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Concorde 2.0: Diffusion of Supersonic Innovation[[1]](#endnote-1)

Rohan Noronha wrote this case under the supervision of Professor Yasser Rahrovani solely to provide material for class discussion. The authors do not intend to illustrate either effective or ineffective handling of a managerial situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

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Whether they were aiming to go *Around the World in 80 Days*[[2]](#endnote-2) or travelling faster than the speed of sound, humans have always been obsessed with speed. However, chasing faster technology had a bumpy road in aerospace.

By 2020, it had been almost two decades since the iconic Concorde—the world’s last supersonic jet—was retired (see Exhibit 1). Despite knowledge advancements on sonic booms, no approved supersonic substitute had emerged. Several companies raced to commercialize jets with speeds between Mach 1.4 and 2.2.[[3]](#endnote-3) In October 2020, Boom Technology Inc. (Boom Technologies), backed by Sir Richard Branson and Japan Airlines Co. Ltd. (Japan Airlines), unveiled a skinny, sharply pointed prototype of a commercial supersonic jet that aimed to begin flying as early as 2026; the aircraft could accommodate up to 88 passengers per flight.[[4]](#endnote-4) The National Aeronautics and Space Administration (NASA) was also working on the X-59 aircraft, which utilized a quiet supersonic technology that aimed to reduce the loud sonic boom. NASA planned to fly the X-59 as early as 2024.[[5]](#endnote-5) Another competitor, Aerion Corporation (Aerion), backed by the Boeing Company (Boeing), was developing an eight-to-12-passenger AS2 supersonic jet, with the aim to fly in 2024. The jet, priced at US$120 million,[[6]](#endnote-6) would travel at a speed of Mach 1.4.[[7]](#endnote-7)

These companies varied in how they hoped to position their finished products; some focused on catering to the commercial aircraft market (owned by airlines), whereas others explored business jets (either privately owned or those owned by military or heads of state). Both markets had a significant financial upside. The business jet market was valued at $18 billion in 2020 and was projected to reach $38 billion by 2030, exhibiting a compound annual growth rate (CAGR) of 7.3 per cent.[[8]](#endnote-8) The global commercial aircraft market was valued at $236.8 billion and was projected to grow at a CAGR of 5 per cent.[[9]](#endnote-9) In this competition, the first mover had the advantage of tapping into a rapidly growing market with high margins.

The financial upside as well as the opportunities for increased connectivity that were made possible by supersonic transport remained, but the landscape had changed significantly since the last supersonic jet had flown. There was an increased emphasis on environmentalism through tighter regulation, consumer advocacy, and, more recently, shifts in travel trends, spurred by COVID-19.

Would there be a way to make commercial supersonic travel work by imitating the good in the Concorde and tweaking the downsides? Did the reasons behind the failure of the Concorde and supersonic transport still apply? Were we moving toward a significant business opportunity or toward another failure? Answering these questions required taking a close look at the story of the Concorde.

The Concorde: An invention before its time

The Concorde was one of the world’s first commercial supersonic (i.e., faster than the speed of sound) passenger jets. It was the most well-known supersonic jet, and it graced the skies between 1976 and 2003 (see Exhibit 2).[[10]](#endnote-10) Despite its transcendent appeal and superior design, its short run was mired by controversy and tragedy. Both professionals in the aerospace industry and lay airplane enthusiasts often referred to the Concorde as a radical innovation before its time.[[11]](#endnote-11)

The idea for the Concorde was conceived during the early 1960s, in the midst of what was considered the golden age of flying. Prior to the emergence in 1966 of the popular subsonic Boeing 747—which, through its larger size, made airfare more accessible—flying was limited to the wealthy.[[12]](#endnote-12) In 1962, a little more than 100 million passengers were registered on civilian flights, a figure that quadrupled in 10 years to approximately 400 million passengers in 1973.[[13]](#endnote-13) While the major competitors in the commercial jet manufacturing industry at the time were US firms—Boeing, Lockheed Martin Corporation (Lockheed Martin), and McDonnell Douglas[[14]](#endnote-14)—most national governments across Europe and North America pumped billions of dollars into the industry.[[15]](#endnote-15) Investment in the aerospace industry was an offset of a larger competition between nations to grow their soft power, which non-coincidentally also yielded the moon landing and the Cold War. The total research and development (R&D) investment in the aerospace industry (as a percentage of gross domestic product) between 1965 and 1969 averaged, 2.039 per cent in France, versus 2.804 per cent in the same period in the United States.[[16]](#endnote-16) Within the United Kingdom, this figure was about 2.400 per cent in 1965.[[17]](#endnote-17) By 2000, this expenditure had dropped in both the United Kingdom (1.670 per cent) and the United States (2.629 per cent), while France (2.093 per cent) mostly maintained the status quo.[[18]](#endnote-18)

The market comprised primarily subsonic jets, but national aerospace programs had begun studying the feasibility of implementing supersonic technology in commercial, private, and military airliners as early as 1947, starting with the US rocket Bell X-1.[[19]](#endnote-19) A few attempts in the supersonic space occurred prior to the Concorde: Canadian engineers were able to produce a supersonic fighter jet known as Avro Arrow, which flew for the first time in 1958 before being grounded on February 20, 1959.[[20]](#endnote-20) The Soviet Union was also active, launching Tupolev Tu-144, a supersonic passenger airliner, in 1968, which was intended as a direct rival to the Concorde.[[21]](#endnote-21) In the early 1970s, NASA and Boeing were in a partnership to begin the development of their own version of supersonic transportation, but the project was abandoned due to concerns that it would never be profitable.[[22]](#endnote-22)

The process of building a masterpiece

The Concorde was special. . . . The quality of the work, the minds, the skill, the talent, the commitment that went into it, that’s what really matters.

Tony Benn, former British minister of technology[[23]](#endnote-23)

In 1962, to minimize risk and reduce individual program costs, the United Kingdom and France decided to come together to build the first-ever commercial supersonic jet.[[24]](#endnote-24) The project was given the name Concorde (in English, *concord* meant agreement or harmony) to represent the union and harmony between two of the largest economic powers of the time and their national aerospace companies—the United Kingdom’s British Aircraft Corporation (BAC) and France’s Sud Aviation (later known as Aerospatiale).[[25]](#endnote-25) This project represented a way for the two nations, which had fallen behind in the innovation race since the end of World War II, to reclaim world innovation capabilities. The deal was structured as an international treaty rather than a commercial agreement, thus adding to the risk of geopolitical tensions if either nation pulled out.[[26]](#endnote-26) This, in turn, exponentially increased the pressure on both countries to produce a strong finished product.[[27]](#endnote-27)

Similar to the building processes of any new aircraft, construction of the Concorde was both a lengthy and costly endeavour. Parliamentary documents from the United Kingdom and France indicated that the project’s cost exceeded $8.62 billion[[28]](#endnote-28) over the 14 years between the signing of the project agreement and the aircraft’s first commercial flight.[[29]](#endnote-29) Given the radical innovation in the Concorde (e.g., speed and design), the development budget and time were significantly greater than for other subsonic aircrafts, which had made incremental improvements on aircrafts within the same subsonic speed range. For example, the Boeing 747, a popular subsonic jet that began flying commercially within a few years of the Concorde, cost approximately $5.075 billion,[[30]](#endnote-30) with a five-year interval from its conception to its first commercial flight.[[31]](#endnote-31)

The process of building a new airplane included four stages; R&D, assembly, testing, and customization.

Research and Development (R&D)

Research was the first stage and the backbone of the building process for any new airplane. Through research, airplane manufacturers looked to better understand the four forces of flight (i.e., lift, thrust, drag, and weight) and to discover ways to manipulate these forces to improve aerospace transportation. R&D required top talent and state-of-the-art facilities, which proved costly. Companies also had to continuously conduct research to remain knowledgeable of emerging trends. Therefore, R&D was undoubtedly one of the largest and most unpredictable components of the total expenses for developing a new aircraft. In 2019, Airbus SE (Airbus) spent $4.48 billion on R&D,[[32]](#endnote-32) while Boeing spent $3.2 billion.[[33]](#endnote-33)

Research could occur in two forms—basic research and applied research.[[34]](#endnote-34) *Basic research* was curiosity-based and therefore had more flexibility and required fewer concrete outcomes. Basic research was not always immediately used commercially (e.g., in products). For example, a basic research question could ask how the crystal structure of some metals reacted in high temperatures. Due to the depth of knowledge necessary for basic research, it was common for aerospace companies to outsource or partner with universities on certain studies of this kind. Such partnerships were mutually beneficial: companies were able to tap into top talent and facilities, while universities received funding support to carry out high-quality research. In 2020, there were research partnerships between Airbus and the University of Michigan[[35]](#endnote-35) and between Boeing and the University of Washington.[[36]](#endnote-36) Basic research projects represented only a fraction of aerospace companies’ large R&D budgets because of their low probability of yielding tangible results.[[37]](#endnote-37)

*Applied research*, on the other hand, was driven by practical problems rather than by expanding knowledge for its own sake. For example, given the Mach 2 speed of the Concorde, significant research was conducted to explore the effects of wing shape on the exterior wing temperature in high speeds. Due to its immediate commercial or practical impact, applied research received a significant amount of funding, both internally and externally, through government grants.[[38]](#endnote-38) The goal of this research was to investigate whether theories could be applied to the company’s conceptual designs for new aircraft models, which were often iterations of older designs.[[39]](#endnote-39) These designs were created from the vision of the company but were vetted first through market studies to ensure there would be demand for the new proposed specifications.[[40]](#endnote-40) Confident that there would be demand for such a breakthrough technology, Sud Aviation and BAC went against the norm, deciding not to vet their proposed Concorde design extensively in the market[[41]](#endnote-41) and not to require binding purchase orders.[[42]](#endnote-42)

Although the Concorde was able to utilize top talent both from the United Kingdom and France, and each country had its own research expertise, the Concorde’s design had to be created from scratch, as no other commercial passenger jet had ever flown previously.[[43]](#endnote-43) The Concorde differentiated itself from subsonic jets with features such as its aluminium body, specialized paint coating for temperature control, droop-nose section, and wings arranged in an ogival delta.[[44]](#endnote-44) While these specific elements had not been replicated in subsonic models, the Concorde pioneered other elements such as supercruise capability and the predecessor to full authority digital engine control—two elements that were considered indispensable in modern aeronautical design (see Exhibit 5). There were many challenges that occurred with piloting these novel designs. Despite the Concorde’s unique components, to accommodate the speed at which it was hoped the jets could fly, there was still a limited takeoff weight, which necessitated leaving some seats vacant and limiting the scope of passenger baggage.[[45]](#endnote-45) The windows of the plane were always hot, and, in flight, the plane would expand an average of seven inches due to elevation temperatures.[[46]](#endnote-46) Due to air compression at elevated speeds, material and structural challenges led to fatigue issues.[[47]](#endnote-47) The engineers of the planes had to find ways to mitigate or minimize these issues to ensure flying remained safe enough to occur.

