great haste.

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Of course, the engineers never meant to kill anyone, Moller hastens to add. But he says they were driven by confirmation bias as they worked toward their goal. And that goal was to deliver an aircraft as quickly as possible -- one that looked new, was more fuel efficient, that airlines would want to have and that pilots could fly immediately without requiring further training.

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In the coming proceedings and investigations, particular attention will be paid to the time between the crash in Indonesia and the one in Ethiopia. This will be the most dangerous window for Boeing. If the prosecution can prove or find witnesses to say that people at Boeing or aviation regulators had

cautioned against the further operation of the 737 Max after the Lion Air crash, it could make the company look extremely culpable. If anyone at Boeing had even the slightest inkling of the new system's inherent risks, things could get tricky.

Moller is confident the case can be won. In court, he plans to talk about trust, which he can already do very convincingly. "You board an airplane, sit down in seat 10C or 14F and you have no idea who the pilot is," Moller says. "You have no idea who was the last one to have messed around with the maintenance of the plane. You sit down, buckle up and you even worry about sitting upright and putting your feet in the right position. You are locked into this tube. Some are nervous, some are not. But all have to have absolute trust that everything is in order, the equipment and the people operating it. Absolutely safe. And if there is the slightest doubt about the safety of the plane by the airline: Don't fly. The plane must be grounded."

The Kreindler attorneys have already filed their first complaints with the U.S. District Court for the Northern District of Illinois in Chicago. They chose Chicago because that's where Boeing's board of directors and corporate management is located, far from the company's production facilities in Seattle. "It was Boeing's board that approved the Boeing 737 Max project," Green says. The lawyers in New York already know who the judge will be. His name is Alonso, a youthful-looking man who was appointed under Barack Obama. "This is his first major aviation case," Green says.

The Kreindler & Kreindler lawyers aren't likely to be wearing kid gloves. And they aren't only interested in damage payments, which are self-evident and could be in the hundreds of millions. (The $100 million that Boeing offered as compensation to families of the victims in early July is likely a joke in their eyes.) Instead, Moller and Green are hoping to win a claim of punitive damages, which could be much more costly to Boeing. An initial hearing took place in late June and Judge Alonso ruled that the case could proceed, and the lawyers could produce their evidence.

If Moller and Green are successful with their strategy, the consequences could be grave for Boeing. It may mean a tripling of the damage payments that the company would have to pay, and Boeing's insurer would not be liable. And that could threaten the aircraft manufacturer's very existence.

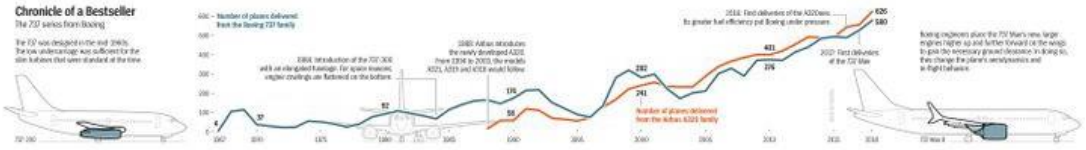
How Fierce Competition with Airbus Fueled the Current Crisis

The Boeing 737 is the most successful commercial jet ever produced. Since 1968, more than 10,500 of them have been delivered and on average, a 737 takes off or lands somewhere in the

world every 1.5 seconds. There are around 2,900 of the short- and medium-haul aircraft in the air at all times.

But the plane was never part of the technical avantgarde. When Boeing first designed the 737 in the mid-1960s, the company took over as many parts as possible from existing plane models. The nose, fuselage and the long, narrow turbines were almost identical with those of the three-engine 727. Boeing did develop all-new wings, but essentially, the technology inside the 737 was straight out of the 1950s when it took off for its first test flight in 1967.

Even then, the development of the plane was a hectic response to the competition. Boeing's main rival at the time wasn't Airbus, but Douglas, with its new DC-9. Boeing itself figured it was about 17 months behind and threw everything into catching up to MacDac, as the industry rival was known. And it worked, but initially, most airlines showed no interest in the new, smaller passenger jet from Boeing. Indeed, the project was almost abandoned, despite Lufthansa becoming Boeing's first 737 customer and ordering 21 of the planes.



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Success only came in the 1970s. Boeing introduced a slightly elongated version, the 737-200, and over the years was able to sell 1,114 of them. The plane was then modernized in the 1980s and outfitted with more fuel-efficient engines -- and that change laid bare a problem that all later versions of the 737, in particular the Max, would suffer from.

Modern jet engines use less fuel the larger their diameter. But the CFM56 engine, which is still in production today and is used on numerous different aircraft models, has such a large diameter that it doesn't fit under the wings of the 737, with its low undercarriage. In the 1980s, engineers came up with the solution of ordering a smaller, customized version of the engine with the underside of the cowling flattened. Now, the engines were oval shaped instead of perfectly round, giving the plane its unique appearance, but nobody seemed to mind. Almost 2,000 of the new-and-improved 737 Classics were sold.

Its successor, the 737NG (with NG standing for "next generation") hit the market around a decade later. It was larger, more fuel efficient and could cover greater distances. Furthermore, the cockpit offered a full array of modern instruments, but it was still so similar to the 737 from the 1960s that pilots didn't need any additional training. That was, and still is, an important factor in airplane construction because airlines are eager to avoid having to send their pilots in for comprehensive retraining. Time in the simulator is time when pilots aren't flying.

Another 7,000 of the 737NGs were sold and Boeing turned its attention to developing a brand new short- and medium-haul plane. In the early 2000s, teams of engineers in Seattle began thinking about how they could replace or revamp the 737NG, with the primary objective of achieving even greater fuel efficiency. Boeing lost a lot of time trying to transfer technologies developed for the 787 Dreamliner to a 737 successor, but the project, called Yellowstone 1, made little headway, primarily because of the vastly different parameters of the two aircraft. The 737 is narrower and production is much quicker to meet higher demand. The 787, meanwhile, is a widebody aircraft, with two aisles and a third section of seats down the middle. It proved impossible to transfer technologies, materials and production procedures.

