Airbus A220 – A Game-Changer

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Abstract

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The purpose of this thesis is to discuss and analyze if indeed the Airbus A220 is a game-changer within the aviation industry. To determine this, interviews were conducted with airBaltic, Scott Hamilton and Petter Hörnfeldt. Moreover, Hamilton's book was also used. Online research was used specifically from Hörnfeldt's YouTube channel. Online information from Boeing, Airbus, Pratt & Whitney etc. was researched.

It is to be noted that any corporate materials provide the background coupled with marketing spins on information therefore selective reading and critical thinking was needed to cross-reference information. Also, the annual reports also highlighted the facts, especially in the CEO year-in-review report included in an annual report.

This study´s findings reveal both the benefits and potential drawbacks of the A220, offering valuable insights for airlines evaluating similar fleet choices. The analysis emphasizes the A220´s role in airBaltic´s modernization strategy and highlights its influence on broader industry trends, especially as airlines increasingly focus on fuel-efficient and environmentally sustainable solutions.

It can be concluded that the A220 is indeed a game changer for its specific regional usage e.g. European destinations. Moreover, as a case-study, the decision for airBaltic to opt to use the A220-300 exclusively was a good decision for them. That said, the SWOT analysis does highlight some hurdles, but airBaltic has taken these into consideration. Customer feedback is remarkable about the A220 and its low environmental footprint. The question remains, will the A220 be viable in 10-20 years with technology moving fast and stricter environmental standards being put on airlines.

Key words
A220, Airbus, Boeing, Bombardier, Embraer, Pratt & Whitney

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1 Introduction

The Airbus 220 (A220) is arguably and considered to be the best current plane in its class available today with its modern avionics, fuel efficiency, passenger comfort and environmental performance. That said, this thesis will explore the validity of this outstanding modern aircraft by objectively providing insights through interviews and facts. Determining whether the A220 is indeed a 'game changer' involves considering various factors such as performance, economics, delivery and versatility.

The thesis will encompass an introduction to the A220, the history behind the development of the aircraft, the materials used and why the surge in popularity among low-cost carriers (LCC) and regional airlines. Moreover, this thesis will incorporate interviews conducted with senior pilots who currently fly the A220. The thesis has also reached out to **Scott Hamilton** a former commercial pilot, founder and editor of Leeham News and Analysis with over 30 years of experience reporting on the aviation industry. He is the author of the well-received book *Air Wars: The Global Combat between Airbus and Boeing* (2021).

Another contributor to this thesis, through interviews, is **Petter Hörnfeldt**, commercial pilot and host/owner of Mentour Pilot with two million subscribers on his social media network.

The thesis will also discuss the current situation between the duopoly Boeing and Airbus Industries. As such, politics do indeed impact businesses directly and indirectly. Currently, Boeing is going through some turbulent times due to alleged poor management, whistle-blowers and tragedies. It is notable that both Boeing and Airbus rely heavily on a supplier network and some of these outsourced suppliers provide parts to both aviation giants. In an attempt to understand strategies, the thesis will focus on the success of airBaltic and its decision to phase out its fleet of Fokkers and Boeings and adopt a single type of plane, specifically the A220-300. Again, through interviews, articles, news and

various other sources the thesis will try to explain and highlight why these decisions enhanced air-Baltic's operations and profile in a very competitive and evolving market.

Thesis Questions	**Knowledge-based and result-based. (Chapter)**	**Pages**
How did the Airbus A220 become what it is today?	2, 6	3, 4, 12, 13
How is the competition between Airbus and Boeing?	3, 5	6, 7, 8, 10, 11
What are the pros and cons? (Case Study)	7, 8	16, 17, 18, 19, 20

2 The C-Series by Bombardier

Bombardier, a Canadian company based in Quebec initially began developing snowmobiles and watercrafts (Ski Doo and Sea Doo brands respectively). Over the years it expanded to trains and trams and eventually to the sky. Through its expansion program and acquisitions, it entered the aerospace industry in the 1980s. Its main focus was the development of business jets (Learjet) and regional aircraft. (Bombardier s.a.)

The C-Series was launched in 2008, offering the economics, performance, environmental and passenger-oriented improvements. It is to be noted that the C-Series plane was what is known as a 'clean sheet' design and prototype plane. Clean sheet refers to that it is not an existing plane that has been refitted and repurposed, it is a brand-new design and concept which is a very expensive endeavor for any plane producer. The first flight of a C-Series aircraft took place in 2013. (Bombardier s.a.)

Lufthansa Group was the first carrier to show interest, ordering up to 60 aircraft. Bombardier's largest C-Series order came from Delta Airlines in 2016; an order for 75 firm CS100 aircraft with options for 50 more CS100 aircraft. In the fall of 2017, Bombardier announced a partnership with Airbus on the C-Series aircraft program. (Bombardier s.a.)

2.1 The sale of the C-Series – Economic, Political and Fair Trade

The C-Series became the subject of international trade disputes. The United States levied a 219% duty on C-Series imports after Boeing complained to the US Department of Commerce (DOC) that Bombardier had sold the planes to Delta Airlines at an unfair advantage because Bombardier received Canadian government subsidies **for** the C-Series.

In October 2017, Airbus announced that they had acquired a majority stake in the C-Series program. In the deal, an Airbus plant in Mobile, Alabama, was expanded to accommodate for C-Series assembly, which circumvented the large duty (219%) levied by the US Department of Commerce. Program headquarters remained in Montreal and Airbus was given the opportunity to buy the remaining stake in the program from Bombardier. That said, the provincial government of Quebec still maintains a 25% interest in the C-Series. Subsequently, Airbus renamed the C-Series to A220.

2.2 A missed Opportunity by Boeing and why

Boeing's decision not to acquire the C-Series was influenced by a complex mix of strategic priorities, financial considerations, competitive dynamics, and operational challenges. Management at

Boeing considered the fact that they already had a narrow-body aircraft i.e. the 737 and thus the C-Series would cause large financial commitments and internal competition within the already established 737 product line fleet. Also, at that time tremendous amounts of resources had been concentrated on the 737 Max. Bombardier had their own financial turmoil which Boeing considered too high a risk threshold to seriously acquire the C-Series program.

According to **Scott Hamilton**, author of *Air Wars-The Global Combat Between Airbus and Boeing,* his opinion is structured and straight forward.

“Boeing is a mess. Beginning with the rugged B-17 and the technological marvel, the B-29, in World War II, Boeing became the gold standard of commercial aviation. The development of the 707 eventually enabled Boeing to leapfrog over the Douglas Aircraft Corp., designers of the fabled DC-3 and post-war DC-6, the most successful piston airliner ever.”

Boeing dominated the jet age through the Douglas decline and takeover by the McDonnell Corp, creating McDonnell Douglas. Hamilton continues, “But McDonnell never understood civil aviation and its commercial aircraft business withered on the vine.”

“This led Boeing to completely misjudge the threat Airbus presented, when the consortium was formed in 1970. In a way, Boeing can’t be blamed. Europe’s commercial aviation industry developed airplanes for their markets, not a global market. Even Airbus’ first aircraft, the A300B2, was a mediocre airplane (it entered service in 1974). The following derivatives, including the shorter A310, simply didn’t compete effectively with Boeing’s 767.”

“Even development of the A320 didn’t wake up Boeing. Again, in a way, it couldn’t be blamed. Even Airbus thought it would sell only 600 of its A320s over the lifetime of the program. It wasn’t until 1992—a full 22 years after Airbus was created—that Boeing recognized the threat when United Airlines, at the time an exclusive Boeing customer, ordered the A320,” he notes.

Airbus eventually developed a full line of aircraft. **Ray Conner**, a retired CEO of Boeing Commercial Airplanes, said it best (2015 interview with The Seattle Times). “Boeing never had had to compete with a full family of airplanes before. Boeing clearly didn’t know how to do so.” By this Conner meant that Boeing had never faced serious competition, especially one like Airbus with a large portfolio of aircraft on offer to compete directly with Boeing.