Thus, when compared to the R&D processes of counterparts such as the Boeing 747, both the basic and applied research processes for the Concorde were significantly more labour-, time-, and knowledge-intensive, owing to the radical nature of innovation in the Concorde. For example, the Boeing 747 took approximately 16 months in the R&D stage,[[48]](#endnote-48) whereas the Concorde took 11 years.[[49]](#endnote-49)

Assembly

In the assembly stage, aeronautical engineers used the designs derived from the R&D stage to create the structural components of the new jet. As the integrators who moved the needle from concept to reality, airplane manufacturers had to build a network of parts suppliers.[[50]](#endnote-50) The Concorde included parts from over 800 suppliers, including many luxury brands; for example, its Olympus engines were built by Rolls-Royce (see Exhibit 3).[[51]](#endnote-51) Each Concorde jet cost a hefty sum of $709 million[[52]](#endnote-52) to build and used a significantly greater number of suppliers compared to its counterparts. For example, each Boeing 747, which included parts from approximately 300 suppliers, cost $161 million.[[53]](#endnote-53) Aerospace companies constructed several prototypes, and this gave those working at the assembly stage the ability to test the efficacy of the suppliers for the final model. In the case of the Concorde, six development jets were created: two prototypes, two pre-production aircraft, and two production aircraft.[[54]](#endnote-54) These prototypes and pre-production jets were advancements of the previous models, and each was focused on testing the efficacy of a certain function or part of the airplane. The development aircrafts were the final models before launch and were used to receive regulatory certification. These prototypes were on display because of their semblance to the Concorde jets that were purchased by Air France and British Airways.[[55]](#endnote-55)

Testing

The various prototypes of airplanes underwent several tests to ensure they were safe.[[56]](#endnote-56) These assessments were meant to simulate possible challenges that could occur during takeoff, landing, or flying, such as turbulence, clogged engines, or signal failure. Though these assessments were rigorous in nature, they could not foresee or simulate all of the challenges that an airplane could face (see Exhibit 4). The Concorde underwent 5,500 hours of test flying across six years before receiving authorization to fly internationally.[[57]](#endnote-57) In comparison, the Boeing 747 entered into service less than a year after the first Boeing 747 was completed at the assembly factory.[[58]](#endnote-58) For most new jets, test runs occurred behind closed doors, but in the case of the Concorde, the first test voyage, in 1969, was covered by media around the world.[[59]](#endnote-59)

Customization

Once the final design of a new airplane had undergone tests and been approved by regulatory bodies, airline companies that would be purchasing a plane often chose to work with the manufacturer to fill out the cabin designs.[[60]](#endnote-60) This was not a mandatory stage and was done for cosmetic reasons. Manufacturers offered various designs to fit the unique demands of the airlines. These designs were approved by aeronautical engineers to ensure that the designs would not inhibit safety and flying ability. Elements such as the placement of safety exits and the number of seats on the plane were uniform across airlines, but variation was found in areas such as inflight entertainment, seat materials, and washrooms.[[61]](#endnote-61) Some airlines preferred to hire their own designers for the cabins,[[62]](#endnote-62) and this was the route followed by both British Airways and Air France for the Concorde. The original interior of the Air France jet was built by industrial designer Raymond Loewy, who was credited with designing the Air Force One livery, interiors for NASA’s Apollo programs, and the logo for Royal Dutch Shell.[[63]](#endnote-63)

The Beauty and the Beast

In 1976, after receiving the requisite regulatory approvals, the Air France and British Airways Concorde jets began to fly commercially.[[64]](#endnote-64)

A Breakthrough Innovation

The resultant aircraft was a technological breakthrough, with its shape grounded in physics and its development spearheaded “by engineers for engineers.”[[65]](#endnote-65) Upon launch, the Concorde’s beautiful shape, unique takeoffs and landings, and technological features enamoured amateur aviators and experts alike (see Exhibit 5). Its maiden voyages on January 21, 1976, from London to Bahrain and from Paris to Rio de Janeiro (via Senegal) received enormous media attendance and spectators.[[66]](#endnote-66)

The Concorde was able to reach peak speeds of Mach 2.[[67]](#endnote-67) In comparison, in 2020, commercial jets from Boeing and Airbus travelled at an average speed of Mach 0.85 (see Exhibit 6).[[68]](#endnote-68) British Airways used the slogan “Arrive before you leave” because the jets sometimes arrived in their destination cities prior to the time at which they took off from their departure cities.[[69]](#endnote-69) Reaching Mach 2 speed (twice the speed of sound) was possible in part due to the Concorde’s futuristic structural design.[[70]](#endnote-70)

The Concorde had 100 seats for passengers, with 40 spots in the front cabin and 60 in the back.[[71]](#endnote-71) The cabins of the jets were plain in comparison to the designs of other airplane models; the Concorde had smaller seats and minimal standing room and was void of any inflight entertainment (see Exhibit 7). This element of simplicity may have provided a sense of security to passengers who were uncomfortable with the complex supersonic technology. Additionally, the omission of inflight entertainment may have contributed to the once-in-a-lifetime flight experience.

More than Just a Faster Horse

With Concorde, there’s this idea that design could change the way people lived, the way people travelled. . . . It’s a kind of optimism you don’t see in design anymore.

Lawrence Azerrad, graphic designer, and author of *Supersonic: The Design and Lifestyle of Concorde*[[72]](#endnote-72)

At its pinnacle, the Concorde could not be described as anything but a cultural phenomenon, appearing at the 1992 Olympic Games and in several air shows and advertising campaigns. For example, a rebranding campaign by the food and beverage conglomerate PepsiCo Inc. (PepsiCo) involved painting an Air France Concorde in blue, red, and white and flying it to introduce PepsiCo’s new logo and colours.[[73]](#endnote-73) The Concorde’s legacy even stretched to television and film, where the jet appeared in an episode of the British science fiction series *Doctor Who[[74]](#endnote-74)* and served as the model for the Aerialbot Silverbolt from the *Transformers* film series.[[75]](#endnote-75)

However, beyond its pop culture references, the Concorde was also a source of both inspiration and hubris for many French and British citizens. When referring to the Concorde, Neil Stebbing, the long-time director of sales at British Airways, said that the “technological advancements were more than national progress, they were the source of national pride.”[[76]](#endnote-76) At daily takeoffs, pilots as well spectators on the runaway—many of whom would never have had the chance to actually fly on the jets—often waved the national flags of the United Kingdom and France while singing the countries’ national anthems.[[77]](#endnote-77) These sentiments were reiterated when Queen Elizabeth II flew on the Concorde for her silver jubilee visit to Barbados[[78]](#endnote-78) and when Queen Elizabeth I spent her 85th birthday on the airplane.[[79]](#endnote-79) French diplomats also used the Concorde fleet several times for their diplomatic visits around the world.[[80]](#endnote-80)

Pilots enjoyed overseeing these momentous occasions; further, they enjoyed flying the jet because of its intricate features. Mike Bannister, chief pilot of the Concorde fleet at British Airways, said flying the Concorde “was like . . . driving a sports car rather than a truck. It was so responsive, you could fly it with your fingertips.”[[81]](#endnote-81)

Brian Lovegrove, a former British Airways employee who often flew on the Concorde for work, said, “You could never have enough of seeing it. It was a delight to watch and hear.”[[82]](#endnote-82) Lawrence Azerrad, a graphic designer and an author of a book about the Concorde, found it astonishing that the Concorde’s exterior, which was built on the basis of functionality, yielded the airplane’s iconic design, which people viewed as a symbol for the future. Lawrence said, “The miracle of Concorde is that its revolutionary, iconic design is purely functional. The physics of the craft informs its shape.”[[83]](#endnote-83)