Ultimately two camps developed within the company: those who wanted to completely redesign the plane and those who simply wanted to make improvements to the existing design. And the latter camp won out, using purely economic arguments. Both camps were fully aware that the 737 was technically outdated, and even in the latest version, the modern-day industry standard technology "fly by wire" isn't completely introduced. Some of the 737 controls still depend on cables and hydraulics. In fly-by-wire planes, by contrast, computers translate the pilot's yoke movements into electronic signals and electric motors then adjust the relevant flaps accordingly. The comprehensive introduction of fly-by-wire technology into all aspects of flying would have required a complete redesign and the end of the 737. That, though, was too expensive for Boeing and the company feared it would lose too much time. Its competitor Airbus, after all, was far ahead.

It is impossible to tell the story of the 737 Max -- indeed, the story of Boeing's entire recent history -- without taking a closer look at Airbus. The self-confident Americans underestimated their European competitor's strength, not wanting to believe that Airbus's ascent to become the world's second-largest aircraft manufacturer was the kind of economic miracle that changed the entire game. Founded in 1970, massively subsidized by European governments and heavily promoted by an industry that was deeply invested in its success, Airbus was able to revolutionize the global passenger jet market in the course of just three decades. And then came the wonder of 1999, when Airbus received significantly more orders for its aircraft than did its American rival, despite the fact that Boeing had just merged with erstwhile competitor McDonnel Douglas a few years before.

Boeing's War Against Airbus

In response to this humiliation, Boeing executives adopted an aggressive approach instead of laying solid foundations for the future. There was a possibility for peaceful coexistence, a comfortable, global duopoly of two companies that didn't need to get in each other's way on pricing, delivery schedules and services. Such a situation would not have been good for airplane buyers, but Boeing and Airbus would certainly have benefited.

Instead, Boeing went to war against Airbus in the hopes that its sheer size and market share, combined with pricing and discounts -- and complaints filed with the World Trade Organization about improper subsidies -- would be enough to overpower Airbus. The last element of that strategy came back to bite Boeing, and at the same time, a costly competition developed between the two companies that ultimately hurt airplane construction more than it helped. Delivery and order statistics became something of a fetish to which more important issues were forced to take a back seat -- such as safety and environmental issues.

The air shows at Farnborough near London and the Paris Air Show in Le Bourget, each held in alternate years, have become the focus of the two companies' obsession with getting a leg up on their competitor. Both Airbus and Boeing save up orders throughout the year so they can suddenly announce them with great fanfare at hastily arranged press conferences with snacks and champagne.

At the 2017 Paris Air Show, Boeing took the lead, primarily with the brand new 737 Max. The company was able to announce an astonishing 571 orders for the aircraft worth around $75 billion, according to the plane's list price. One year later, Boeing was again far ahead of Airbus, and 2018 proved to be a particularly successful year for the Americans: For the first time, Boeing was able to ratchet up sales to above $100 billion, fully $25 billion more than Airbus. The company also celebrated the delivery of a record 806 aircraft in a single year. And Boeing's order books were full for the next seven years.

The crash of the Lion Air flight in late October 2018? Hardly an issue for Boeing. Economically, it was a mere pinprick and Boeing's stock quickly recovered, soaring to the historical high of $446.01 per share on March 1, 2019. But nine days later, Ethiopian Airlines Flight 302 crashed near Ejere.

Treading Lightly

At this year's Paris Air Show in June, Boeing had little choice but to tread softly, but the company wasn't terribly convincing in that role. CEO Dennis Muilenburg had made a number of television appearances in the week ahead of the show, during which he repeatedly insisted that safety was the company's top priority, and he also penned an open letter. And the initial handwringing slowly yielded to formulations that were clearly developed by company lawyers with an eye toward the coming lawsuits. The lives lost in the two crashes "continue to weigh heavily on our hearts and minds," Muilenburg wrote, but he "remains confident in the fundamental safety of the 737 Max." When it came time for the Paris Air Show, he was no longer talking about the past at all, focusing instead on the future and on the progress that had been made toward the recertification of the 737 Max.

An interview DER SPIEGEL conducted with Boeing spokesman Paul Bergman on the sidelines of the Paris Air Show ended abruptly after around five minutes because Bergman refused to answer any questions about the crashes and their consequences for the company. The mood in the company? "We don't comment on that." The Justice Department investigations pertaining to the recertification of the 737 Max? "Please understand that I am unable to comment on that." Why did the FBI get involved? "Unfortunately, I can say nothing about that." What about the approaching lawsuits? "Sorry," Paul Bergman said, "We have a policy of not speaking about liability proceedings."

There is a debate on the internet over whether Seattle's nickname "Rainy City" is accurate or not. When it comes to total precipitation, the moniker is definitely inaccurate, but if the reference is to the frequency with which rain falls from the sky, it is well earned. The city on the shores of Puget Sound -- basically just a gigantic fjord carved into America's northwest -- experiences rainfall on 152 days each year. But mid-June saw an extended period of high temperatures and no rain, with people crowding into outdoor cafés. Local newspapers were full of stories about the surprisingly good weather.

The area in the far northwestern corner of the United States, a densely populated urban area that was only carved out of the wilderness at the end of the 19th century, enjoys an extremely strong economy. Microsoft employs 47,000 people here and Amazon pays another 45,000 salaries. Lewis-McChord just down the highway, one of the biggest military bases in the world, provides jobs for 56,000 people and Sea-Tac airport is another major employer in the area. The city and its surroundings exude prosperity and wealth, much of which comes thanks to Boeing and its 80,000 employees in the Puget Sound area -- in Seattle, Everett, Renton, Frederickson and Auburn.