Hamilton continues, “Today’s competition may be summed up this way: Boeing, with its emphasis on shareholder value, failed to invest in new products since the 1997 merger with McDonnell Douglas, except for the Boeing 787—a program it proceeded to royally screw up. Airbus continued

to pour money into research and development. The A380 was new (though a financial and market mistake), and after a false start, so was the A350. Its derivatives of the A330 and A320 (especially the A321) added value and capabilities to these airplanes. Boeing's derivatives of the 757 and 767 (the -300 and -400 models, respectively) were sales duds. So was the final derivative of the 747, the 747-8," he highlights.

"While Boeing rested on its achievements, Airbus aggressively went after Boeing customers. Launching the A320neo family enabled Airbus to win an order from American Airlines (another exclusive Boeing operator), which forced Boeing to re-engine the 737 rather than produce a new airplane. Boeing's emphasis on cost-cutting and cost control hurt R&D and eliminated a lot of institutional knowledge in engineering and production. This led to where we are today," Hamilton notes. (Hamilton Interview; Hamilton 2021, 38-52)

3 Overview of Boeing, and Airbus

Both Boeing and Airbus offer the civil aviation industry a varied host of aircraft to cater to the general aviation industry. As industry giants, these two companies obviously have their own strategies in a very competitive market. Besides the market pull and push demand fluctuations i.e. a smaller plane e.g. the Boeing 787 Dreamliner versus a giant, the Airbus A380 (very expensive to build, with huge cost overruns), they do have a common objective to deliver the most fuel-efficient, technologically advanced aircraft with the least amount of environmental footprint or impact. (Finnish-American Chamber of Commerce, Headline magazine 2009.)

Over 15 years ago in 2009, Boeing's then VP Sales – Europe & Central Asia, **Marlin Dailey** said to the Finnish-American Chamber of Commerce, Headline magazine, "Our strategy currently is to focus on mid to long haul commercial planes and this the 787 Dreamliner delivers with fuel efficiency and advanced composite technology versus competitors who have chosen to invest in very large capacity aircraft." As such he obviously was referring to Airbus A380 which ended production in 2021. (Finnish-American Chamber of Commerce, Headline magazine 2009.)

3.1 Profiles and Competition

Boeing was founded in the US in 1916 whereas Airbus was established in 1970 in France. As noted previously competition is fierce because each aircraft produced has a direct competitor between the two manufacturing giants. That said, both companies rely on numerous suppliers worldwide for the various components. (CNBC 2024.)

A good example is Spirit AeroSystems which supplies wings and fuselage to several Airbus and Boeing planes. It should be highlighted that Spirit AeroSystems (through a complex web of mergers and acquisitions) was owned by Boeing. The company was divested in 2005 from Boeing, but continued as a supplier. In March 2024 Boeing announced it will buy back Spirit AeroSystems to ensure quality and increase delivery times. (CNBC 2024.)

3.2 Direct Competition, Deliveries, and Game-Changers

In the single-aisle aircraft, the Airbus A320 competes directly with the Boeing 737 for short and medium-haul travel. The Airbus A220 competes with Boeing 737 Max 8 and to a lesser degree with the smaller four-abreast (2 x 2 seating) Embraer E195 and E190.

It should be noted that the Boeing 737 Max was grounded in late 2019 after the Lion Air Flight 610 and Ethiopian Airlines Flight 302 plane crashes. Moreover, although having been re-certified by the

Federal Aviation Administration (FAA) in 2020 there have been other issues plaguing Boeing's 737 Max portfolio such as the Air Alaska Flight 1282 incident in early 2024 where a door plug blew out.

As of August 2024, a total of 912 Airbus A220s had been ordered of which 342 had been delivered and were all in commercial service with 21 operators (Airbus Communications 2024).

Game-changers

Douglas DC-3 introduced in 1935, is highlighted and considered a pillar in modern aviation. This was due to its low maintenance and reliability as a transport plane. Moreover, with a passenger capacity of 21-32 (or 3,770 kg), it could provide regular and consistent service to destinations within a 1,500 mi (2400 km) mile range.

Boeing 707 introduced in 1958 was the beginning of the jet engine era. The plane changed the landscape of flying by access to destinations faster with its four turbojet engines at speeds of 600 mph (966 km/h). With its passenger capacity of 140-198 and range of over 10,000 km thus bringing the world closer.

Boeing 747 introduced in 1969, often referred to as the jumbo jet with its hump (two floors) on the nose of the fuselage. It was the first widebody jet (double rows) with a passenger capacity of 400-600 (depending on configuration). The 747 introduced long-distance travel at more affordable prices. It could remain airborne for 14-16 hours before refueling and covered a distance of 9200 mi (14,800 km). Currently production is limited and only as a cargo plane

Concorde introduced in 1976 was the age of supersonic travel. London (or Paris) to New York (2.50-3.30 hours). With a maximum passenger capacity of 100 passengers, the Concorde reached speeds of Mach 2 (1,350 mph or 2,180 km/h) with a range of 4,150 mi (6,600 km). Only British Airways and Air France operated the Concorde due to high operational costs. The Concorde was retired in 2003 after 27 years of service. New supersonic jets are currently being designed and tested for the future.

Airbus A320 introduced in 1988, adopted the advanced technology of fly-by-wire (sophisticated avionics reading pilot inputs). This new technology made flying safer and more efficient.

Boeing 777 introduced in 1995 was the first computer designed commercial aircraft. Its medium and long-range capabilities made this plane a desirable investment for larger airline companies. Its passenger capacity is 396.

Airbus A380 (on list due to its size and capacity) introduced in 2007, known as the double-decker is the largest passenger plane in the world. It can carry up to 850 passengers in an all-economy

configuration. Although its advanced engineering it has forced airports to reconfigure and invest in boarding access ramps. Several A380s have been retired and production by Airbus ended in 2021. For it to be profitable for an airline, every seat needs to be occupied.

Boeing 787 Dreamliner introduced in 2011 is made of composite materials (lighter) contributing to a more fuel-efficient plane. The Dreamliner gave passengers larger windows and lower cabin altitude providing a more comfortable travel experience.

Airbus A220 introduced in 2018, however was in service since 2016 as Bombardier C-Series. This single aisle plane is very popular due to its modern avionics, fuel efficiency, lower environmental impact, passenger comfort, lower operating costs and airline economics.

(Hamilton 2021, 130-138)

4 Suppliers, Materials, and Assembly

The Airbus A220 utilizes advanced materials to optimize strength, weight and durability of its fuselage, wings and other components. As such, the A220 relies on suppliers across the globe. The use of advanced materials such as carbon fiber, aluminum-lithium alloys, titanium and composite materials in the A220 enhances its efficiency, performance, durability and environmental sustainability.

4.1 Wings

The wings on the A220 are made from carbon fiber reinforced polymer (CFRP) which provides excellent strength-to-weight ratio and its resistance to fatigue and corrosion. Moreover, the use of CFRP helps in reducing the overall weight of the aircraft resulting in enhanced fuel efficiency. The wings are made in Belfast, Ireland by SpiritAero Systems.

4.2 Fuselage

The fuselage primarily comprises advanced aluminum-lithium alloys. These alloys are lighter than conventional aluminum and offer better resistance to corrosion and fatigue which directly contributes the A220s performance and durability. That said, certain sections of the fuselage and specific components also use composite materials to further reduce weight while maintaining the structural integrity of the A220.

4.3 Strengthening the Model

Titanium is used in areas that are subject to high stress or needed to withstand high temperatures, and resist corrosion. Advanced alloys and composites are used in structural and non-structural parts to optimize weight, strength, and durability in the A220.

5 Blindsided or Poor Judgement

Boeing and its missed opportunity to acquire the C-Series from Bombardier is highlighted by **Petter Hörnfeldt**, a commercial pilot and producer of content for his multimedia platform, Mentour Pilot, with over two million subscribers across his social media network. Hörnfeldt describes what the airline market would look like today had the C-Series become a Boeing 797 instead of the Airbus A220.