For passengers, who had the privilege to fly on the Concorde, the journey began at the luxurious Concorde lounges that could be found at airports in New York, Paris, and London. These lounges had the finest of wines on tap and were furnished with chic Bauhaus furniture from some of the most expensive designers, such as Le Corbusier and Charles and Ray Eames.[[84]](#endnote-84) The lounges also included custom paintings from the US artist Sol Lewitt, the father of minimalism, and, in the New York lounge, a picture of Marilyn Monroe, who was considered the epitome of luxury and wealth.[[85]](#endnote-85) The lounges were constantly upgraded, with each receiving $2 million in renovations over two decades.[[86]](#endnote-86) While most lounges at airports were dedicated to passengers of specific airlines, the Concorde lounge was for passengers who flew on a specific airplane. Passengers described their experience during takeoff as similar to being in a dentist’s chair because of how far the chairs leaned back.[[87]](#endnote-87) Once the plane was in the air and configuration returned to normal, passengers were treated to an expansive inflight menu (see Exhibit 8). Food was a quintessential element of the Concorde experience. The wine selection was top notch, with each bottle retailing for between $100 and $250.[[88]](#endnote-88) The three-course meal that was served on the Concorde cost, on average, $90.[[89]](#endnote-89) Popular entrees included delicacies such as caviar, steak, chicken liver, and grouse breasts.[[90]](#endnote-90) While these offerings were similar to those offered to first-class passengers on other planes until the 1990s, the dishes on the Concorde were cooked by esteemed chefs such as Michel Roux, Shaun Hill, Vineet Bhatia, Mark Edwards, and Richard Corrigan.[[91]](#endnote-91) Roux for example, who was inducted into the Ordre national du Mérite as chevalier for his influence in the culinary arts, was known for owning the first-ever Michelin three-star restaurant outside of France and was described as the chef who had reshaped British cooking.[[92]](#endnote-92)

Passengers could track how high the plane was flying by looking at a monitor at the front of the cabin (see Exhibit 7).[[93]](#endnote-93) When the Concorde was approaching its peak, at 60,000 feet (about 18,288 metres or eight kilometres), an announcement was made telling passengers to look out the window—for at this point, they could see the curvature of the earth.[[94]](#endnote-94) By the 1990s, in-seat entertainment had grown in popularity; however, it did not exist on the Concorde.[[95]](#endnote-95) The exclusion may have been a purposeful element of design. The coloured fabric seat covers with lengthwise stripes were strategically designed to make the small interior feel bright and spacious.[[96]](#endnote-96) After passengers pushed for a redesign, the French Concorde underwent a makeover by French designer Andrée Putnam, who had worked previously with some of the world’s most iconic hotels as well as museums in France.[[97]](#endnote-97)

Another well-documented component of the passenger experience for many was the opportunity to sit among celebrities, dignitaries, and business magnates. A flight attendant on the Concorde famously said, “If money had a smell, you could smell it on the Concorde.”[[98]](#endnote-98) Celebrities who travelled on the Concorde included Steven Spielberg, Calvin Klein, Richard Gere, Elton John, Diana Ross, and Michael Jackson. Paul McCartney, another frequent flyer, was often remembered for the performance he gave with his guitar for the passengers and crew during the voyage.[[99]](#endnote-99)

At the end of the flight, every Concorde passenger received a certificate commemorating their voyage as well as other customized gifts, such as crystal paperweights, Smythson stationery, and leather-bound flasks, which passengers could then show off to their friends and work colleagues (see Exhibit 9).[[100]](#endnote-100) Many passengers also collected the cutlery used during meals served on the Concorde; such cutlery was designed by Loewy specifically for the Concorde.[[101]](#endnote-101) Painter Andy Warhol was a notorious collector of the cutlery,[[102]](#endnote-102) which is on display at museums around the world. Flying on the Concorde was a sign of status and membership in an exclusive club, and these mementoes reinforced this idea.[[103]](#endnote-103)

Types of Passenger

Overall, the Concorde’s unique characteristics and meticulously designed experiences led various passengers to purchase a seat. Some passengers were thrill seekers who were enamoured with the Concorde’s aesthetically beautiful design or its Mach 2 speed. Travellers who were in love with the Concorde would purchase tickets regardless of the price tag. These thrill seekers did whatever they could to be able to board the Concorde, even if it was only for one experience. Among such individuals was Justin Cornell, a bank teller from the United Kingdom who was so determined to fly on the Concorde that he purchased 900 boxes of cookies at his local grocery in order to garner enough Air Miles[[104]](#endnote-104) to purchase a ticket. Cornell attributed his subsequent motivation to lose weight to his Concorde experience, eventually losing 140 pounds.[[105]](#endnote-105) Another individual received the opportunity to fly on the jet by agreeing to take part in an episode of the third season of the Canadian reality television show *Thrill of a Lifetime*, which portrayed the experience of travelling aboard the Concorde.[[106]](#endnote-106)

Some travellers chose the Concorde for its relative advantages compared to other options. These travellers were drawn to the Concorde because of its convenience, dedicated routes between the major economic hubs (i.e., London, New York, and Paris), and much shorter flight times. The option to return home the same day they had left gave these individuals more time to spend with their families and more work availability. For some business travellers, having to adjust and then readjust to time zone differences (e.g., London was five hours ahead of New York) was more easily evaded, in part, thanks to the Concorde, whose shorter flight times saved hours—sometimes even days. Raymond Pearlson, the inventor of Syncrolift, travelled with the Concorde over 150 times to sell his ship-lift system. He said, “The only reason I was able to fly so much was because of Concorde. . . . It was a time machine that allowed me to cut down on so many hours of travel so I could be a human instead of a zombie.”[[107]](#endnote-107)

Leisure travellers made up another large segment of Concorde passengers.[[108]](#endnote-108)As these travellers may have been more risk-averse than other types of adopters, leisure passengers took a longer time to start flying and did so only after they had seen that the technology was reliable and that the ticket price was relatively manageable. The decision to travel on the Concorde was grounded in a desire to belong to an exclusive group as well as for the immersive experience. However, such passengers were also mindful of the price tag. In addition to normal travellers, this category of travellers included many public figures such as politicians, celebrities, and upper-class citizens.

Many of the Concorde’s avid visitors boarded the jet for its immersive experience. While the Concorde was initially envisioned for the mass market, its ticket price eventually went up to the $10,000–$12,000 range.[[109]](#endnote-109) Therefore, the Concorde experience was deemed unaffordable for most people; the majority of passengers who did get the chance fly on the Concorde were part of an elite group (see Exhibit 2). Some passengers received tickets through promotional contests run by the airline or by corporate or media partners; however, these individuals were few and far between.[[110]](#endnote-110)

Not a Beauty but a monster

While the Concorde was a treat for those who had the opportunity to fly aboard it, some circles viewed it not as a beauty but as a monster that emitted air-polluting exhaust and disruptive sonic booms. The Anti-Concorde Project was founded in 1966 by environmental activist Richard Wiggs; through the project’s demonstrations and advertisements,[[111]](#endnote-111) Wiggs was successful in lobbying the US government to ban supersonic travel over the continental United States prior to the Concorde’s first commercial flight.[[112]](#endnote-112) Some international jurisdictions followed suit in banning supersonic jets; consequently, upon launch, the Concorde was mostly limited to flying over water masses and sparsely populated regions.[[113]](#endnote-113) The anti-Concorde coalition was backed by many notable academics and socialites, including a Nobel laureate and members of the Royal Society, the world’s oldest independent group of scientists.[[114]](#endnote-114) Charles Lindbergh, the first pilot to fly across the Atlantic, was also opposed to the Concorde project. “Without a basic appreciation of nature,” he said, “I believe an overemphasis on science will destroy us.”[[115]](#endnote-115) This initiative galvanized widespread support around the world and became one of the first times that environmental lobbyists were successful in regulating new technology, especially one that had national vested interests.[[116]](#endnote-116)

In addition, other factors in the context of the airline industry turned against the Concorde, including the price of oil, which caused all airlines that had placed them to rescind non-binding purchase orders.[[117]](#endnote-117) This limited the number of routes the Concorde could fulfill and became a point of frustration for the BAC and Aerospatiale, who attempted to lobby governments around the world to revert their judgment regarding where Concorde could fly.[[118]](#endnote-118) The regulation banning supersonic flight was championed by American politicians from both major political parties because it not only pleased most citizens living around airports but also inhibited the success of a rival aerospace program.[[119]](#endnote-119) British Airways and Air France challenged this ruling and were given the opportunity to fly into Washington’s Dulles International Airport and New York’s John F. Kennedy International Airport.[[120]](#endnote-120) During its short run, the Concorde flew to each of these locations thrice a week, much to the despair of those living near the airports.[[121]](#endnote-121) According to Allan Greene, president of Sane Aviation for Everyone, a coalition of concerned groups and individuals in the New York metropolitan area, “The appalling noise was like a constant reminder that people like us don’t count and that our lives can be sacrificed to serve the super-rich flying public.”[[122]](#endnote-122)

Landing Forever

On July 25, 2000, Air France flight 4590, a Concorde jet commissioned to travel from Paris to New York, crashed during takeoff, killing the 109 passengers as well as four people who were on the ground.[[123]](#endnote-123) The disaster occurred when the fragments of a piece of metal on the runway punctured one of the plane’s tires and flew into the engine, causing the engine to combust.[[124]](#endnote-124) The Concorde had worked for many years to build its reputation as a safe travel option, and this was a devastating event due to the loss of life. Prior to this accident, the jet’s first crash, the Concorde had a relatively strong safety record.[[125]](#endnote-125) In reaction to the crash, the Concorde underwent extensive renovations, with all fuel tanks lined with Kevlar, a heat-resistant synthetic fibre, and old tires replaced with a more durable version that would be less prone to obstructions.[[126]](#endnote-126)

The Concorde had not fully recouped the financial and reputational losses that had stemmed from the tragic accident when the September 11, 2001 attacks on the World Trade Centre in New York became the last nail in the Concorde’s coffin. September 11 not only affected global travel demand but also reduced the level of comfort and safety people had when they flew. This vulnerability was reinforced by advanced security measures, such as the presence of border security officers, that were implemented across most jurisdictions.[[127]](#endnote-127) This additional hassle affected the pleasant, special, and stress-free experience of Concorde passengers. Across the airline industry, premium business travel, which made up a significant portion of the Concorde’s business, was reduced by 31.6 per cent within the six months following 9/11.[[128]](#endnote-128) It took the business travel segment of the market two years and six months to reach its pre-9/11 peak, and at that point, the Concorde was no longer around.[[129]](#endnote-129)