Meticulous Synchronization

Boeing Field is just a short drive north from Sea-Tac Airport along Interstate 5 and its -- in some places -- 14 lanes of traffic. Plant 2 at the Boeing site is where thousands of bombers were assembled in World War II and is also where initial 737 prototypes were built. When Boeing clients pick up their new jets from Seattle, the handover takes place at Boeing Field. Twenty-first century airplane construction is meticulously synchronized. In Everett, about half an hour north of downtown Seattle, Boeing "wide bodies" -- the large, long-haul aircraft -- are built in what is allegedly the largest factory building in the world by volume. A couple final models of the legendary 747 are still being built here, a legendary aircraft that is comprised of 6 million individual parts. Fuselages of the 767 move slowly through the production lines, referred to in the factory as "bays." The 787 "Dreamliner," plagued by a series of growing pains and glitches, can also be seen from the gallery.

On a Wednesday in mid-June, the 879th 787 was nearing completion, on order from Turkish Airlines. Planes number 881 and 883 were right behind it, a numbering system that results from the fact that only every second Dreamliner is produced in Everett. The even-numbered planes have been built since 2011 on the other side of the continent in North Charleston, South Carolina.

Following the second 737 Max crash within just five months, rumors began making the rounds in April that the South Carolina factory continually turned out subpar planes and there was talk of material defects. Then, in late June, it was revealed that the investigations launched by the Justice Department after the two crashes had been expanded to include 787 production. DER SPIEGEL has also learned of additional accusations leveled against Boeing and lodged with the Cologne-based European Union Aviation Safety Agency (EASA).

In June, EASA received a written complaint from a high-ranking Boeing engineer originally from Germany named Martin Bickeböller. In the development of the 787, Bickeböller was responsible for evaluating the production process. A trip to the factory in Everett provides visitors with a pretty good idea of the efforts being made to continually optimize the airplane construction process. But that same logic had also led to a situation in which the Dreamliner was essentially only assembled by Boeing, with the individual parts and sections delivered by suppliers located across the U.S. and the rest of the world. Things like the mid-fuselage section or the wings.

'Safety Issues'

Bickeböller was responsible for the oversight of the production of these two components -- and he must have been deeply unsettled by some of the things he saw. As early as five years ago, in spring 2014, he sent an initial complaint to the American supervisory authority, the Federal Aviation Administration (FAA). In doing so, he invoked stipulations designed to protect whistleblowers from punishment from their employers. Bickeböller also filed a lawsuit with a labor court. The magazine was able to examine other relevant documents by applying for their release via the Freedom of Information Act.
Bickeböller declined to speak with DER SPIEGEL, but the case files document the accusations he has made against Boeing.
The documents note, for example, that: "Safety issues were notifications of the Complainant with respect to the inability of 787 main section suppliers to establish part configuration of their airplane sections." Apparently, components were delivered that had never been checked to see if they met the required quality standards and parameters. They could, in other words, have been defective, yet installed into a jet anyway. Bickeböller informed the FAA that the planes that received the components in question were likely still in service.

The FAA appears to have investigated at least some of Bickeböller's accusations. In one document from Feb. 22, 2016, investigators wrote to Bickeböller: "The investigation substantiated that a violation of an order, regulation or standard of the FAA related to air carrier safety occurred." But as Bickeböller complained to EASA, other allegations were not investigated by the FAA. And instead of receiving praise from his employer for his conscientiousness, he received poor evaluations and, after 20 years as a top engineer, was demoted to a less important position.

Bickeböller's complaint endangered the planned inauguration of the 787, which had already been delayed due to technical difficulties. The problems identified by the engineer, however, weren't addressed by Boeing, which is why he turned to EASA in June. In parallel, Bickeböller and his attorney, the Berlin-based aviation lawyer Elmar Giemulla, approached the U.S. Congress in Washington, D.C. There, DER SPIEGEL was also able to examine documents pertaining to his complaint. In those papers, it states that management and top executives at Boeing had ordered that the coordination problems with the company's suppliers be "closed." The reason: "to get the 787 production certificate."

When contacted for comment about these accusations, a press spokesman for Boeing stated: "Boeing and the FAA investigated the allegations, and Boeing addressed all concerns raised. The FAA closed their letter of investigation in 2016."

At the Boeing factory in Renton, located on the shores of Lake Washington about 20 minutes south of downtown Seattle, the company culture likely wasn't much different. Some 12,000 engineers and mechanics work there building the 737 Max in two, vast factory halls. It is the only site where the model is produced. Before the crisis, the facility was able to turn out 52 planes per month, but the production rate has since been lowered to 42 per month -- two per day, with 21 workdays per month.

Like at all Boeing facilities, the runway is right next to the factory. In Renton, it is called Clayton Scott Field, named after the "personal pilot" of company founder William Boeing. The area surrounding the airfield is used these days primarily as a vast parking lot, with 14 completed, yet unpainted, 737 planes visible, most of them from Generation Max along with a few NGs. Since flights without passengers are still permitted, the 737 Max planes are being gradually transferred from Renton to other airports around the U.S. for storage until reapproval.

The costs associated with the flight ban are immense, and not just for Boeing. The grounding of the 737 Max is also a huge burden for the airlines that fly them.

Deep-Seated and Fundamental Problems

Seattle is home to a man who could recite all aspects of the Boeing crisis in his sleep because he was often the one who learned and wrote about them first. Dominic Gates, a gaunt, friendly man in his mid-60s, works as the aerospace reporter for the Seattle Times, and if you want to keep up to date on what's going on at Boeing, you need to read his articles. For the past several months, Gates has been writing about almost nothing else, with one investigative story following the next. Taken together, they combine to create a rather staggering image: Namely that there are deep-seated and fundamental problems with the company culture at Boeing.