“To summarize briefly, Bombardier designed and built a clean-sheet aircraft called the C-Series, Boeing made a trade complaint about price (jet) dumping and subsides which led Bombardier to join forces with Airbus who acquired the aircraft known today as the A220.” According to Hörnfeldt, this concise version of events does not reveal the missed opportunity for Boeing. He believes that it would have been easier for Boeing to absorb the C-Series into its own portfolio of aircraft because of the mostly US-based supply chain than it was for Airbus.

5.1 Delta Force

While Boeing focused on promoting and sales of the 737 Max, Hörnfeldt fast forwards to April 2016 when Boeing was shocked to learn that Delta Airlines had entered into an agreement for the purchase of 75 Bombardier CS100 (today the A220-100), with an option for an additional 50 planes to revamp their aging fleet of short to mid-haul planes. (Hörnfeldt interview)

The CS100 would save Delta Airlines more than 25% in efficiency due to the modern avionics, advanced lightweight materials coupled with the PW1500G engines used in the C-Series. (Hörnfeldt interview)

The order from Delta Airlines to Bombardier propelled Boeing into action. “Boeing was shocked by this because they had been hoping to get that order for Delta Airlines for their 737 Maxes. Boeing reacted extremely strongly and immediately they filed a complaint with the U.S International Trade Commission (USITC) accusing Bombardier of price dumping meaning that it was selling the aircraft at a loss the complaint also claimed that the Canadian authorities had subsidized the program illegally,” Hörnfeldt highlights. (Hörnfeldt interview)

5.2 Quid Pro Quo

It should be noted that, according to Hörnfeldt, it is not uncommon for early sales of brand-new designs to be deeply discounted especially when it comes to large orders from key customers like for example in the case of your very first US customer. Penetrating the US airlines with a successful

clean-sheet plane provides a solid and lucrative marketing platform for future sales. (Hörnfeldt interview)

“Boeing’s gamble did not kill off the deal because Bombardier’s C-Series’ only avenue was joining up with Airbus who expanded their Mobile, Alabama assembly facility to include the A220 and thus the 219% tariffs levied at them by the USITC were overturned. “ (Hörnfeldt interview)

6 Supporting Communities

The Canadian government invested in the C-Series, besides being a Canadian company providing local employment, was because it identified the increased need to service remote communities in the large Canadian landscape. The C-Series, due to its configuration suited the transportation needs throughout Canada and the aircraft could land and take-off on short runways, therefore very little new investments in infrastructure was needed at regional airports. (Hörnfeldt interview)

“An important design aspect of the C-Series was its wings. Bombardier had designed the wing with a future fuselage stretch in mind this longer model than called the CS500 is now referred to as the Airbus A220-500 and is able to compete directly with the Boeing 737 Max 8.” says Hörnfeldt. (Hörnfeldt interview)

6.1 Rebranding A220 Portfolio

According to a recent interview with Airbus’s CCO **Christian Scherer,** suggested that the longer A220 variant would actually be named the A221, suggesting that the entire A220 family will be re-named. (The Air Current 2022.)

So, the A220-100 would probably be called the A219, the A220-300 would be called the A220 and the bigger variant (A220-500) would be the A221, "mirroring" the naming convention of the A320 family. Moreover, Scherer would also like to include CFM International (engine supplier) to offer alongside the PW1500G engines on the A220’s as a future option to customers. It should be noted that there have been issues with the PW1500G, specifically supply parts and maintenance. (The Air Current 2022.)

6.2 Missed Opportunity

“Boeing miscalculated the potential of this aircraft very badly and today Breeze Airways (ordered 90 A220s, so far 24 delivered) is even talking to Airbus about adding extra fuel tanks to its Airbus A220-300s to give the plane a 4,000 nautical mile range enough for flights from the US to South America or even to Europe and for Boeing this is not just a miscalculation it is very much a lost opportunity,” Hörnfeldt notes.

Airbus reportedly did not have to pay any cash or assume any debt in the Bombardier deal, at least not for its initial of 50.1% controlling stake but of course the European manufacturer did have to invest in other ways by for example setting up and expanding its assembly production line in Mobile, Alabama to include the C-Series.

“Later in 2020 Airbus then acquired the remaining 25% of Bombardier's stake in the program and continued to invest even more into its building infrastructure but if you compare these costs with what it would cost to develop and certify a clean-sheet design of this quality well then Airbus basically got the C-Series for nothing and if Boeing had hoped that duties and tariffs would keep the aircraft away from the U.S market it was also sadly mistaken because in February 2018 the USITC reversed its previous decision agreeing that there was no threat to the U.S aviation industry from the C-Series.”

This was a strategically smart business move by Airbus to eliminate the alleged threat (219% tariffs) on the CSeries/A220 to the continental US for part of its assembly process.

The provincial government of Quebec still retains a 25% share of A220 program and recently (July 23, 2024, Bloomberg), it will make a new investment of “several hundred million dollars” to help Airbus SE ramp up production of its narrow-body aircraft in the Canadian province, bringing its total outlay to more than US$1.5 billion.

6.3 Market Cannibalization

With the success of the A220 fleet, especially the A220-300, sales of the A319 Neo, which have somewhat low orders and even the A320 Neo are getting only a fraction of the orders than forecast or anticipated, could mean the decline of these models.

“Airbus could easily launch the longer A220-500 which would completely sideline the A320 Neo but with Boeing announcing that it will not develop any new aircraft soon, Airbus has no real reason to hurry. It is also worth pointing out that even though the A220 is an awesome aircraft with quite a significant sales and order track record, Airbus has been struggling to make it as profitable as the rest of the single aisle aircraft,” says Hörnfeldt.

Table 1. Airbus A220 Orders October 2024 (Airbus 2024)

Airbus A220 Orders October 2024	A220-100	A220-300
Air Austral		3
Air Baltic		90
Air Canada		60

Air France		60
Air Lease Corporation (ALC)	9	67
Air Nuigini	6	
Air Tanzania		4
Air Vanuatu	2	1
Aviation Capital Group (ACG)		20
Azorra Aviation		22
Breeze Airways		90
Carlyle Aviation Partners		1
Comlux	2	
Croatia Airlines		6
Delta Airlines	45	100
Egyptair		12
GTLK		6
Ibom Air		10
Ilyushin Finance co.		14
Iraqi Airways		5
ITA Airways	7	
JetBlue		100
Korean Airlines		10
Lufthansa		40

Macquarie Financial Holdings		26
Nordic Aviation Capital (NAC)		8
Odyssey	10	
Qantas		29
SWISS	9	21
Govt, Executive & Private Jets	7	2
Undisclosed		8
Total	97	815
Overall Total	912	

7 airBaltic – we deliver, we care, we grow

Globally, airBaltic is the largest commercial airline utilizing exclusively the A220-300 planes. The current fleet is 49 planes, with a strategic goal of having 100 A220-300 in their fleet by 2030. During 2023/24 fiscal years, airBaltic has surged in popularity (and revenues) and increased its destinations to over 70 mostly in the Baltics, Europe, Middle East and northern Africa. (airBaltic 2024.)

As a company, the strategic decision for airBaltic to acquire the A220-300 as their single fleet of planes was to simplify operations and operational costs. This meant pilots and cabin crew could focus all training on a single aircraft model. This also simplified the workload and expertise needed solely on the A220-300. (airBaltic 2024.)

Besides the modern fleet, airBaltic has received very good feedback from customers. The single aisle planes with larger overhead luggage bins and larger windows coupled with more leg-room certainly makes the A220-300 an ideal plane to own and operate. (airBaltic 2024.)