In early 2003, Air France and British Airways announced the intent to retire the Concorde fleet by the end of the year, citing reduced passenger volumes and maintenance costs as the reasons for the discontinuation.[[130]](#endnote-130)

As Air France and British Airways were the only carriers to purchase the jets, this announcement signified the end of almost 30 years of service. Only 14 Concorde jets had entered into service throughout the plane’s lifetime, and this number was a gross underestimate of what the BAC and Aérospatiale had estimated during the commencement of the program.[[131]](#endnote-131) Following the announcement, seat demand that had previously reached lows suddenly spiked; consequently, customers had to be turned away during the Concorde’s final two months of operation.[[132]](#endnote-132) Concorde jets travelled around parts of Europe, North America, and the Asia Pacific as part of a farewell tour, and the largest newspapers in France and the United Kingdom had a week-long series leading up to their respective last flight. The Air France fleet made its final journeys in May 2003, while the final British Airways Concorde voyage was made on October 6, 2003.[[133]](#endnote-133) These final voyages were met with media coverage, and at Heathrow Airport, British Airways built a 1,000-seat grandstand for spectators to view the plane landing for a final time.[[134]](#endnote-134) John Cowburn, one of those who gathered, told the British Broadcasting Corporation that “Today is a very sad day but we must make the most of it. Concorde is potentially the most special thing man has ever built.”[[135]](#endnote-135) After the Concorde was retired, humans reverted to a travel technology that was inferior in both speed and design. As of 2020, almost two decades later, the travel time from London to New York remains seven hours, compared to the 3.5 hours that the same distance had taken aboard the Concorde.[[136]](#endnote-136)

Following the retirement of the fleet, the Concorde jets, along with their prototypes, were sent to museums around the world.[[137]](#endnote-137) They could be found in exhibits in the United Kingdom, France, Germany, the United States, and Barbados.[[138]](#endnote-138) Interestingly, the Concorde continued to have avid fans. For example, in 2020, there were Club Concorde members in over 20 countries.[[139]](#endnote-139) In these groups, members shared their anecdotal flight experiences and learned more about different kinds of aviation projects. Many of the old pilots, frequent flyers, and celebrities who had flown on the airplane were part of these groups. By 2015, Club Concorde members were able to raise nearly $200 million in the hopes of purchasing two Concorde planes. These groups had occasional gatherings, where they would attempt to recreate the meals and parties that had occurred on Concorde flights.[[140]](#endnote-140) While it may have seemed bizarre to celebrate something that no longer was, for these people, many of whom grew up in the era of science fiction, the Concorde represented not only the zenith of air travel but also a glimpse into the future.

Over the years, many Concorde enthusiasts remained emotionally connected to the jet. Some enthusiasts were able to have their weddings aboard the jet stationed at the Brooklands Museum in Weybridge, Surrey, England. As of 2015, ceremony reception (with 32 seated guests) was available on the Concorde for £2,000.[[141]](#endnote-141)

The Commercial Market for Supersonic Passenger Jets in 2020

In the almost two decades since the Concorde’s grounding, there had not been a supersonic replacement for the jet. However, this was not for lack of trying. In the 2010s, several private-sector start-ups emerged to create supersonic passenger jets. These firms included Boom Technology (backed by Japan Airlines), Aerion (backed by Boeing and Lockheed Martin), and Spike Aerospace Inc. (backed by Siemens AG and Greenpoint Technologies Inc.).[[142]](#endnote-142) All three were poised to begin flight testing by the early to mid-2020s.[[143]](#endnote-143)

Environmentalism had begun to gain traction when the Concorde first began flying, but concepts of sustainability became more prevalent by 2020. Laws regulating the amount of carbon that airplanes were allowed to emit came into being, as did an increase in brand activism and consumers demanding that companies play a bigger role in preserving and protecting the environment. Companies and industries were often chastised by millennials for poor environmental practices.[[144]](#endnote-144) Environmental equity remained an important topic for responsible consumers and was a particularly relevant theme in the discussion of supersonic jets. With supersonic flights unaffordable for most people, the introduction of supersonic technology could produce a scenario where the wealthy remained the largest emitters. Historically, the aviation industry was under constant fire, as it was responsible for more than 8 per cent of greenhouse gas emissions in 2019.[[145]](#endnote-145) With the introduction of new supersonic jets, this percentage would probably increase. A 2018 report by the International Council on Clean Transportation estimated that the supersonic jet engines under production would burn five to eight times more fuel per passenger than the current subsonic models.[[146]](#endnote-146) Noise pollution also remained a point of concern. Despite fears that creating supersonic jets would be irresponsible innovation, there was still hope that supersonic travel could meet standards and not be as adverse environmentally as previously thought.

In 2013, NASA released a study that suggested it would be possible for the booms of supersonic jets to meet regulatory emissions requirements and to produce no more sound than subsonic models did.[[147]](#endnote-147) This possibility moved closer to reality with the quiet supersonic technology under development in NASA and Lockheed Martin’s X-59 project.[[148]](#endnote-148) With new technologies and NASA’s work, there was a greater likelihood of limiting emissions, where possible.[[149]](#endnote-149)

The aviation industry had been disproportionately affected by the COVID-19 pandemic. As an industry that had previously depended on filling 75–85 per cent of seats in order to break even, the 62 per cent drop in passenger volume was devastating.[[150]](#endnote-150) With the world economy stalled due to COVID-19, and companies opting to hold conferences and important meetings through teleconference for the safety of their staff, the largest drop was in the number of business tickets. Though such tickets made up only 20 per cent of total seats, they represented 75 per cent of an airline’s revenue.[[151]](#endnote-151)

With the emerging economies of Brazil, Russia, India, and China, the customer base for a supersonic jet could be larger than it had been during the early 2000s. The question that remained was whether supersonic jets would be permitted to land in these territories.

Would any supersonic jet be able to replicate the Concorde in terms of beauty and function? Would the aerospace industry and its multi-level stakeholders even welcome the re-integration of supersonic technology?

Exhibit 1: Concorde LANDING



Source: With permission, Andrew Hunt, “Aerospatiale-British Aerospace Concorde 101,” Airliners.net, accessed December 1, 2020, www.airliners.net/photo/Air-France/Aerospatiale-British-Aerospace-Concorde-101/6165577?qsp=eJwtjDEKw0AMBP%2Bi2k0IuHAXf8Ap8gGhWxJjJ3dIguQw/nvkw90wu8xGkj%2BOnz9qAQ1kYJUXdVRY%2BW00bLSgfrOm4OMrgYjdsvpYwyV23ERQHOn0U1z0mGDSUs9IXwKg98Z07cOn2crKrQHneaV9/wPW6S/o.

Exhibit 2: Airline Industry in 1976 and 2003

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1976 | 2003 | |
|  | Subsonic (annual) | Subsonic (annual) | Concorde (lifetime) |
| Number of Passengers | 471.8 million | 1.6 billion | 2,500,000 |
| Number of Flights | 9.56 million | 21.28 million | 50,000 |

A survey of British Airways Concorde Customers indicated that 43% of passengers had flown more than once.

Source: Created by case authors based on data from “Air Transport, Passengers Carried,” The World Bank, accessed August 5, 2020, <https://data.worldbank.org/indicator/IS.AIR.PSGR>; “£356 Fares and the 105-Year-Old Passenger: 40 Fascinating Facts about Concorde for Her 50th Anniversary,” *Telegraph*, March 2, 2019, accessed July 20, 2020, www.telegraph.co.uk/luxury/travel/concorde-40-fascinating-facts-history/; John Fitzgerald, “Thrill Seekers Pack Last Run of Concorde,” *Globe and Mail*, October 2, 2003, accessed August 5, 2020, www.theglobeandmail.com/news/national/thrill-seekers-pack-last-run-of-concorde/article18431677/; Richard Witkin, “Repeat Passengers (One Has Flown 63 Times) Encourage Concorde’s Operators Despite Current Losses,” *New York Times*, June 10, 1978, accessed August 10, 2020 www.nytimes.com/1978/06/10/archives/repeat-passengers-one-has-flown-63-times-encourage-concordes.html; E. Mazareanu “Revenue of Airlines Worldwide 2003–2021,” Statista, June 10, 2020, accessed August 5, 2020, www.statista.com/statistics/278372/revenue-of-commercial-airlines-worldwide/.

Exhibit 3: Rolls-Royce Engine

**A picture containing indoor, engine, table, sitting

Description automatically generated**

Source: With permission, Nimbus227, “Olympus 593 FAAM Turbine,” Wikimedia Commons, March 25, 2010, accessed November 1, 2020, https://commons.wikimedia.org/wiki/File:Olympus\_593\_FAAM\_Turbine.JPG, “Olympus 593 AB,” Wikimedia Commons, October 31, 2017, accessed November 30, 2020, https://commons.wikimedia.org/wiki/File:Olympus\_593\_AB.jpg.

Exhibit 4: Testing a new Airplane

Some of the tests conducted in the airline safety process included the following:

* Wind tunnels: In the wind tunnel, models were mounted on a machine called a force balance,to measure aerodynamic forces such as lift and drag.
* Wing-bend tests: Wings had to be able to flex nearly 90 degrees in a test rig to account for elements such as air turbulence.
* Ingestion tests: These tested the durability of the engines to having objects, such as birds or water, lodged inside.
* Hot and cold tests: These tested the plane’s ability to fly in extreme conditions in high altitudes.
* Static testing: These checked to determine whether there were any gaps or cracks within the infrastructure of the airplane.