Seattle Times journalist Dominic Gates says that critics or whistleblowers inside Boeing "are discriminated against, demoted or thrown out of the company entirely." Brian Smale/ DER SPIEGEL

It is not a theory that Gates developed while sitting at his desk. It is one that has formed over the course of several years in discussions with insiders, observations of his own and combing through reports and industry literature. He has the contacts he needs to report in depth on the aerospace giant but also the information he needs to make important connections over time. And that proved extremely helpful in his reporting on the current Boeing crisis. At a time when the entire world was still scratching their heads over what could possibly have led to the Max crash in Ethiopia, Gates wrote a story that Boeing isn't likely to forget any time soon.

On the basis of interviews with engineers who had been involved, he described how the new software for in-flight adjustments to a flap on the tail of the aircraft, the likely cause of the crashes, was developed extremely quickly and then changed -- and that these critical changes were kept from the safety and certification agencies.

Gates had collected most of the information pertaining to the software development prior to the second crash in Ethiopia because he had become deeply involved in investigating the cause of the Lion Air crash in Indonesia. His report, which was followed by further revelations dug up by the *New York Times*, hit Boeing just as the company was rolling out a PR strategy that sought to place all blame on the pilots' shoulders. But thanks to Gates, this disinformation strategy failed. Overnight, he became one of the aerospace giant's most dangerous enemies.

Gates would never say such a thing himself. Perhaps his own personal history gives him the distance he needs to take a sober look at the goings on around him. He is originally from Northern Ireland and journalism, he says, is his second career. He used to teach mathematics in Africa, where he met his wife, a journalist from Seattle. She was the reason he ended up in the far northwestern corner of the United States.

He has since developed a network of dozens of informants -- "very helpful people," he says. They live throughout area, in Seattle, Renton and Everett, in the typical wooden houses the region is known for or in one of the huge developments that have grown up around Boeing's factories. Gates has to meet his sources in secret or communicate with them using encrypted channels. Boeing employees who report safety concerns either internally or to government agencies are taking a significant risk. "They are discriminated against, demoted or thrown out of the company entirely," the *Seattle Times* reporter says. Boeing denies the charge, saying that the company has strict policies in place to protect employees who turn to the authorities with safety concerns and that those policies are rigorously adhered to.

Estrangement Between Management and Employees

Yet despite the self-confident image the company strives to project externally, the company tends to be less self-assured when it comes to dealing with whistleblowers within its ranks. They are generally considered to be traitors, and traitors cannot expect mercy. Recently, Gates has begun to suspect that the mood has turned sour behind the factory gates, a conclusion he has arrived at based on the number of people who are interested in talking to him despite the significant personal risks that entails. "For many decades of Boeing's history, most employees were immensely proud of where they worked," Gates says. "In the ensuing years, many mechanics and engineers at Boeing have lost this pride." There has been a gradual estrangement between company leadership and its employees.

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The alienation began with the merger of Boeing and McDonnell Douglas in 1997 and the increasing amount of attention being paid to the company's share price, Gates says. Longtime CEO James McNerney, the predecessor of current company head Muilenburg, charted a course aimed at drastically increasing profits.

He sought out conflict with the unions, which had until then been an important part of company culture and a point of pride among employees. Even senior company managers were union members, though that didn't stop McNerney. On the contrary.

Even one of McNerney's predecessors, Philip Condit, was apparently unhappy with the tradition-rich site on the shores of Puget Sound and wanted to escape the Seattle culture. Condit hit the city with a symbolic blow below the belt by moving company headquarters to Chicago in 2001 after holding a kind of competition to determine where Boeing executives would end up. Only 500 company employees moved into the gray office tower there, but the gesture was a painful one for many back in Seattle. McNerney continued Condit's bull-in-a-china-shop act by moving part of 787 production to Charleston, despite the fact that there were no qualified mechanics and engineers in the region. Why? Because is South Carolina, Gates says, the level of union membership is the lowest in the entire country.

Until the end of the 1990s, the Boeing company was heavily reliant on engineers. But then, CEOs like Harry Stonecipher and his successor Condit aimed to streamline airplane construction to improve profit margins. As an investor, you would rather put your money into companies that grow up to 20 percent a year rather than just 4 to 6 percent, Stonecipher told DER SPIEGEL in a 2001 interview. Profitability and stock market performance became the company's most important goals. Philip Condit before him also emphasized the creation of shareholder value. It is, he said in 1998, "the principle measure of our success." Such priorities were, of course, a sign of the times, but they led to an estrangement between company executives and employees on the factory floor.

And the company continued to have a problem with its home. Company leaders continued to speak publicly about their desire to take large production facilities out of the Northwest, with the question arising when it came to choosing a site for the production of the 737 Max and against with the new 777x, the next-generation long-haul jumbo. There was a constant stream of blackmail attempts that almost led to a complete falling out between the company and the city. The relationship of locals to Boeing has become extremely complicated, says Gates. "Many Seattleites who don't work for Boeing have had enough of the corporation's demands for tax relief and concessions from labor unions, laced with threats of building future planes elsewhere if the demands aren't met."

When Dennis Muilenburg took over as CEO in 2015, he had hoped to return Boeing to its core strengths, a hope shared by company employees. After all, as Gates points out, Muilenburg is an engineer himself. But the farmer's son from Iowa narrowed the company's focus on profit to a greater degree than ever before, even as he constantly repeated lofty aphorisms about the kind of management strategies he hoped to avoid. When he was chosen Person of the Year in 2018 by the magazine Aviation Week, he told the publication: "We're a tough competitor. But there's no occasion where we want our employees to be faced with a choice of competing or values. That's a false choice."