7.1 Starlink

The company under the leadership of **Martin Gauss**, opted to be the first airline to work with SpaceX (an Elon Musk company) and its Starlink's satellite internet constellation. What makes this relationship unique and customer focused is that one can stream a movie or make a WhatsApp call free of charge onboard airBaltic and without sign-up. Upgrades and offerings to customers like this enhance the airBaltic experience onboard positively.

7.2 The Future and Issues

On June 27, 2024, airBaltic CEO Martin Gauss gave an interview to Aviation Week discussing durability issues with the PW1500G engines and the future possible initial public offering (IPO) of the airline. If the IPO goes through, new equity raised could be used to obtain more planes. (Shay June 27, 2024)

Although airBaltic has seen a second consecutive record year of revenue, the planes have suffered due to engine problems. "The engine generates a 30% reduction in fuel emissions, but unfortunately all these savings are offset by higher maintenance costs, which means you have a net gain of zero at the end," Gauss says. (Shay June 27, 2024)

Gauss explains that PW forecasts airBaltic will be missing 36 engines during its winter flying season because parts are not available for maintenance, repairs and overhaul (MRO). "We have a very close contact with PW and unfortunately they also do not see this going away within the next two years," says Gauss. (Shay June 27, 2024)

So far, airBaltic has been able to keep the PW1500G engines on-wing during its busy summer season, so the downtime is limited to the slower winter months. “On the bright side is that time on-wing is improving. The PW1500G engines started off only staying on-wing for 150 hr. due to the combustion/heat exchanger problem, which has been corrected. Its average, however, is 2,200 hr. on-wing due to lingering problems, including contaminated powdered metal,” Gauss notes. (Shay June 27, 2024)

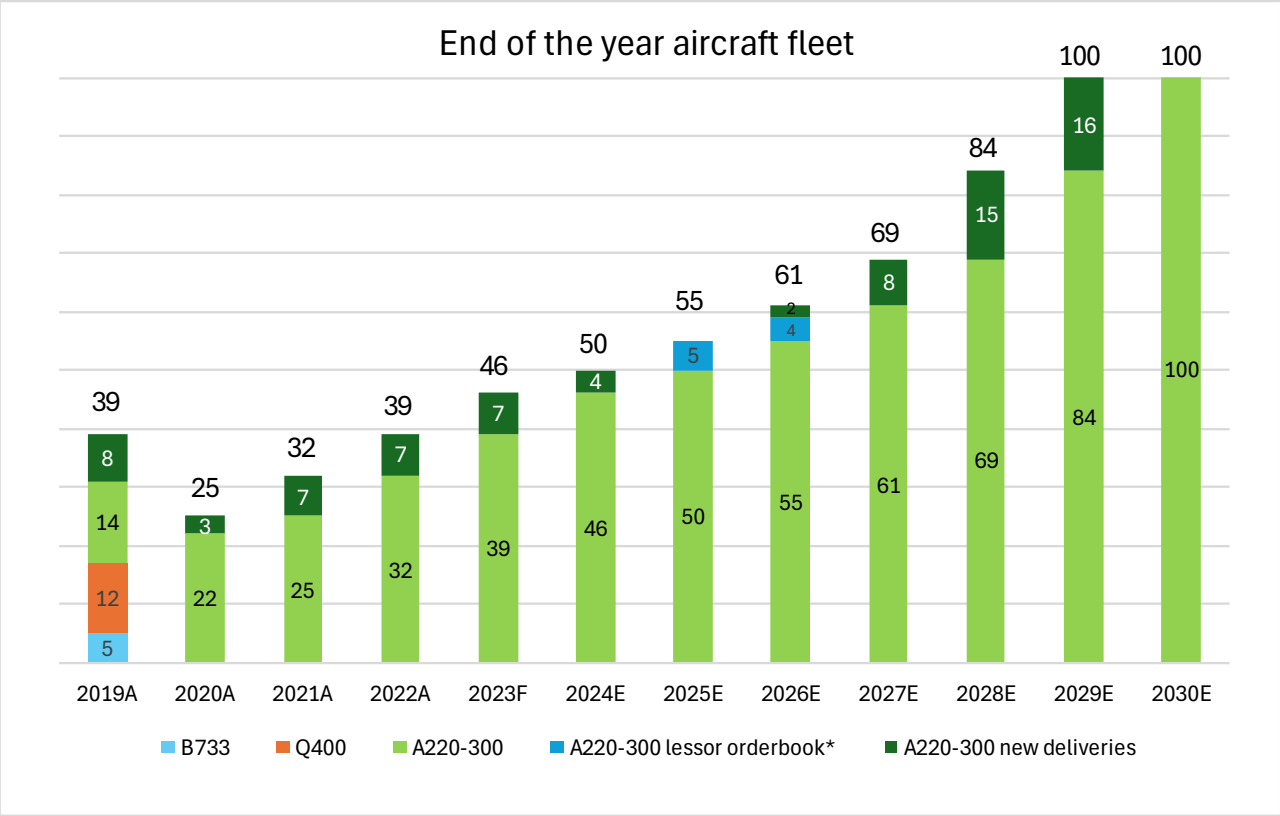

Figure 1. airBaltic’s fleet history and future

8 SWOT on airBaltic (Case-Study)

Based on interviews, clearly the A220 serves a niche market within the aviation industry. Fundamentally it is a perfect plane that is optimized for the short/medium haul routes e.g. Europe, continental USA etc. As such, the A220-100 and -300 models carry around 100-160 pax which is ideal for domestic and international markets. This is supported by efficiency and advanced avionics and comfort.

The A220 meets e.g. airBaltic´s ambition to streamline its operational commitments and increase efficiency. The standardized fleet reduces maintenance costs, the need to source parts for various plane types from multiple manufacturers, trainings staff and logistics support. With these factors it leads to economies of scale and provides operational flexibility coupled with sustainability goals.

The objective of this SWOT analysis is for any airline that opts to have a single plane/type fleet. airBaltic is a prime example, trying to increase their strengths, identify possible weaknesses, seize opportunities and thwart any threats. As a case-study, currently airBaltic, based on its good revenues (possible IPO second half 2024), modern fleet with low emissions coupled with increased offering of destinations, brand recognition and customer approval ratings, is doing well. In sum it is on a very solid and good trajectory upwards so far.

That said, like with most things, nothing is perfect and there is always room for improvement, no matter how well we try. Moreover, unforeseen circumstances, pandemics and political insecurity, always should be on the radar. Financial downturns can be predicted but how far and how severe that is uncertain. Competition is always knocking on everyone’s proverbial ‘back door’. However, due to airBaltic’s home in Latvia, it certainly fulfills the Baltic nation’s needs. Finally, airBaltic should reap the benefits and take advantage of opportunities that it has worked hard to establish.

8.1 Strengths

As a case-study, currently airBaltic has the youngest fleet of planes contributing to good revenues since they are fuel-efficient with less of a carbon footprint, meet and even exceed current environmental standards and provide positive customer comfort. Moreover, the implementation of Starlink will add to the customer care and experience.

Based in Latvia, airBaltic’s location is well positioned to service European destinations and in the future to the East and Russia (once political changes occur). The company has a fresh brand (colors) which blends well with its modern fleet and customer service. These aspects certainly contribute to customer loyalty and recognition. Currently airBaltic is 97.97% government owned which provides a certain financial stability and sustainability.

- Modern and fresh fleet
- Fuel efficiency
- Customer satisfaction and loyalty
- Brand recognition
- Geographic location
- Government support

8.2 Weaknesses

It has become clear that due to the single option of the PW1500G engine for the A220 there have serious delays in maintenance, repairs and overhaul (MRO) resulting in planes being grounded until a replacement engine can be installed or current one fixed serviced or maintained. Due to the advanced technology, these engines have required more frequent MRO (Maintenance, repair and operations) than anticipated.

Limitations of the airBaltic A220-300 fleet are that they are not long-haul planes. Another immediate identifiable weakness is that airBaltic has to rely on European destinations for the most part and there is fierce competition by other carriers. Moreover, the investments made for the purchase of this new and modern fleet is considered a high investment which affects profits. Finally, to make a profit these planes should be full of paying customers, and this is probably achievable only during the peak tourist seasons.