Source: Created by case authors based on data from “Test Programme and Certification,” Airbus, accessed August 5, 2020, www.airbus.com/aircraft/how-is-an-aircraft-built/test-programme-and-certification.html; “Wind Tunnel Testing,” National Aeronautics and Space Association, accessed August 5, 2020, www.grc.nasa.gov/WWW/K-12/airplane/tuntest.html; Katia Moskvitch, “The Extreme Tests Planes Go through before Taking Off,” BBC Future, March 18, 2014, accessed August 5, 2020, www.bbc.com/future/article/20140319-stress-tests-for-safer-planes.

Exhibit 5: UNIQUE FEATURES OF Concorde

* **Droop Nose**: This enabled the Concorde to pierce the air when travelling. Pilots were required to fly at a steep angle throughout to maintain visibility.
* **Delta Wing**: The ogival- (delta- or triangular-) shaped wings were aerodynamically complex to minimize drag and enable adequate lift for takeoff.
* **Turbojet Engines**: Cumulative jets (four) were twice as powerful as engines on similar subsonic jets. The afterburner system was similar to those on fighter jets and spaceships.
* **Air Intakes**: The air intake system in the Concorde was cutting edge. It slowed down the air rushing towards the engines at its Mach 2 (1,350 miles per hour) cruising speed to less than 300 miles per hour. The jet’s engine would not function properly without this mechanism.
* **Heat Proof Airframe**: A combination of steel aluminium, titanium, tempered glass, and specialized white paint enabled the plane to endure heat generation.
* **Fuselage**: This was three times narrower than the fuselage of the Boeing 747 despite the plane’s similar length—drawing comparisons to a rocket. This reduced drag caused by supersonic flight.
* **Automated Flights**: The plane’s autopilot allowed Concorde pilots to fly “hands free.” While this was not the first use of this technology, it made it a commonplace.
* **Landing Gear**: Concorde was the first form of transportation with antilock brakes—a modern standard for air travel and cars.
* **Fuel Transfer**: The jet carried roughly 31,500 gallons of fuel, weighing more than 200,000 pounds.

Source: Created by case authors based on “Anatomy of Concorde: Supersonic Dream,” PBS: NOVA Science Programming, 2004, accessed November 30, 2020, www.pbs.org/wgbh/nova/concorde/anat-nf.html.

Exhibit 6: Flight-Time Comparison

|  |  |  |  |
| --- | --- | --- | --- |
| **Method of Transportation** | **London–New York** | **Singapore–London (via Bahrain)** | **Paris–Rio de Janeiro**  **(via Dakar)** |
| **Concorde** | 3 hours and 30 minutes | Less than 9 hours | Less than 7 hours |
| **Subsonic Aircraft in 2020** | 7 hours and 15 minutes | 14 hours | 11 to 12 hours |

Source: Laura Ash, “How Fast Did Concorde Actually Fly from New York to London?,” Simple Flying, June 28, 2020, accessed November 2, 2020, https://simpleflying.com/concorde-new-york-to-london-time/; “The Jointly Operated British Airways & Singapore Airlines Service 1977–1980,” Heritage Concorde, accessed November 2, 2020, www.heritageconcorde.com/singapore-airlines-concorde-operations; “Concorde First Scheduled Services,” Heritage Concorde, accessed November 2, 2020, www.heritageconcorde.com/concorde-first-scheduled-services; “Flights to New York,” British Airways, accessed November 2, 2020, www.britishairways.com/en-gb/destinations/new-york/flights-to-new-york; “Find Cheap Flights from Singapore to London”, Kayak.com, accessed November 2, 2020, www.kayak.com/flight-routes/Singapore-Changi-SIN/London-LON; “Find Cheap Flights to Rio de Janeiro,” Kayak, accessed November 2, 2020, www.kayak.com/flight-routes/United-States-US0/Rio-de-Janeiro-RIO.

Exhibit 7: Interior of the Concorde

**A group of people sitting on a bus

Description automatically generated**

Source: With permission, “Time Capsule Trip Report: Flying the Concorde,” DC Rainmaker, July 11, 2011, accessed November 1, 2020, www.dcrainmaker.com/2011/07/time-capsule-trip-report-flying.html.

Exhibit 8: Food and Menus ABoard the Concorde

|  |  |
| --- | --- |
| ***Toulouse – Dubai***  Three Thousand Nine Hundred Eleven Miles  Three Hours Thirty Minutes  Canapés – Apéritif  *Canapés – Ap*é*ritif*  **Dinner**  *Diner chaud*  Caviar from the Caspian Sea  *Caviar frais de la Caspienne*  Fresh salmon in Champagne sauce  *Saumon frais sauce champagne*  Sautéed potatoes Green peas and Belgian carrots  *Pommes Anna – Petits pois et carottes grelot*  Apple tart  *Tarte aux pommes*  < Duet > of strawberries and kiwi fruit  *Duo de fraise et de kiwi* | ***New York – Toulouse***  Three Thousand Eight Hundred Ninety-One Miles  Three Hours Twenty-Four Minutes  Canapés – Champagne  *Canapés – Champagne*  **Lunch**  *Déjeuner chaud*  Lobster salad with julienne of mango pear  *Salade de homard la julienne de mangue*  Tournedos in peppercorn sauce  *Tournedos au poivre*  Potato croquette with truffles and slivered almonds, carrots, and spinach subric  *Pommes berny – Subric des carottes et épinards*  Seasonal Salad  *Salade de saison*  Cheese from France  *Fromages de France*  Fresh Fruit salad  *Salade de fruits frais*  Petits fours  *Mignardises* |

Note: Transcribed from pictures 1&2 - Air France Concorde.

Source: Gilbert Ott, “The Concorde Experience, Menus and More…,” GodSaveThePoints, February 19, 2016, accessed December 1, 2020, www.godsavethepoints.com/theconcordeexperience/.

Exhibit 8 (CONTINUED)

A picture containing plate, food, dish, piece de resistance

Description automatically generated

Source: With permission, “Time Capsule Trip Report: Flying the Concorde,” DC Rainmaker, July 11, 2011, accessed November 1, 2020, www.dcrainmaker.com/2011/07/time-capsule-trip-report-flying.html.

Exhibit 9: A Variety of COncorde Souvenirs

A bunch of items that are sitting on a table

Description automatically generated

Source: With permission, “Concorde Collection,” Nathan.com, accessed November 2, 2020, <http://nathan.com/concorde-collection/>.