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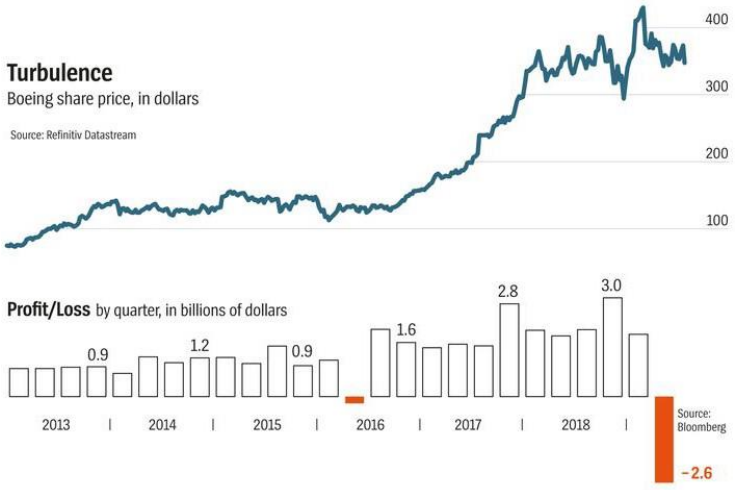
Gates has been keeping an eye on Muilenburg for several years now. The Boeing CEO has frequently claimed that "the cyclical nature of the airplane business is over," says Gates, apparently believing that the aircraft market will continue to grow forever, with no interruptions or slow periods. The message Muilenburg wants to send, Gates says, is that "Boeing is the global industrial champion." It might sound absurd, Gates says, but the most amazing thing is that "investors bought Muilenburg's story" and since then, the share price has been up to three times what it was then.

A Millstone Around Boeing's Neck



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Now, Muilenburg finds himself mired in his first large crisis. The crashes, the grounding of the 737 Max, the damaging report from the Charleston factory, the dissatisfaction of workers in Seattle, the attacks led by pilots and in-flight service personnel, the investigations by the Justice Department: All of that has led to an unprecedented drop in sales. At the end of July, Boeing announced record second quarter losses of $2.6 billion. And Muilenburg can no longer completely exclude the possibility of 737 Max production being halted altogether. The company's cash cow has transformed into a millstone around its neck and Boeing has become vulnerable.

And this all comes at a time when the Airbus-Boeing duopoly has been developing cracks. The two may still be the world's undisputed aerospace leaders, but companies in China, Russia and Japan are in the process of grabbing a bigger piece of the pie. Furthermore, it has become easier to build airplanes because a highly specialized global market of suppliers has developed that can deliver almost any part in the desired quality at the desired moment in time. The times when airplane construction was a calling card of unattainable technological excellence are coming to an end. Things are becoming more difficult, especially for Boeing.

How Did the 737 Max Get Approved in the First Place?

As has always been the case with large scandals, it is difficult to pinpoint the beginning. But there are plenty of reasons for identifying the year 2008 as the start of the 737 Max crisis, when Lufthansa made an announcement at the Farnborough Airshow that it planned to buy 30 Bombardier CS100s for its subsidiary Swiss. The jets, which are a bit smaller than the A320 and the Boeing 737, were a completely new model and, according to a former senior Lufthansa executive, that model was "the best on the market at the time." The deal came as a provocation to the management of Airbus and Boeing, spoiled as they had been by success, and they reacted. But Airbus reacted more quickly and rapidly developed the A320neo.

The Dec. 1, 2010 announcement by the Europeans that the entire A320 family would be re-engineered and outfitted with new, unusually fuel-efficient and quiet engines must have hit Boeing's Chicago headquarters like a bolt of lightning. Airbus promised to sink kerosene consumption by an entire 15 percent. And the year after the announcement, Airbus promptly sold more than 1,000 A320neo planes -- with many longtime Boeing customers among the purchasers.

At the time, Boeing had no fully developed plan for a new model or an acceptable new version of the 737. Most importantly, the company was not in a position to be able to install the new generation of jet engines on its planes. So, the industry was quite surprised when Boeing, just nine months later, appeared to catch up to Airbus. In late August 2011, the construction of the 737 Max was announced, and the company even promised that the plane could be operated 7 percent more cheaply than the A320neo.

It seems safe to assume that it was a difficult period for Boeing engineers. Even the smaller CFM56 turbines could only be crammed under the wings of the old 737 by resorting to a handful of tricks. But the CFM LEAP, which Airbus intended to use, has an air intake that is almost two meters in diameter -- and the Boeing engineers had to fit them onto a plane where they didn't fit at all.

Once again, they tried to compress the engine shape. And once again, they commissioned a customized, smaller version of the engine. They tried pretty much everything to create more space under the plane, even lengthening the landing gear by 20 centimeters. The most important change, though, was installing the turbines a bit higher on the wings and quite a bit further forward.

String-and-Chewing Gum Tricks

A former Lufthansa executive, himself a trained aerospace engineer who has decades of experience in reading technical evaluations of aircraft, is convinced that courts could very well determine that the actions taken by the Boeing engineers amount to "gross negligence." The ex-Lufthansa manager, who has to remain anonymous due to old contractual agreements, says he is convinced that the construction of the 737 Max on the whole is "amateurish." It is, he says, the culmination of the technical shortfalls that Boeing has essentially been seeking to eliminate since the mid-1990s.

The repositioning of the engines decisively changed the 737 Max's flight mechanics relative to all of its predecessors. In extreme flight situations with an especially steep angle of attack (the plane's position relative to airflow), the turbine cowlings with their flat bottoms create their own aerodynamic lift, not unlike an additional wing. That can lead to the sudden rise of the plane's nose, making a stall more likely. Should that happen, the plane loses lift and crashes.