- Short-medium haul flights
- Repayment on investment of fleet
- Competition from other European carriers
- Seasonal demand

8.3 Opportunities

As airBaltic’s evolves the opportunities increase, besides the strengths listed above. It can expand its current portfolio of approx. 70 destinations to lesser travelled destinations. And this can be achieved by either investing in longer haul planes (unlikely for now) or continue developing its alliances and code sharing partnerships which expands its current portfolio of destinations.

Customers are becoming more environmentally conscious, and this is where airBaltic shines with its modern fleet. This is an opportunity to emphasis its environmental stewardship compared to competitors. Technology is constantly on the move, and airBaltic (done so with Starlink) can continue to expand on this, creating a better customer experience. Capture market share from competitors.

- Expand its destination portfolio
- Increase and develop alliances
- New technology for customer experience
- Highlight environmental successes
- Capture new markets

8.4 Threats

Today threats are abundant and sometimes unpredictable such as the Covid-19 pandemic which impacted everyone. For airBaltic economic stability is crucial because there is a ripple effect if not a direct hit such as a recession. This includes geopolitical issues such as wars etc. Moreover, competition is always watching and moving, so competitors are always trying new ways to conquer customers, usually through prices.

Other threats are changes in environmental legislation and aviation regulations. That said, in worst case scenario, as what happened to Boeing 737 Max, is to be grounded should anything happen with the A220. If this happens, the proverbial ‘all eggs in one basket’ comes to mind and contingency plans need to be implemented.

- Economic instability
- Competition
- New rules and regulations in aviation or environment
- Geopolitical instability
- Pandemics

9 The Power to Fly

New engines require a higher frequency of engine maintenance due to their complex and very advanced technological changes. Clean-sheet engines take longer to develop than the aircraft itself. Moreover, with regard to cost saving, lower emissions and new environmental standards, plane designers have to work very closely with the engine designers. The largest engine manufacturers are GE, Rolls Royce and Pratt & Whitney. (Reuters 2024.)

9.1 No Engine, No Flight

According to a recent Reuters report airlines are increasingly having to wait for engine maintenance. The shortage in parts and labor has the maintenance, repair and overhaul (MRO) providers struggling to keep up with demand. (Reuters 2024.)

This can severely affect airlines, including airBaltic, by having planes without engine MRO or reserve engines that can be rather quickly replaced. For airlines with part of their fleet in line for MRO it means having to wet-lease or dry-lease aircraft from larger leasing companies.

A dry lease is an agreement where an aircraft is leased without any accompanying crew, maintenance, or insurance. A wet lease involves not only the aircraft but also the crew, maintenance, and insurance, a complete package. And less known is the damp-lease (sometimes referred to as moist-lease) a damp-lease is fundamentally a mix between wet and dry-lease meaning that only the aircraft and maintenance is provided without crew and insurance. (FAA s.a.)

Consultancy group Bain & Company has reported that the expected turnaround time for next-generation engines will take longer (basically engines that improve efficiencies with lower emissions) such as the Pratt & Whitney GTF (A220) and CFM International LEAP (Boeing 737 Max) and climax in 2026. (Bain & Company 2024.)

“If MRO capacity continues to grow on its current trajectory, Bain & Company’s analysis indicates the demand for shop visits at the end of the decade will exceed supply by more than 17%. That shortfall, in turn, would impede air traffic growth by forcing operators to limit flights and routes.” (Bain & Company 2024.)

9.2 Forced to Maintain the Existing

The problem is being exacerbated by the slower delivery of new aircraft, resulting in airlines having to continue operations with older aircraft that were going to retire while they await their new planes. Finding parts for older aircraft is getting harder to source from the suppliers.

CNN reported that 85% of foreign-made planes in Russia were owned by leasing companies (valued at $12.4 billion). Russian airlines at the time of the sanctions operated 305 Airbus jets, 332 Boeing jets, and 83 regional jets built by Bombardier, Embraer, and others. Only 144 of the planes active in Russia at the time were built by Russia. (CNN 2022.)

And if an airline resorts to third party or fake parts such as the Russian aviation industry is currently forced to do due to sanctions, this does not comply with safety regulations. Most countries are fully aware of this will not allow the airline to land at their airports due to non-compliance and safety issues. Note that e.g. Aeroflot wet-leased all their planes and when the sanctions were imposed, Russia simply kept or confiscated the planes with a staggering amount of 400 planes of varying sizes and models. Today the courts will have to resolve this issue and leasing companies want compensation and not their planes repossessed due to little or no maintenance in accordance with international legislation. But this is for a separate thesis topic.

9.3 Limited Options

These days aircraft manufacturers offer no more than two engine types to buyers. In the case of the A220 there is only one option, the PW1500G. But the future will probably see another option available based on demand. That said, due to the grounding of some of Boeing's newest plane models and increased scrutiny by regulators, more in-depth quality controls have been implemented worldwide.

A major engine issue with Pratt & Whitney (owned by RTX Corporation) geared turbofan engines (A220) require maintenance much sooner than expected. This is obviously a major driving force of the maintenance crises airlines are facing coupled with a backlog.

More specifically the powdered metal used to produce many engine components has proven to be contaminated. The issue affects nearly 1,200 engines and is estimated to impact 350 aircraft annually through 2026. The contaminated metal dust, which can cause cracks, includes inspections of the A220. All this takes time, resulting in planes not being utilized and costing the airlines financial difficulties and brand scarring.

Situation in 2023 and path forward

- Summer 2023 significantly affected by engine shortage
- Support received from Pratt & Whitney in 2023
- New engine issue “powdered metal” announced in late 2023
- Worldwide repair capacity is very limited
- airBaltic ´s fleet will continue to experience impact in 2024

- airBaltic is currently in the process of transitioning to a “power by the hour (FMP) engine agreement

Image 1. airBaltic PW1500G (airBaltic 2023)

10 Overview Analysis, Theories and Observations

10.1 Making Better Harder

In theory, one could think the better you make things, the harder it is to make them better because there is less room for improvement. A comparison analogy and observation that one can have is that we are currently in the midst of the Paris Olympics 2024, world records have been achieved over the years and new ones are slowly emerging, but a world record gets harder to break every time it is broken because the standard is higher. This analogy one could make for anything that is constantly moving forward attempting to achieve more in sports, hobbies or businesses.

By adding software to hardware, these problems make a hard and challenging problem even harder, adding increased complexity of having planes run by computers instead of solely mechanical components cannot be overstated. Moreover, the further we progress, the more software and components we introduce in plane production. All this comes at massive cost increase and delays through testing, modifications, more testing and certification.

10.2 Safety First

That said, if safety is expensive, imagine what a accident will cost. Planes have become ‘smart planes’ and as such coding has become more complex, expensive and longer to develop for full integration and functionality.

In the past, a company like Boeing had all their employees, i.e. engineers, designers, manufacturers under one roof and all working the achieve the same goal for a single aircraft. Ford Automobile Company introduced the Model T in the early 1900s. The idea was to make an affordable car that once designed and approved could be mass produced on an assembly line. This theory was adopted by Volkswagen and most other brands in the automobile industry. For the airline industry this has become more complex.

Back to Boeing, and ‘under one roof’ besides design and engineering, almost all parts came from Boeing or its subsidiary. No competition, simple and mass production. Today the industry giants, for investor reasons, cut staff costs by outsourcing which adds an additional layer of vetting for the part. There are several reasons that airlines take so long to move from clean sheet (drawing) to certification a delivery. Regulations have become stricter, bureaucracy and paperwork has increased, environmental legislation is very high on the list, and safety requirements are paramount.

Clean-sheet planes or engines cost billions to bring to market. Based on an assessment by **Brian Potter** budgets are never met and in fact always go over, way over. The following list is in US dollars. (Potter January 31, 2024.)