ENDNOTES

1. This case has been written on the basis of published sources only. Consequently, the interpretation and perspectives presented in this case are not necessarily those of Aérospatiale or the British Aircraft Corporation or any of their employees. [↑](#endnote-ref-1)
2. First published in French, in 1872, *Le Tour du monde en quatre-vingts jours* (*Around the World in 80 Days*) was an adventure novel written by Jules Verne. [↑](#endnote-ref-2)
3. Michael Dempsey, “New Jets Promise to Revive Supersonic Travel,” BBC News, October 17, 2020, accessed October 20, 2020, www.bbc.com/news/business-54416696. [↑](#endnote-ref-3)
4. Tamara Hardingham-Gill, “‘Supersonic Travel Is Here’: Boom Rolls Out Xb-1 Demonstrator Aircraft.” CNN Travel, October 7, 2020, accessed October 20, 2020, www.cnn.com/travel/article/boom-supersonic-rolls-out-xb-1-demonstrator-aircraft/index.html. [↑](#endnote-ref-4)
5. Matt Kamlet, “NASA Marks Continued Progress on X-59,” NASA, September 17, 2020, accessed October 20, 2020, www.nasa.gov/aeroresearch/nasa-marks-continued-progress-on-x-59. [↑](#endnote-ref-5)
6. All dollar amounts are in US dollars. [↑](#endnote-ref-6)
7. Paul Sillers, “How Soon Will Supersonic Jets Return to Our Skies?,” CNN Travel, February 5, 2020, accessed October 20, 2020, www.cnn.com/travel/article/when-will-supersonic-flight-return/index.html. [↑](#endnote-ref-7)
8. Business Wire, “Global Business Jets Market (2020 to 2030)—Entry of New Business Jets OEMs Presents Opportunities—ResearchAndMarkets.com,” news release, Business Wire, August 20 2020, accessed October 11, 2020, www.businesswire.com/news/home/20200820005417/en/Global-Business-Jets-Market-2020-to-2030---Entry-of-New-Business-Jets-OEMs-Presents-Opportunities---ResearchAndMarkets.com. [↑](#endnote-ref-8)
9. Business Wire, “Global Commercial Aircraft Market Report (2020 to 2030)—COVID-19 Impact and Recovery—ResearchAndMarkets.com,” news release, Business Wire, June 11, 2020, accessed October 11, 2020, www.businesswire.com/news/home/20200611005439/en/Global-Commercial-Aircraft-Market-Report-2020-to-2030---COVID-19-Impact-and-Recovery--ResearchAndMarkets.com. [↑](#endnote-ref-9)
10. *Encyclopaedia Britannica*, s.v. “Concorde,” accessed August 5, 2020, www.britannica.com/technology/Concorde. [↑](#endnote-ref-10)
11. Dara Bramson, “Supersonic Airplanes and the Age of Irrational Technology,” *Atlantic*, July 1, 2015, accessed August 5, 2020, www.theatlantic.com/technology/archive/2015/07/supersonic-airplanes-concorde/396698/. [↑](#endnote-ref-11)
12. Ciara Appelbaum and Sophie-Claire Hoeller, “Vintage Photos Show What Air Travel Looked like in Every Decade,” Insider, October 24, 2017, accessed August 5, 2020, www.insider.com/air-travel-in-every-decade-2017-8. [↑](#endnote-ref-12)
13. “Air Transport, Passengers Carried,” The World Bank, accessed November 1 2020, https://data.worldbank.org/indicator/IS.AIR.PSGR. [↑](#endnote-ref-13)
14. Bramson, op. cit. [↑](#endnote-ref-14)
15. Glenn Bugos, “The History of the Aerospace Industry,” Economic History Association, accessed August 5, 2020, https://eh.net/encyclopedia/the-history-of-the-aerospace-industry/. [↑](#endnote-ref-15)
16. Daniel Lederman and Lauren Saenz, “Innovation and Development around the World (1960–2000),” (World Bank Policy Research Working Paper 3774, Office of the Chief Economist, Latin America and Caribbean, The World Bank, November 2005), accessed August 5, 2020, http://documents1.worldbank.org/curated/en/205791468315566096/pdf/wps3774.pdf. [↑](#endnote-ref-16)
17. Organization for Economic Co-operation and Development, “Gross Domestic Expenditure on R-D by Sector of Performance and Source of Funds (1963–1980),” OECD.Stat, March 2015, accessed August 5, 2020, https://stats.oecd.org/Index.aspx?DataSetCode=GERD\_FUNDS\_PRE1981. [↑](#endnote-ref-17)
18. Organization for Economic Co-operation and Development, “Gross Domestic Spending on R&D,” OECD, accessed August 5, 2020, https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm. [↑](#endnote-ref-18)
19. Yvonne Gibbs, ed., “NASA Armstrong Fact Sheet: First Generation X-1,” NASA, August 7, 2017, accessed August 5, 2020, www.nasa.gov/centers/armstrong/news/FactSheets/FS-085-DFRC.html. [↑](#endnote-ref-19)
20. Ian Austen “Hunting for a Canadian Legend: The Avro Arrow Jet Fighter,” *New York Times*, September 13, 2017, accessed October 11, 2020, www.nytimes.com/2017/09/13/world/canada/avro-arrow-jet-.html. [↑](#endnote-ref-20)
21. Jacopo Prisco, “Concordski: What Ever Happened to Soviets’ Spectacular Rival to Concorde?,” CNN Style, July 10, 2019, accessed August 5, 2020, www.cnn.com/style/article/tupolev-tu-144-concordski/index.html. [↑](#endnote-ref-21)
22. Bruce Dorminey, “5 Things You Likely Never Knew about Boeing’s 747,” *Forbes*, February 16, 2019, accessed August 5, 2020, www.forbes.com/sites/brucedorminey/2019/02/16/5-things-you-likely-never-knew-about-boeings-747/. [↑](#endnote-ref-22)
23. Chris Bateman, “That Time the Supersonic Concorde Visited Toronto,” BlogTO, May 10, 2014, accessed October 11, 2020, www.blogto.com/city/2014/05/that\_time\_the\_supersonic\_concorde\_visited\_toronto/. [↑](#endnote-ref-23)
24. *Encyclopaedia Britannica*, op. cit. [↑](#endnote-ref-24)
25. David Slotnick, “The Concorde Made Its Final Flight a Little More than 16 Years Ago and Supersonic Air Travel Has Yet to Return—Here’s a Look Back at Its Awesome History,” Business Insider, April 2, 2020, accessed August 5, 2020, www.businessinsider.com/concorde-supersonic-jet-history-2018-10. [↑](#endnote-ref-25)
26. Peter Gillman, “The Story of the Concorde–77.01 (Part Two),” *Atlantic Monthly*, 239, no. 1 (January 1977): 72–81, accessed August 5, 2020, www.theatlantic.com/past/docs/issues/77jan/gillman2.htm. [↑](#endnote-ref-26)
27. Ibid. [↑](#endnote-ref-27)
28. Figure adjusted to represent amount in US dollars in 2020. [↑](#endnote-ref-28)
29. Alberto Domini and Julien Chicot, *Case Study Report: From Concorde to Airbus* (Luxembourg: Publications Office of the European Union, February 2018), accessed August 5, 2020, http://publications.europa.eu/resource/cellar/4940e0c9-2359-11e8-ac73-01aa75ed71a1.0001.01/DOC\_1. [↑](#endnote-ref-29)
30. Jean-Paul Rodrigue, “Development Costs for Selected Aircraft,” The Geography of Transport Systems, accessed August 5, 2020, https://transportgeography.org/?page\_id=2487; Figure adjusted to represent amount in US dollars in 2020. [↑](#endnote-ref-30)
31. Kent German, “Boeing 747: Queen of the Skies for 50 Years,” CNET, February 9, 2019, accessed August 5, 2020, www.cnet.com/news/boeing-747-queen-of-the-skies-for-50-years/. [↑](#endnote-ref-31)
32. E. Mazareanu, “Airbus Group (EADS) – Research and Development Expenditures 2010–2019,” Statista, August 3, 2020, accessed August 5, 2020, www.statista.com/statistics/259476/eads-research-and-development-costs/. [↑](#endnote-ref-32)
33. E. Mazareanu, “Boeing – Expenditures on Research and Development Projects 2001–2019,” Statista, April 28, 2020, accessed August 5, 2020, www.statista.com/statistics/268991/expenditures-on-research-and-development-by-boeing/. [↑](#endnote-ref-33)
34. Amir R. Amir and Stanley I. Weiss, *Encyclopaedia Britannica*, s.v. “Aerospace Industry,” March 23, 2020, accessed August 5, 2020, www.britannica.com/technology/aerospace-industry/Design-methods. [↑](#endnote-ref-34)
35. “Airbus in Partnership with Key Research Universities and Institutes,” Airbus, June 21, 2017, accessed July 3, 2020, www.airbus.com/newsroom/press-releases/en/2017/06/airbus-in-partnership-with-key-research-universities-and-institu.html. [↑](#endnote-ref-35)
36. Jonathan Ahn, “Boeing’s University of Washington Partnership Introduces Prospective Scientists to the Future,” Boeing, May 10, 2019, accessed September 24, 2020, www.boeing.com/company/about-bca/washington/barc-lab-uw-05-10-19.page. [↑](#endnote-ref-36)
37. Amir and Weiss, op. cit. [↑](#endnote-ref-37)
38. Ibid. [↑](#endnote-ref-38)
39. Ibid [↑](#endnote-ref-39)
40. Ibid. [↑](#endnote-ref-40)
41. Gillman, op. cit. [↑](#endnote-ref-41)
42. Simon Calder, “Concorde Timeline: The Highs and Lows of the Iconic Plane,” *Independent*, July 24, 2020, August 5, 2020, www.independent.co.uk/travel/news-and-advice/concorde-supersonic-plane-british-airways-heathrow-air-france-a9635681.html; Peter Lyth, “Supersonic/Gin & Tonic: The Rise and Fall of Concorde, 1950–2000” in *Transport and Its Place in History*: *Making the Connections* (New York: Routledge, 2020), accessed November 30, 2020, https://books.google.ca/books?id=9NXpDwAAQBAJ&pg=PT34&lpg=PT34&dq=concorde+non-binding+purchase+orders&source=bl&ots=RYZ9Vshmdc&sig=ACfU3U0pMNBe8lBjy\_dE4OG1mNMe4S4h0g&hl=en&sa=X&ved=2ahUKEwit3rav46ntAhUrGVkFHS8eD-Y4ChDoATACeg. [↑](#endnote-ref-42)
43. “Concorde Production and Construction,” Heritage Concorde, accessed July 28, 2020, www.heritageconcorde.com/concorde-production-and-construction. [↑](#endnote-ref-43)
44. Ben Barry “How Concorde Pushed the Limits – Then Pushed Them too Far,” *National Geographic*, September 5, 2019, accessed November 30, 2020, www.nationalgeographic.co.uk/science-and-technology/2019/08/how-concorde-pushed-limits-then-pushed-them-too-far; “Anatomy of Concorde: Supersonic Dream,” PBS: NOVA Science Programming, 2004, accessed November 30, 2020, www.pbs.org/wgbh/nova/concorde/anat-nf.html. [↑](#endnote-ref-44)