To prevent such a scenario, the Boeing engineers reached deep into their bag of tricks. They knew that such an in-flight behavior was expressly prohibited by FAA regulations, so to ensure approval of the 737 Max, they needed a bit of electronic help. Boeing developed a software program that constantly monitored the angle of attack. As soon as this angle became too risky, the Maneuvering Characteristics Augmentation System (MCAS) would automatically lower the plane's nose without the pilot having to do anything at all. To do so, it doesn't manipulate the rudder, but the horizontal stabilizer trim, the most forceful control surface on the entire aircraft.

It was only by way of such string-and-chewing-gum tricks that engineers were able to achieve the stability necessary for safe flight. The FAA was informed of the system early on and accepted it. In hindsight, it is an open question whether they were really aware of all the details of the new software solution.

When Boeing first presented the MCAS system to the FAA, the program only activated reluctantly and adjusted the horizontal stabilizer trim by just 0.6 degrees. Later, though, during the development process, Boeing gave the program much more leeway and increased its control over the plane, allowing it to make changes of up to 2.5 degrees. According to information currently available, it looks as though the FAA never approved this much riskier system.

Because of the several inconsistencies, the former Lufthansa executive believes the company could be facing the retroactive loss of its insurance coverage for the 737 Max. In a statement about the allegations, Boeing wrote: "The FAA considered the final configuration and operating parameters of MCAS during Max certification and concluded that it met all certification and regulatory requirements."

Significant Errors

Yet there are still more significant errors that are currently under discussion and investigation. For many experts, for example, it is incomprehensible that with the 737 Max, Boeing appears to have ignored the vitally important principle of redundancy. A fundamental rule of aeronautics has long held that every system in an aircraft must have a backup so that any system failure that might occur can be compensated for. For example, the Boeing 737 Max has two angle of attack (AoA) sensors mounted on the outside of the plane just under the right and left cockpit windows. The data collected by the two sensors is fed into the Flight Management System, which monitors the plane's flight.

But for reasons that have not yet been pinpointed, the MCAS software only uses the information delivered by a single AoA sensor. Should it be damaged -- by a collision with a bird, for example -- MCAS could be activated in error. With no pilot input whatsoever, without the pilot even knowing that the system as even been activated, MCAS will automatically adjust the horizontal stabilizer. For 9.26 seconds, the system will enact Aircraft Nose Down commands before a five second pause and then a repeat of the maneuver -- over and over again until the system calculates that the angle of attack has been corrected. If the pilot intervenes to pull on the yoke and raise the plane's nose, nothing happens. By doing so, in fact, pilots run the risk of the automatic anti-stall system countering their efforts even more energetically because the false data it has been fed leads the system to believe that danger is imminent.

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Pilots around the world were particularly furious that Boeing did not inform them of the MCAS software and launched a class-action lawsuit against Boeing. Indeed, until November 2018, there wasn't a single word about MCAS in the plane's operating manual. The company didn't tell pilots about the system because they apparently believed that in day-to-day operations, it would never make itself apparent. The result was that pilots could not train for erroneous MCAS activation --because officially, the system didn't exist.

An Opaque, Dangerous Game

When boarding an aircraft, passengers must have absolute faith that engineers and mechanics have done all they possibly can to build a safe airplane. Every traveler must be able to trust that aircraft construction and maintenance followed strict oversight and certification protocols whose entire purpose is that of reducing safety risks as close to zero as possible. But that trust has now been shaken.

The system of air travel supervision, which has been transformed into little more than a pendant of the industry itself by radical neo-liberal politicians intent on deregulation, has been called into doubt. The FAA, respected worldwide for the depth of its expertise, demonstrably rubber-stamped the Boeing 737 Max despite the fact that the agency no longer had a clear overview of the individual steps in its development and production.

Indeed, the monitoring system is no longer worthy of the name, having transformed into an arrangement in which a company like Boeing is ultimately responsible for policing itself and certifying the market-readiness or airworthiness of its own products. It has become an opaque, dangerous game that raises questions about unbridled capitalism.

When confronted with such accusations, all the FAA can do is claim that the certification of the 737 Max followed standard agency procedures and took five years. "The 737 Max certification program involved 110,000 hours of work on the part of FAA personnel, including flying or supporting 297 test flights," the agency said in a statement.

Essentially, every airline passenger profits from knowledge that has been collected in a rather macabre way. Every crash, whether or not it results in fatalities, is examined by experts for months on end to determine the cause. They aren't interested in placing blame. Rather, they want to know what they can learn so that similar crashes can be avoided in the future.

The knowledge collected is reflected in a complex list of rules at the FAA and similar agencies. One of the most important FAA documents for commercial air travel is called "FAR Part 25," a 240-page document. It is essentially a list of all the safety requirements that every new civilian airplane must fulfill prior to certification.

All warning lights in the cockpit have to be red, for example. Another rule is that planes must be able to safely fly and land even after a frontal collision with a bird weighing 3.63 kilograms or less. Or: It must be possible to evacuate planes with more than 44 seats within 90 seconds on the ground.

Inexplicable Errors

The rules documented in FAR Part 25 are something like a constitution for global civilian air travel. For Boeing, though, the tome represents the greatest threat it is currently faced with. Although the 737 Max was officially certified in 2017 in accordance with the rulebook, there are significant doubts as to whether that certification was right and proper.
Both Boeing and the FAA seem to have made inexplicable errors. They violated standards that were developed and respected for decades --standards which earned them global trust. Paragraph 25,671 of FAR Part 25 expressly states, for example, that an airplane must be able to safely land if, for example, the control surface on the horizontal stabilizer becomes jammed in flight or otherwise malfunctions.

Continuing flight in such circumstances must be possible "without requiring exceptional piloting skill or strength." Malfunctions "must have only minor effects on control system operation" and if the failure is not "extremely improbable," then the pilots must have the ability to immediately regain control.