Aircraft	**Budgeted**	**Actual**
Boeing 777	5 bn	12-14 bn
Boeing 787	5 bn	32 bn
Airbus A380	10.7 bn	33.9 bn
Airbus A350	5.3 bn	10 bn
C-Series	3.4 bn	6 bn

This is followed by delivery of parts, shared suppliers, expertise in the labor force (Boeing and Airbus) should be added to this mix of explanations, one could also include political insecurity i.e. if a part originates from a certain region e.g. China, they could delay shipment because of a feud with the American government or one of the EU countries.

When the US was the principal supplier of commercial planes, basically the certification was conducted by the Federal Aviation Administration (FAA). Today it is not only the FAA but also the European Aviation Safety Agency (EASA) and all the other country's safety authorities who give certifications pending where the plane is being used. This just adds to the complicated web 'to do' list from clean sheet to certification and delivery.

One could conclude by stating it is unfair to compare how simple and some may inject 'better' things were in the past. There is truth to everything. But when it comes to commercial planes things certainly are different. When, for example the DC-3, in the mid-1930s, for the wing strength testing was done and accepted by running a steam roller over the wing. Today's plane wings are tested to breaking point in controlled factories utilizing simulators in all situations and environments. (Hamilton interview)

The airline manufacturing industry is fluid, meaning it has to adapt to situations on a global level, adopt environmental regulations and standards and continue to develop new planes to meet the demanding commercial aviation needs. This is challenging for both Boeing and Airbus due to the complexities of the industry in general.

10.3 Political Influence

A good question is who controls the global air traffic? The answer is the cooperation from various countries' governments combined with airlines through the International Air Transport Association (IATA) and the International Civil Aviation Organization (ICAO). These two organizations set the rules, regulations and recommendations for civil aviation.

Politics do indeed influence the entire airline industry but more specifically the manufacturers. Both Boeing and Airbus have a robust military aircraft portfolio and therefore need to adhere to the political climate. The US government is Boeing's largest customer. And if Boeing wants to sell military aircraft to foreign countries, they need approval to do so.

These political decisions also affect commercial aircraft and its sales. In regard to this and the C-Series and very good example can be made with the elimination of the Boeing F-18 military plane purchase by Canada. When Boeing filed a complaint with USITC accusing Bombardier of price manipulation and Canadian government subsidies resulting in 219% tariffs (discussed earlier in this thesis) Canada took offense.

Boeing F-18 planes were expected to be the choice by the Canadian government to make for their upgrade of military aircraft. This did not happen and they chose the more expensive Lockheed Martin F-35. One can easily speculate and read between the lines that was a political decision (quid pro quo) more than a financial one in retaliation for Boeing's complaint against Bombardier/Airbus.

If we lived in an ideal world, planes would be flawless, exceed any and all environmental standards, not require regular maintenance and upgrades, passenger occupancy and satisfaction at 100% and zero safety concerns. But this is not the case obviously, airlines as well as manufacturers have to continuously adapt to change, make strategic decisions and aim to achieve the 'ideal world' scenario.

10.4 The Bottom Line

To sum up and often quoted in books, articles and speeches (corporate and financial institutes), the words of former Airbus CEO (1985-98) **Jean Pierson** truly describes the situation in the manufacture of commercial airlines (but can be adopted to several situations and scenarios): "You can't win, you can't break even, and you can't quit!". (Potter January 31, 2024.)

10.5 Positive Impacts of the A220 in Canada

Price Waterhouse Coopers (PwC) conducted an impact analysis in 2023 on the A220 and its influences on the Canadian economy. According to PwC projections for 2023 to 2038 show that the A220 program will continue to be a vital driver of Canada's economy. Indications show that the program is forecasted to contribute 28.55 billion euros to GDP. As such, tax revenues are projected to be 7.4 billion euros which is significant to the Canadian government.

These forecasts emphasize Airbus Canada's dedication to economic growth and sustainable development. Moreover, a fleet of 20 A220 aircraft is estimated to reduce CO2 emissions by approximately 1.1 million tons over 15 years compared to older-generation aircraft of similar size, showcasing Airbus Canada's commitment to environmental stewardship.

Expanding operations

The Mirabel, Quebec site, home to the A220 program and its main final assembly line, is set to expand in the coming months as it transitions into a dedicated flight test center for the A220 aircraft. The site will host both test aircraft and testing equipment, requiring the expertise of highly skilled personnel to support ongoing aircraft improvements.

Additionally, a new delivery center will be constructed at the site within the next year to manage activities with airlines globally. This expansion is crucial for creating additional space, improving workflows on the final assembly line, and offering A220 customers a delivery experience consistent with other Airbus locations worldwide. These infrastructure upgrades are designed to help increase the A220 delivery rate, with assembly capacity expected to rise to 14 aircraft per month by 2026.

Local contribution

Currently, Airbus in Mirabel employs around 3,000 people and has already achieved 80% of its goal to hire 700 new employees during 2023. A PwC study has also shown that the average salary of an Airbus Canada employee is 87% higher than the average income across all industries in Quebec.

"The economic impact of the A220 program extends well beyond our company. Benefiting a multitude of stakeholders at both the provincial and federal levels, this significant contribution since 2018 has resulted in thousands of additional jobs, numerous contracts to local suppliers, and considerable exports around the world that showcase the ingenuity and expertise from here. I am honored to give the A220 everything it deserves to ensure its success, which is ultimately our

collective pride and international standing. I have no doubt that the future of the A220 and Airbus in Canada is bright," said Benoît Schultz, CEO of Airbus Canada. (Canada Newswire 2023)

10.6 Conclusion

This methodology emphasized the qualitative approach that integrated interviews and readings to generate a comprehensive insight into the research topic i.e. A220 – a game changer. Interviews provide direct perspectives from participants, while secondary readings offered contextual support. By employing thematic analysis and content review, this study aims to produce an interesting, informative and meaningful information while maintaining rigor through ethical and methodological standards.

11 Research Methodology

For the thesis on the A220 the most applicable approach is utilizing qualitative research through interviews and secondary readings from online platforms, web sites, books, news articles and publications. The selection of secondary sources was based on relevance, credibility, and recency. Research was focused on databases such as Google, YouTube and published articles.

11.1 Approach

This research utilized a qualitative approach that was focused on interviews and secondary readings to collect, assess and analyze data. By using qualitative research, the thesis was designed to explore the evolution of the A220 by examining the perspectives and experiences of professionals. Through semi-structured interviews and the analysis of secondary sources, this study aims to provide an understanding of why the A220 is arguably a game changer in the current airline industry.

An important aspect to note is that, as stated above, “in the current airline industry” to focus on the next 10-years as orders are being filled and deliveries made. The innovations and emphasis on new technologies are constantly evolving and redefining the boundaries of the next generation planes of the future, especially in the field of propulsion (engines) and aerodynamics.

It is also note-worthy that while reading annual reports, materials produced by e.g. Airbus or Boeing there is a certain amount of marketing spin and as such the interviews confirm or give a more realistic interpretation. However, as listed companies, transparency is paramount and thus reading the CEO review in an annual report usually tells (not highlights) what has happened and where the future is aimed at going. Analyzing carefully what is said is important in truly understanding what is going on.

11.2 Research Design

The goal is to explore subjective experiences and develop insights into the complexity of building a clean-sheet plane and what makes the A220 great. This study will rely on two primary methods: interviews for gathering direct information from participants and secondary readings for contextual understanding and support. As such, the qualitative approach allows for evolving analysis as data is collected and presented.

11.3 Data Collection

The direct interviews targeted experts in their field of aviation i.e. Scott Hamilton, Petter Hörnfeldt and airBaltic administration. The interviews are a key method for gathering in-depth, firsthand

insights from professionals. This provided the flexibility to explore new angles for structural flexibility that surfaced during the interview exchanges.