45. Michael Kaplan, “Fast Days on the Concorde: Rock Stars, Wine & the ‘11-Mile-High Club,’” *New York Post*, June 15, 2019, accessed August 17, 2020, https://nypost.com/2019/06/15/fast-days-on-the-concorde-rock-stars-wine-the-11-mile-high-club/. [↑](#endnote-ref-45)
46. Craig Freudenrich, “How Concordes Work,” HowStuffWorks, accessed September 24, 2020, https://science.howstuffworks.com/transport/flight/modern/concorde.htm. [↑](#endnote-ref-46)
47. Herve Morvan, “André Turcat: The Test Pilot Who Took Concorde Supersonic,” The Conversation, January 6, 2016, accessed September 14, 2020, https://theconversation.com/andre-turcat-the-test-pilot-who-took-concorde-supersonic-52827. [↑](#endnote-ref-47)
48. “747 Commercial Transport/YAL-1,” Boeing, accessed August 5, 2020, www.boeing.com/history/products/747.page. [↑](#endnote-ref-48)
49. “BAC Concorde - Luxury at twice as fast as the speed of sound". BAE Systems Heritage. Accessed January 09, 2021. https://www.baesystems.com/en/heritage/bac-concorde. [↑](#endnote-ref-49)
50. Amir and Weiss, op. cit. [↑](#endnote-ref-50)
51. “Concorde Production and Construction,” op. cit. [↑](#endnote-ref-51)
52. Domini and Chicot, op. cit.; Figure adjusted to represent amount in US dollars in 2019. [↑](#endnote-ref-52)
53. Stephen Dowling, “The Boeing 747: The Plane That Shrank the World,” BBC Future, June 19, 2020, accessed August 5, 2020, www.bbc.com/future/article/20180927-the-boeing-747-the-plane-that-shrank-the-world; Figure adjusted to represent amount in 2020 US dollars. [↑](#endnote-ref-53)
54. “The Concorde Fleet – Breakdown of Each Air Frame Built,” Heritage Concorde, accessed August 5, 2020, www.heritageconcorde.com/airframe-detail. [↑](#endnote-ref-54)
55. Ibid. [↑](#endnote-ref-55)
56. Amir and Weiss, op. cit. [↑](#endnote-ref-56)
57. E. Trubshaw, *Concorde Flight Testing – Powerplant and Performance Flying*, September 1, 1991, accessed August 5, 2020, www.sae.org/publications/technical-papers/content/912192/. [↑](#endnote-ref-57)
58. Dowling, op. cit. [↑](#endnote-ref-58)
59. Stephane Defer, “The Day Concorde Flew into the History Books,” Airbus, March 2, 2019, accessed August 5, 2020, www.airbus.com/newsroom/stories/concorde-day.html. [↑](#endnote-ref-59)
60. International Air Transport Association, *Best Practices Guide: Cabin Interior Retrofits and Entry into Service Program*, February 2019, accessed August 5, 2020, www.iata.org/contentassets/df216feeb8bb4d52a3e16befe9671033/best\_practices\_guide\_cabin\_retrofit\_and\_eis\_ed1.pdf. [↑](#endnote-ref-60)
61. “The Psychology of Comfort in Airplane Interior Design,” Boeing, accessed October 27, 2020, https://boeing.mediaroom.com/2002-03-08-The-Psychology-of-Comfort-in-Airplane-Interior-Design. [↑](#endnote-ref-61)
62. Golnoosh Torkashvand, Lucas Stephane, and Peter Vink, “Aircraft Interior Design and Satisfaction for Different Activities: A New Approach toward Understanding Passenger Experience,” *International Journal of Aviation, Aeronautics, and Aerospace* 62, no. 2 (2019): 1–14. [↑](#endnote-ref-62)
63. “Designers,” Air France, accessed August 5, 2020, https://corporate.airfrance.com/en/designers. [↑](#endnote-ref-63)
64. Benjamin Zhang, “The Concorde Made Its First Supersonic Passenger Flight 40 Years Ago — This Is What It Was Like,” Business Insider, February 14, 2016, accessed August 5, 2020, www.businessinsider.com/concorde-first-supersonic-passenger-flight-2016-2. [↑](#endnote-ref-64)
65. Bramson, op. cit. [↑](#endnote-ref-65)
66. Zhang, op. cit. [↑](#endnote-ref-66)
67. Howard Slutsken, “What It Was Really Like to Fly on Concorde,” CNN Travel, March 1, 2018, accessed August 4, 2020, www.cnn.com/travel/article/concorde-flying-what-was-it-like/index.html. [↑](#endnote-ref-67)
68. Kate Repantis, “Why Hasn’t Commercial Air Travel Gotten Any Faster since the 1960s?,” Slice of MIT, March 19, 2014, accessed August 10, 2020, https://alum.mit.edu/slice/why-hasnt-commercial-air-travel-gotten-any-faster-1960s. [↑](#endnote-ref-68)
69. Jennifer Latson, “Concorde Discord: Insulted Prime Minister Gets Revenge with Airplane,” *Time*, September 26, 2014, accessed August 5, 2020, https://time.com/3398174/concorde/. [↑](#endnote-ref-69)
70. Slutsken, op. cit. [↑](#endnote-ref-70)
71. Ibid. [↑](#endnote-ref-71)
72. Madeleine Morley, “Lawrence Azerrad: With Concorde, There’s This Idea That Design Could Change the Way People Lived,” WePresent, accessed August 11, 2020, https://wepresent.wetransfer.com/story/concorde-lawrence-azerrad/. [↑](#endnote-ref-72)
73. Nicholas Cummins, “Air France’s Pepsi Cola Concorde Could Only Cruise for 20 Minutes,” Simple Flying, October 15, 2019, accessed August 5, 2020, https://simpleflying.com/air-france-pepsi-cola-concorde/. [↑](#endnote-ref-73)
74. “Doctor Who. "Time-Flight: Part One". IDMB, 25 min, 22 March 1982, https://www.imdb.com/title/tt0562979. [↑](#endnote-ref-74)
75. Craig Cote. "Realizing a dedication for avionics through testing & software". Skytracs. December 02, 2020. Accessed January 09, 2021. https://www.skytrac.ca/realizing-a-dedication-for-avionics-through-testing-software/. [↑](#endnote-ref-75)
76. Bramson, op. cit. [↑](#endnote-ref-76)
77. Ibid. [↑](#endnote-ref-77)
78. Jennifer Newton and Bryony Jewell, “Concorde at 50: How Supersonic Passenger Jet with 1,350mph Top Speed and Iconic Nose-Cone Made the World a Smaller Place . . . before Devastating Air-Crash That Killed 113 Chimed Its Death Knell,” *Daily Mail Online*, March 2, 2019, accessed August 5, 2020, www.dailymail.co.uk/news/article-6763597/Fifty-years-Concorde-supersonic-jet-1-350mph-speed-world-smaller-place.html. [↑](#endnote-ref-78)
79. United Press International, “Mum to Ride Concorde,” *Sun Sentinel*, July 28, 1985, accessed August 5, 2020, www.sun-sentinel.com/news/fl-xpm-1985-07-28-8501310669-story.html. [↑](#endnote-ref-79)
80. Michael Rose, “The French President’s Triumphal Tour,” *Maclean’s*, June 8, 1987, accessed August 5, 2020, https://archive.macleans.ca/article/1987/6/8/the-french-presidents-triumphal-tour. [↑](#endnote-ref-80)
81. Jane Levere, “Concorde at 50: What Flying Supersonic Was Really Like,” The Points Guy, March 2, 2019, accessed August 5, 2020, https://thepointsguy.com/news/what-flying-concorde-was-really-like/. [↑](#endnote-ref-81)
82. Bramson, op. cit. [↑](#endnote-ref-82)
83. Morley, op. cit. [↑](#endnote-ref-83)
84. “Concorde Cabin & Passenger Experience,” Heritage Concorde, accessed August 5, 2020, www.heritageconcorde.com/concorde-cabin--passenger-experience. [↑](#endnote-ref-84)
85. Ibid. [↑](#endnote-ref-85)
86. Morley, op. cit., [↑](#endnote-ref-86)
87. Bramson, op. cit. [↑](#endnote-ref-87)
88. Kaplan, op. cit. [↑](#endnote-ref-88)
89. Ibid. [↑](#endnote-ref-89)
90. “Concorde’s Incredible Menu Revealed,” Love Food, February 1, 2018, accessed August 5, 2020, www.lovefood.com/galleries/71814/concordes-incredible-menu-revealed?page=1. [↑](#endnote-ref-90)
91. Ben Walker, “Top Chefs Mourn Passing of Concorde,” The Caterer, October 22, 2003, accessed August 5, 2020, www.thecaterer.com/archive/top-chefs-mourn-passing-of-concorde. [↑](#endnote-ref-91)
92. Mattha Busby, “Michel Roux Sr, Chef Who Reshaped British Cooking, Dies Aged 78,” *Guardian*, March 12, 2020, accessed November 30, 2020, www.theguardian.com/food/2020/mar/12/chef-michel-roux-dies-aged-79. [↑](#endnote-ref-92)
93. “Concorde Cabin & Passenger Experience,” op. cit. [↑](#endnote-ref-93)
94. Ibid. [↑](#endnote-ref-94)
95. Stephen de Sausmarez, “Concorde Cabin Interiors,” Heritage Concorde, 2014, accessed November 30, 2020, www.heritageconcorde.com/concorde-cabin-interiors. [↑](#endnote-ref-95)
96. Ibid. [↑](#endnote-ref-96)
97. Roger Director, “Putman’s Progress,” *New York Times Magazine*, April 16, 2000, accessed August 5, 2020. https://movies2.nytimes.com/library/magazine/specials/041600putmans-progress.1.html. [↑](#endnote-ref-97)
98. Kaplan, op. cit. [↑](#endnote-ref-98)
99. Ibid. [↑](#endnote-ref-99)
100. Bramson, op. cit. [↑](#endnote-ref-100)
101. Morley, op. cit., [↑](#endnote-ref-101)
102. Amanda Petrusich, “The Concorde and the Lost Glories of Commercial Air Travel,” *New Yorker*, October 25, 2018, accessed August 5, 2020, www.newyorker.com/culture/culture-desk/the-concorde-and-the-lost-glories-of-commercial-air-travel. [↑](#endnote-ref-102)
103. Associated Press, “Supersonic Concorde Is King of the Air but Its Status on Bottom Line Is Unclear,” *Los Angeles Times*, December 1, 1987, accessed October 11, 2020, www.latimes.com/archives/la-xpm-1987-12-01-fi-25795-story.html. [↑](#endnote-ref-103)
104. AirMiles were loyalty or reward pointing programs where points could be redeemed against flights with certain airlines. [↑](#endnote-ref-104)
105. “‘My Supersonic Seat Cost £800 of Biscuits,’” BBC News, October 23, 2003, accessed August 5, 2020, http://news.bbc.co.uk/2/hi/uk\_news/magazine/3204699.stm. [↑](#endnote-ref-105)
106. "Thrill of a Lifetime: Season 3, Episode 14". Wikipedia. Accessed January 09, 2021,