It is difficult to imagine that the 737 Max fulfilled these certification protocols. What, though, does the FAA have to say about it? Daniel Elwell should know. He was acting head of the agency at the time of the crash and had earlier been deputy administrator of the FAA. Seventeen days after the crash in Ethiopia, he appeared before the Senate Subcommittee on Aviation in the Hart Senate Office Building in Washington D.C. and spent two hours squirming in his seat. Committee Chairman Ted Cruz's opening remarks, focusing on the two crashes, on trust and on safety, were articulate and poignant -- but his eloquence would not be matched by Elwell and the other officials who appeared in the witness stand. Indeed, Elwell's performance was particularly miserable. On several occasions, he seemed not to have understood the question or was forced to admit that he didn't know the answer.

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Elwell spoke of an FAA culture that values "safety above all else" and pointed to the significant safety improvements that have been made. Since 1997, he said, the risk of a deadly accident in the U.S. has dropped by 94 percent and that in the last 10 years, there had been only a single death out of a total of 90 million flights -- the result of an April 2018 incident when the turbine of a Boeing 737-700 exploded in flight, shattering a plane window and killing the woman in the seat behind it. Elwell's message, essentially, was that the two crashes were regrettable, but they were mere exceptions to the rule. And that the FAA monitoring processes were effective.

Elwell had brought along statistics pertaining to the 737 Max and said that the FAA hadbeen completely integrated in the development process. Agency employees, he said, had been onboard for 133 of the 297 test flights, including flights during which the MCAS software was tested. But in his testimony before the Senate subcommittee on March 27, Elwell produced such gibberish that it wasn't clear what he was trying to say. The software, he said several times, wasn't a program at all. All it did was "give a proper feel to a pilot" and that, for example, it ensured that the 737 Max felt "exactly like the 737NG." MCAS, Elwell said, was merely a "sub-device" to a larger system and was active only "in a very thin envelope." His response produced little more than empty stares.

At some point, Democratic Senator Richard Blumenthal complained: "If I had been a passenger on one of those planes, I would have wanted a parachute." And when asked why it was actually standard procedure to have companies certify their own products (an element of certification called "organization designation authorization, or ODA), Elwell answered: "The concept of ODA has been around for 60 years. It is part of the fabric of what we use to become as safe as we are today."

A Perverse Representation of the Truth

That is a rather perverse representation of the truth. The FAA was established by Congress in 1958 in response to a collision between two passenger aircraft over the Grand Canyon in which 128 people died. At the time, airplanes were much more primitive than they are today, so the agency was easily able to fulfill its monitoring and certification duties. But with growing fleets and a rapidly rising number of flights, the FAA increasingly had to strike deals with airplane manufacturers and delegate monitoring duties to them. Since 2005, the FAA has been permitted to allow Boeing and other companies to delegate their own employees to handle FAA certification checks. The problem, though, is that this system of delegating safety checks doesn't work in practice.

The "authorized representatives" (ARs) may report to the FAA in theory, but because they are, for example, employees of Boeing, their loyalty to their own company might be higher -- and the pressure coming from above higher. A report from 2015 noted that the FAA de facto only has direct authority over 4 percent of ARs at airplane suppliers. An even earlier report, this one from 2011, listed 45 incidents that took place between 2005 and 2008 in which the FAA was accused of insufficient diligence. Which is hardly surprising given the agency's almost impossible mission. In its certification offices, the FAA employs 1,300 people, whereas Boeing alone has 56,000 engineers on its payroll. Parity is a pipedream.

President Donald Trump's deregulation drive threatens to further accelerate the conflation between regulators and those they are supposed to be regulating. Shortly after entering office, Trump signed two pivotal executive orders, number 13,771 and 13,777, which could further undermine the FAA's independence in that they call for the drastic reduction of regulatory requirements at all government agencies.

That could mean that even more of the FAA's mission will be delegated to the industry. The FAA Reauthorization Act of 2018, passed just a few weeks before the Lion Air crash, follows in the same vein.

The political will to outsource erstwhile state responsibilities to industry has deeply unsettled a functioning global safety system, within which the FAA had been considered the gold standard. Everything that the FAA had checked and approved was consistently adopted by EASA and the Chinese aviation safety authority. Whether that is still the case will become clear once the 737 Max reauthorization process is complete.

The possibility that the FAA reauthorizes the 737 Max but other agencies refuse to follow suit is a rather frightening one for the aerospace industry. If producers are forced to convince several different agencies of the quality of their planes, they will lose time, money and planning dependability. And the airlines that are waiting for their planes may have to completely rewrite their schedules because a specific plane can only fly in the United States, but not in China or Africa. It would mark the end of a well-organized system.

An Industry Pushed to the Limits

Air travel has become an incredibly competitive business, and that starts with the aircraft manufacturers, led by Boeing and Airbus. And they heap pressure on their suppliers to be faster, better and cheaper --to the point that the industry repeatedly finds itself at the limits of what is possible. In the search for new customers, airlines offer rock-bottom ticket prices and there is a steady stream of new markets. In the rising economies of Asia and Africa, the number of air travelers has skyrocketed in recent years and airlines are in dire need of modern, fuel-efficient aircraft.

The purchase price and operating costs of civilian aircraft are extreme. A short-haul passenger plane costs $100 million, with long-haul jumbos going for $400 million, investments that take decades to pay off. And once they are purchased, the costs of keeping them in the air are also significant. The fees are everywhere: general air passenger taxes, safety taxes, airport fees, gangways, buses, baggage handling --the list goes on and on. In the U.S., there is a "September 11 security fee" that allegedly goes toward paying for added safety precautions. The vacation airline Condor once calculated the costs it must pay at the Frankfurt airport and arrived at a total of €90 per passenger.
The result is that airlines have spent years trying to cut costs: Lighter seats have been installed, coat closets have been eliminated and newspapers are no longer passed out to passengers. Some airlines have even got rid of seatback pockets so that nothing is left behind and no extra weight is carried unnecessarily. Efficiency has become the be-all and end-all. A Ryanair flight attendant in Germany receives a base salary of 1,400 euros per month.