11.4 Participant Selection

Participants with relevant knowledge or experience related to the research topic were selected. That said, it is fully understandable that an employee of any company will be reluctant to say anything contrary about their employer. As such, some participants wanted to remain anonymous and therefore to protect the source it was more beneficial not to use their input, but instead try to investigate further. No derogatory or negative information was found for this thesis.

11.5 Interview Process

- The interviews conducted were designed with open-ended questions will and tailored to steer the exchange with follow-up questions. The questions aligned with the research objectives and encouraged detailed responses.
- The interviews were done via email taking into consideration the participants logistical presence. Attached to this thesis are the transcripts from the interviews. The interview process began in April 2024.

11.6 Secondary Literature

Secondary literature includes academic articles, books, and reports. These sources will help contextualize the research and provide theoretical support for the analysis. This was coupled with the acquisition of Air Wars written by Scott Hamilton (ISBN-13: 73764050-9), who also gave a personal interview for this thesis.

12 Ethical Considerations

Ethics were a central concern throughout the study:

- **Informed Consent**: Participants were fully informed of the study's purpose and their consent was obtained before proceeding. Specifically, airBaltic senior management and Investor Relations managers. Interviews of participants gave approval via email
- **Confidentiality**: For those interviewed who wished to remain anonymous, their responses were only used to verify information and compare assessments. As noted, no derogatory or misleading information was found.
- **Voluntary Participation**: Participants involvement was voluntary, and they could withdraw at any time without consequences i.e. publication without consent.

13 Limitations

- **Subjectivity**: The interpretation of qualitative data is influenced by the researcher's perspective, which introduces a degree of subjectivity.
- **Small Sample Size**: Due to the intensive and expansive nature of qualitative research, the sample size may be small, which could limit the generalizability of findings.
- **Time-Intensive**: Both interviewing and thematic analysis are time-consuming processes, making it a labor-intensive study method.

14 Summary

This thesis has described the evolution of the Bombardier C-Series into the Airbus A220. With special thanks to Scott Hamilton, Petter Hörnfeldt, and airBaltic coupled with numerous articles, web sites and books the information would not have been assimilated and assessed. Therefore, a big thank you is appropriate.

The question remains, is the A220 a game-changer? One can conclude it certainly is a popular clean sheet plane with its fuel efficiency and customer feedback. This is reflected in two ways, firstly the order stock of close to 1000 planes (so far) to be delivered by Airbus over the next decade and secondly how airBaltic has benefitted with two consecutive years of excellent turnover.

Overall, the airline manufacturing business is a bit more complicated. In late July 2024 was The Farnborough International Air Show, this commercial venue is one of the most important in terms of attendance and buyers. Reports showed that the airline industry is seeing a surge in the need to modernize fleets and reduce operating costs and fuel efficiency. This is done by renewing their fleet in accordance with their destination portfolios and huge orders have gone to both Boeing and Airbus. Here airBaltic was visionary and made the strategic decision to adopt the A220 with a goal of 100 planes by 2030.

That said, the airline industry is very susceptible to change and sudden crisis's such as a pandemic, recessions, air traffic tragedies, political instability and wars to which they have to adapt very quickly. Having said that, and assuming all is calm on all fronts, commercial airlines still face what a continuous battle such as customer retention, environmental legislation changes or grounding of a specific type of plane.

The A220's PW1500G engine, the heartbeat of the plane which gives airlines the fuel efficiency reductions they seek, has proven to have some issues which they (PW) continue to fix. However, now they are facing MRO delays worldwide, and this is not only PW engines and there is no real end in sight since spare parts and qualified people are not readily available and there is a backlog.

One could conclude that the only real danger for airBaltic (as long as all is calm on all other fronts) is that having only one type of plane, although it reduces costs in training of staff and maintenance personnel, is that basically they have put all their 'eggs in one basket'. A major recall would ground the entire airBaltic fleet. On the bright side, Airbus COO confirmed that they probably would offer a choice of engines with FHM International engines.

Another significant observation is everything is long-term planning. As noted with airBaltic, they have received 49 planes so far. It was in 2016 that airBaltic became the global launch operator of the A220-300.

Technology continues to evolve and the use of sustainable aviation fuel (SAF) is being introduced. Moreover, engine makers are naturally looking at electric for next-generation engines. The A220 is the first commercial plane to use an electric braking system. Companies are looking to retrofit planes with e-brakes as they become available since they are more efficient although still rather new in the aviation industry. So yes, the A220 is a game-changer until next-generation planes come on stream, but for now it is here to stay.

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Appendices

Appendix 1. Interview with Scott Hamilton

PART ONE INTERVIEW APRIL 24, 2024 Scott Hamilton

Scott Hamilton (SH), founder and editor of Leeham News and Analysis has over 30 years of experience reporting on the aviation industry and former commercial pilot. Moreover, he is author of the well-received book Air Wars: The Global Combat between Airbus and Boeing (2021, ISBN 1737640503).

Competition is fierce within the airline industry and especially between the giants Boeing and Airbus. It is not strictly commercial trade such as McDonald's vs Burger King since it involves governments, political pressures, lobbying activities etc. resulting in a labyrinth of parts being sourced from all over the world and manufacturing spread quite wide for the final assembly of a plane. To add the 'bowl of spaghetti' there are several joint ventures e.g. GE Aerospace (US) and Safran (French) resulting in CFM International based in Ohio, USA, regarding the engines.

1. Airbus seems to be thriving whereas Boeing is going through some turbulent times trying to weather issues with some of its fleet of planes and most recent whistleblower claims. Please provide your overview and opinion of the situation.

SH: Boeing is a mess. Beginning with the rugged B-17 and the technological marvel, the B-29, in World War II, Boeing became the gold standard of commercial aviation. The development of the 707 eventually enabled Boeing to leapfrog over the Douglas Aircraft Corp., designers of the fabled DC-3 and post-war DC-6, the most successful piston airliner ever.

This led Boeing to completely misjudge the threat Airbus presented, when the consortium was formed in 1970. In a way, Boeing can't be blamed. Europe's commercial aviation industry developed airplanes for their markets, not a global market. Even Airbus' first aircraft, the A300B2, was a mediocre airplane (it entered service in 1974). The following derivatives, including the shorter A310, simply didn't compete effectively with Boeing's 767.

Today's competition may be summed up this way: Boeing, with its emphasis on shareholder value, failed to invest in new products since the 1997 merger with McDonnell Douglas, except for the 787—a program it proceeded to royally screw up. Airbus continued to pour money intro research and development. The A380 was new (though a financial and market mistake), and after a false start, so was the A350. Its derivatives of the A330 and A320 (especially the A321) added value and

capabilities to these airplanes. Boeing's derivatives of the 757 and 767 (the -300 and -400 models, respectively) were sales duds. So was the final derivative of the 747, the 747-8.

While Boeing rested on its ass, Airbus aggressively went after Boeing customers. Launching the A320neo family enabled Airbus to win an order from American Airlines (another exclusive Boeing operator), which forced Boeing to re-engine the 737 rather than produce a new airplane. Boeing's emphasis on cost cutting and cost control hurt R&D and eliminated a lot of institutional knowledge in engineering and production. This led to where we are today.

2. The Airbus 220 (100 and 300) is a very popular plane. Originally the Bombardier C series. Please provide your perspective about why the A220 is so popular

SH: The A220-100 is a niche airplane serving difficult and hot-and-high airports. Only 102 orders have been placed out of 914—just 11.3%. That said, the -300 is a highly flexible airplane that serves the under 150-seat market nicely (the -100 is 110 seats, typically). Both models have long range for its size (3,300nm if memory is correct). Passenger experience is among the best, even better than the A320 family, vastly superior to the 1960s design of the 737, and even roomier than the very comfortable Embraer E-Jet.

3. Boeing had the opportunity to perhaps acquire Bombardier C series. Why did they not seize the opportunity.

SH: This is covered in Air Wars. Ray Conner said the cockpit design and technology was not compatible with the 7-Series line, so they took a pass. It was one of the dumbest decisions Boeing could have make, and it further cemented Airbus' growing dominance in the single aisle sector.