     https://en.wikipedia.org/wiki/Thrill\_of\_a\_Lifetime. [↑](#endnote-ref-106)
107. Bramson, op. cit. [↑](#endnote-ref-107)
108. Melanie Trottman, “Concorde’s Allure Has Been Fading amid Gripes about Falling Standards,” *Wall Street Journal*, July 26, 2000, accessed October 11, 2020, www.wsj.com/articles/SB964567408581632185. [↑](#endnote-ref-108)
109. David Hedges, “Concorde Unwrapped: Supersonic Jet Prepared for New Exhibition in Bristol, in Pictures,” *Telegraph*, April 19, 2017, accessed August 5, 2020, www.telegraph.co.uk/news/2017/04/19/concorde-216-prepared-exhibition-aerospace-bristol-pictures/concorde-retired-due-cost-flying-aircraft-standard-cost-one/. [↑](#endnote-ref-109)
110. John Fitzgerald, “Thrill Seekers Pack Last Run of Concorde,” *Globe and Mail*, October 2, 2003, accessed August 5, 2020, www.theglobeandmail.com/news/national/thrill-seekers-pack-last-run-of-concorde/article18431677/. [↑](#endnote-ref-110)
111. Bramson, op. cit. [↑](#endnote-ref-111)
112. Steven Overly, “The Concorde Failed to Change How We Fly, but It Still Could,” *Washington Post*, February 13, 2017, accessed August 5, 2020, www.washingtonpost.com/news/innovations/wp/2017/02/13/the-supersonic-flight-that-never-really-took-off-has-landed-for-good/. [↑](#endnote-ref-112)
113. Bill Sweetman, “Why We Don’t Have an SST,” *Air & Space*, August 2014, accessed August 5, 2020, www.airspacemag.com/flight-today/Search-for-Quiet-SST-180952125/. [↑](#endnote-ref-113)
114. Jerry Ravetz, “Richard Wiggs,” *Independent*, February 26, 2014, accessed August 5, 2020, www.independent.co.uk/news/obituaries/richard-wiggs-9153368.html. [↑](#endnote-ref-114)
115. “Why the SST Took a Nosedive,” *Washington Post*, accessed August 5, 2020, www.washingtonpost.com/archive/lifestyle/1982/07/21/why-the-sst-took-a-nosedive/eb2f66ec-d672-49ef-beb1-d125dd90c721/. [↑](#endnote-ref-115)
116. Frances Drake and Martin Purvis, “The Effect of Supersonic Transports on the Global Environment: A Debate Revisited,” *Science, Technology, & Human Values* 26, no. 4 (Autumn 2001): 501–528. [↑](#endnote-ref-116)
117. “Concorde Orders and Options,” Heritage Concorde, accessed August 5, 2020, www.heritageconcorde.com/concorde-orders-and-options. [↑](#endnote-ref-117)
118. Michael Jensen “Huge Lobbying and Legal Drive Being Pressed for the Concorde,” *New York Times*, May 10, 1977, accessed August 5, 2020, www.nytimes.com/1977/05/10/archives/huge-lobbying-and-legal-drive-being-pressed-for-the-concorde.html. [↑](#endnote-ref-118)
119. “Nixon Views Concorde, Expects Similar U.S Jet,” *New York Times*, December 15, 1971, accessed September 11, 2020, www.nytimes.com/1971/12/15/archives/nixon-views-concorde-expects-similar-us-jet.html. [↑](#endnote-ref-119)
120. Regina Nadelson, “The Concorde at 10,” *Washington Post*, May 18, 1986, accessed August 5, 2020, www.washingtonpost.com/archive/lifestyle/travel/1986/05/18/the-concorde-at-10/e863a4f6-0e6d-4fa8-8c8e-a8dfed3a50c1/. [↑](#endnote-ref-120)
121. Giles Hewitt, “Concorde Foes Cheer End to the Sonic Boom,” ABC, April 15, 2003, accessed July 29, 2020, www.abc.net.au/science/articles/2003/04/15/832052.htm?site=12science&topic=enviro. [↑](#endnote-ref-121)
122. Ibid. [↑](#endnote-ref-122)
123. Alan Riding, “The Concorde Crash: The Overview; 113 Die in First Crash of a Concorde,” *New York Times*, July 26, 2000, accessed August 5, 2020, www.nytimes.com/2000/07/26/world/the-concorde-crash-the-overview-113-die-in-first-crash-of-a-concorde.html. [↑](#endnote-ref-123)
124. Roger Forsgren, *The Concorde Accident: A Case Study* (NASA, February 2019). [↑](#endnote-ref-124)
125. Ibid. [↑](#endnote-ref-125)
126. Ibid. [↑](#endnote-ref-126)
127. Kristina Udice, “10 Ways the World Changed after the 9/11 Attacks,” Insider, September 10, 2018, accessed August 5, 2020, www.insider.com/world-changed-after-september-11-2018-9. [↑](#endnote-ref-127)
128. David E. Clark, James M. McGibany, and Adam Myers, “The Effects of 9/11 on the Airline Travel Industry,” in *The Impact of 9/11 on Business and Economics: The Day that Changed Everything*, ed. M.J. Morgan (New York: Palgrave Macmillan, 2009). [↑](#endnote-ref-128)
129. Ibid. [↑](#endnote-ref-129)
130. Emma Lake and Sam Webb, “Iconic Aircraft Grounded: Why Did Concorde Stop Flying, When Was It Retired from Service and How Fast Did It Fly?,” *Sun*, January 16 2020, accessed August 6, 2020, www.thesun.co.uk/tech/2203042/concorde-stop-flying-where-displayed/. [↑](#endnote-ref-130)
131. Slotnick, op. cit. [↑](#endnote-ref-131)
132. Greg Retsinas, “Near the End, It’s Mach for the Masses; Rushing to Ride Concorde before Its Retirement,” *New York Times*, April 17, 2003, accessed August 5, 2020, www.nytimes.com/2003/04/17/nyregion/near-end-it-s-mach-for-masses-rushing-ride-concorde-before-its-retirement.html. [↑](#endnote-ref-132)
133. Slotnick, op. cit. [↑](#endnote-ref-133)
134. “End of an Era for Concorde,” BBC News, October 24, 2003, accessed August 5, 2020, http://news.bbc.co.uk/2/hi/uk\_news/3211053.stm. [↑](#endnote-ref-134)
135. Ibid. [↑](#endnote-ref-135)
136. Slutsken, op. cit. [↑](#endnote-ref-136)
137. Matt Falcus, “Where to See Concorde,” Airport Spotting, November 17, 2017, accessed August 5, 2020, www.airportspotting.com/concorde/. [↑](#endnote-ref-137)
138. Ibid. [↑](#endnote-ref-138)
139. “Who Are We?,” Club Concorde, accessed August 5, 2020, www.clubconcorde.co.uk/who-are-we/. [↑](#endnote-ref-139)
140. Zara Whelan, “There’s a Massive Party Happening under the Wings of a Concorde at Manchester Airport,” *Manchester Evening News*, February 11, 2020, accessed August 5, 2020, www.manchestereveningnews.co.uk/whats-on/music-nightlife-news/theres-massive-party-happening-under-17728544. [↑](#endnote-ref-140)
141. £ = GBP = British pound sterling; US$1 = £0.6419 on January 1, 2015; “Weddings on Concorde,” Brooklands Museum,” accessed August 5, 2020, www.brooklandsmuseum.com/concorde/concorde-events/weddings-on-concorde. [↑](#endnote-ref-141)
142. Tom Chitty, “In Pictures: Here Are the Planes Being Built to Bring Back Supersonic Travel,” CNBC, January 21, 2019, accessed August 05 2020, www.cnbc.com/2019/01/18/boeing-boom-aerion-bring-back-supersonic-travel.html. [↑](#endnote-ref-142)
143. Ibid. [↑](#endnote-ref-143)
144. Samantha Elkan, “The Influence of Environmental Brand Activism on Millennial Environmental Consumer Behavior,” (undergraduate honours thesis, University of Colorado Boulder, 2018). [↑](#endnote-ref-144)
145. “Air Travel and Climate Change,” David Suzuki Foundation, accessed March 18, 2020, https://davidsuzuki.org/what-you-can-do/air-travel-climate-change/. [↑](#endnote-ref-145)
146. Dan Rutherford, Brandon Graver, and Chen Chen, “Noise and Climate Impacts of an Unconstrained Commercial Supersonic Network” (working paper, The International Council on Clean Transportation, January 30, 2019), accessed August 05 2020, https://theicct.org/publications/noise-climate-impacts-unconstrained-supersonics. [↑](#endnote-ref-146)
147. Lawrence R. Benson, *Quieting the Boom: The Shaped Sonic Boom Demonstrator and the Quest for Quiet Supersonic Flight* (Washington, DC: National Aeronautics and Space Administration, 2013). [↑](#endnote-ref-147)
148. Kamlet, op. cit. [↑](#endnote-ref-148)
149. Gwyn Topham, “Richard Branson: ‘Aviation Can Be Carbon Neutral Sooner Than We Realise,’” *Guardian*, October 26, 2019, accessed October 11, 2020, www.theguardian.com/business/2019/oct/26/richard-branson-aviation-can-be-carbon-neutral-sooner-than-we-realise. [↑](#endnote-ref-149)
150. International Civil Aviation Organization, *Effects of Novel Coronavirus (COVID-19) on Civil Aviation: Economic Impact Analysis*, July 29, 2020, Accessed August 21, 2020. www.icao.int/sustainability/Documents/COVID-19/ICAO\_Coronavirus\_Econ\_Impact.pdf. [↑](#endnote-ref-150)
151. “How Much Revenue of Airlines’ Revenue Comes from Business Travelers,” Investopedia, July 15, 2019, accessed August 5, 2020, www.investopedia.com/ask/answers/041315/how-much-revenue-airline-industry-comes-business-travelers-compared-leisuretravelers.asp. [↑](#endnote-ref-151)