The 737 Max is ideal for discount airlines and was developed with their needs in mind. And Michael O'Leary, head of Ryanair, Europe's largest discount airline, immediately went for it. He ordered 135 jets from Boeing and has options for 75 more. The Max, O'Leary said when the purchase was announced in 2014, will "allow Ryanair to lower our costs and airfares." The first planes were initially scheduled for delivery to Ryanair in April, but that deadline was not met. In May, O'Leary still hoped that delivery of the planes would commence in late October or November, but he has since had to completely rewrite the airline's timetable for the approaching season because the laundry list of 737 defects continues to grow.

FAA inspectors have noted that in some emergency situations, the autopilot cannot be disengaged quickly enough. Furthermore, some processors in the flight control computer are sometimes dangerously slow and Boeing itself was forced to admit that some important cockpit warning signals never function properly.

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Other airlines have already received the jets, but they aren't in a much better position than Ryanair, at least for as long as the planes have to remain grounded. The U.S. budget carrier Southwest has ordered 280 of the planes and already has 34 of them in its fleet. American Airlines and Lufthansa partner United have 38 737 Max aircraft in their fleets and now have to improvise. The situation is particularly challenging at Norwegian Air, which operates 18 of the planes, making it the largest 737 Max fleet in Europe -- and the company was facing financial headwinds even before the grounding. The revenue losses are horrendously high -- and will have to be compensated for by Boeing, either in the form of damages paid or discounts on future purchases.

Emergency Order

The story of the grounding of the 737 Max hasn't yet been fully told, but it promises to be an intriguing one. In the time gap between March 10 and 13, scandals are hiding that must still be fully investigated. What did the Chinese know that the Americans did not? After all, following the crash in Ethiopia, China immediately banned all 737 Maxes from taking off or landing in the country whereas it took the U.S. three more days to do so, becoming one of the last countries to impose such a ban.

On Tuesday, March 12, two days after the crash, Trump tweeted:
"Airplanes are becoming far too complex to fly." Later that day, he spoke on the phone with Boeing CEO Dennis Muilenburg, who Trump calls "a friend," and Muilenburg assured the U.S. president that the 737 Max was safe.

But apparently Trump wasn't completely convinced. On the one hand, he had wanted to ground the 737 Max already on Tuesday, a plan the FAA talked him out of by arguing that not all data had been evaluated. On the other hand, he was concerned about panic and market turbulence should he do so. In other crisis meetings, Trump spoke disparagingly of the 737 Max, saying the model "sucks" and paled in comparison to the 757 of the kind he owns as a private jet.

On March 13, Trump spoke with FAA head Elwell and Transportation Secretary Elaine Chao before again talking with Muilenburg. By then, even the FAA had enough information in its possession to ground the 737 Max, the necessity of which the agency had denied just one day previously. A single piece, found in the wreckage in Ethiopia, showed that the horizontal stabilizer trim was configured to force the nose down, just as had been the case with the 737 in the Lion Air crash.

A decision was made for the agency to release a statement, but Trump beat them to it. At a White House press conference called to discuss the drug trade on the U.S. border with Mexico, the president said: "We're going to be issuing an emergency order of prohibition to ground all flights of the 737 Max 8 and the 737 Max 9 and the planes associated with that line." To the annoyance of the FAA and the entire aviation industry, he then added the following: "We didn't have to make this decision today. (...) But I felt it was important both psychologically and in a lot of other ways."

On Wednesday, March 13, the last 737 Max flight with passengers onboard landed at 7 p.m. in Newark from Oakland. And immediately, a debate erupted in the U.S. as to whether the FAA, Trump and Boeing had negligently endangered flight safety for three days.

The facts are clear: 346 people are dead of unnatural causes. Of those, 157 lost their lives in a crash on an undulating, arid plateau just a six-minute flight from Addis Ababa, Ethiopia. The other 189 died just over four months earlier, on the morning of October 29.

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A fisherman named Kanta was nearby, after heading out before sunrise in his wooden boat to fish for shrimp. His boat had been tied up on the shores of the Citarum overnight, in one of the river's numerous arms near the Indonesian beach town of Tanjung Pakis. Kunta, 51, has been fishing since he was a boy, having learned the trade from his father. Together with his companion Sakir, he headed out to sea on the morning of the crash.

As the sun rose that day, Kunta could hardly see it through the haze. And one hour later, a single, loud blast rolled over the waves. Residents of Tanjung Pakis compared it to a New Year's firecracker exploding inside of a cane of bamboo. Immediately after the noise, silence returned. There were no screams and no cries for help. Kanta steered his boat in the direction the sound came from, wondering if perhaps something had gone wrong with one of the oil rigs drilling off the coast. But he found no answers, just a couple of life jackets floating on the sea. Kanta didn't learn until later what had happened.

The rest of the world heard about the crash at the same time -- that 189 passengers had lost their lives in a crash of a 737 Max, not knowing that the plane that flew them to their deaths had exhibited problems on several occasions in the three preceding days. The AoA sensors weren't working as they were supposed to. Each time, the plane was checked, each time mechanics fixed the problem the pilots described and each time the Boeing 737 Max was cleared.

On Nov. 10, 2018, a broad public heard for the first time about a software program called MCAS. On Nov. 13, Boeing's Dennis Muilenburg said on the television channel Fox Business that the 737 Max is safe and that Boeing is "providing all of the information necessary to make sure we do a full assessment of the situation." Not long later, at 8:44 on the morning of March 10, Ethiopian Airlines Flight 302 slammed into the ground in Ejere, creating a 10-meter-deep crater.

By Uwe Buse, Dinah Deckstein, Marco Evers, Ullrich Fichtner, Maik Großekathöfer, Guido Mingels, Martin U. Müller, Marc Pitzke and Gerald Traufetter