4. How big a role does government (local and foreign) influence and play a role in the airline manufacturing industry

SH: Airbus was viewed by Boeing, McDonnell Douglas and Lockheed (before it became Lockheed Martin) as just another European jobs program. There was good reason for this, and again, the Americans failed to realize the looming threat. Boeing and McDonnell Douglas viewed Airbus' government subsidies as the only reason Airbus could sell airplanes. While there is some truth to this, it's not the whole trust. Interestingly, Boeing Commercial Airplanes CEOs Scott Carson and Jim Albaugh each told me that they viewed this complaint as just an excuse for Boeing's decline in the competition. (This is in Air Wars.)

Boeing's complaints about government subsidies, to me, fall on deaf ears and smack of hypocrisy. Boeing benefitted from government largess since the days of its founder, Bill Boeing. He threated

to leave Seattle for California until the city built him an airport- Boeing has taken tax breaks from state and local governments and benefitted from NASA funding for decades. Boeing's complaints about Airbus government aid and tax breaks, while philosophically valid, are rank hypocrisy in the real world.

5. Why is the A220 so popular for airlines? Customers (passengers)?

SH: Best passenger experience of any single aisle airplane.

6. What are A220's biggest threats?

SH: This is too ambiguous for me to answer.

7. Plans to build a 'stretch' version of the A220 called the A220-500. Is this viable. Is Boeing threatened.

SH: We at Leeham Co. think Airbus may have already missed its opportunity to have a successful -500 program. By the time the model would be ready to enter service (our estimate, around 2028), new airplanes will (or should) have been designed and programs launched. The -500 would be the last of today's generation of airplanes. We need airplanes for tomorrow. Boeing will be threatened by the -500 only if it stands still with the MAX 8.

8. What makes the A220 unique in comparison to Boeing's 737 max 7

SH: The A220 is new technology. The basic 737 is 1960s technology. Today's MAX 7 is a shrink of the MAX 8, which makes it less than optimal.

9. There have been issues with the PW engines used for the A220 especially in hot, humid, sandy countries. Why is this and has it been resolved i.e. the teething period from 2016

SH: All the GTF engines (not just those for the 220) have technical issues. The A320neo with GTF in India was especially hard hit. About a third of the global fleet of A320 GTF-powered airplanes is grounded now with technical issues. Google all this for context and detailed information. Pratt & Whitney says it will be another year or two before all these issues are resolved.

10. Why is the A220 only offering the PW1500 engine to airline buyers

SH: There was no competing new technology engine in the same size offered at the time.

11. Will other engines become available to the A220 e.g. from CFM International

SH: There is no technical reason why not. It all comes down to commercial viability.

12. The PW1500 has been plagued with issues. Please elaborate

SH: Google this.

13. The A220 uses electric brakes versus hydraulic. Please discuss this if you can i.e. the pros and cons.

SH: I don't have this competence.

14. The A220 is assembled in Montreal, Canada for the international market and in Ohio, USA for the domestic US carriers. Is this politics or some other reason.

SH: Covered in Air Wars. See the chapters on Bombardier and the C Series.

15. Carbon fiber versus aluminum

SH: Composite construction is expensive, significantly more than aluminum.

16. Final thoughts about the future of Airbus/Boeing, governments, politics, tariffs etc.

SH: Boeing is XXXX unless and until it gets back to making airplanes correctly and designing new aircraft. As long as Trump doesn't get elected, there won't be tariffs. The governments and politics (assuming no Trump) will be confined the historical pattern of state departments/ministries advocating for Boeing or Airbus, which political trades a consideration (like Israel favoring its mentor, the US and Boeing, for example).

PART TWO INTERVIEW MAY 15, 2024 Scott Hamilton

Hi Scott, hope all is well with you. Sorry to pester you but would you be able to answer question in light of the current situation with Boeing.

1. With the current issues at Boeing, how do you see its future?

SH: It will take a decade to work its way out of the current production and financial issues. Management hoped to basically recover production and $10bn in free cash flow by 2025-2026. This will probably be delayed by at least two years. Debt won't be paid down until longer out. And any new airplane program will negatively impact cash flow and profits during the developmental and ramp-up periods.

2. Would you agree it was management, profits and old technology. If so, why?

SH: Management, and the successive Boards of Directors, were more interested in shareholder value than in investing in new products. The managements' war on unions resulted in transferring work to "green" labor forces, the loss of institutional knowledge and the loss of production efficiency. The industrial screw ups on the 787 had the knock-on effects of negative impacts on the 747-8 development and going with derivatives of the 737 and 777 instead of new airplanes.

3. How do you predict the future of Boeing?

SH: Bleak through the 2030 decade.

4. Airbus?

SH: It will suffer from an embarrassment of riches. Gaining market share at Boeing's expense, Airbus will struggle to meet demand.

5. Anything else you wish to highlight?

SH: Nope.

PART THREE INTERVIEW JULY 29, 2024 Scott Hamilton

Hi Scott, I am trying to wrap my brain around understanding the aviation business and seem to be spinning my wheels. Perhaps you could explain/clarify.

My dilemma is trying to understand the aviation industry in general coupled with the A220. Specifically: Technology has advanced, but why does it take 5-10 years for a clean sheet plane to be certified (yes regulations, testing, parts being validated, multiple suppliers and sub-suppliers, more testing and approvals etc. then training and manuals). By this I mean, by the time the orders by airlines for new commercial planes go in, they could be obsolete by the time of delivery or worse, political or economic crises, M&A etc changes may have occurred rendering contracts mute.

Just reading the Farnborourgh news and all sorts of deals and sales, but by the time those orders are filled it will take years. Could you enlighten me please. Thanks.

PS Clean sheet to certification/delivery, why has technology not sped things up compared to e.g. production of DC-3 and other planes Boeing 707 etc.?

I know this sounds impossible, but wish I could have gotten your book signed by you. Bought from Amazon UK, but should have perhaps bought from you directly.

SH: Hi Daniel, As you can imagine this is not a simple answer. I'll try, see below.

Yes, technology had advanced but while this might suggest quicker timelines, it's also complicated things. The 787 was supposed to be what I call an erector set or prefabricated airplane. Fuselage sections were supposed to be "stuffed" with components and interiors by the time they reached the final assembly line so they'd essentially just snap together in 3 days using 800 people. For a variety of reasons, this turned out to be a pipedream (I write about this in Air Wars).

But the very advancement in technology in the design of the airplane also turned out to be a problem. As planes become more "smart," writing code becomes more complex and takes longer. Having messed up the 787, Boeing's NMA was to try again with new production and new design. Boeing also wanted to speed the actual certification time (normally an 18 month process) to nine months or less. The MAX crisis killed this plan. The FAA is now going *very* slowly through all certification. EASA also no longer simply signs off on FAA work, but does more of its own before certifying Boeing--and Airbus airplanes.

It doesn't actually take 5-10 years to certify an airplane under normal circumstances. What's happened with the 737 MAX and 777X is extraordinary. Certification in recent times used to be about 18 months. Boeing has completely screwed this up for Airbus and Boeing. But Embraer still moves ahead, with the Brazilian regulator.

You're right: order today, plane might be obsolete by delivery post-2030. Yes, true enough--but the entry into service of a new airplane probably won't be till 2034-2035 and it will take years and years before production ramp up can overtake today's rates. Contracts usually have substitution rights. It is what it is.

Appendix 2. Interview with Petter Hörnfeldt

July 20, 2024

Petter Hörnfeldt, widely known as *Mentour Pilot*, is a Swedish airline pilot and influential figure in aviation media. He gained popularity on YouTube by producing educational videos that explore aviation topics ranging from pilot training and safety protocols to airline operations and incident analysis.

With extensive experience flying and a Captain on the Boeing 737, Hörnfeldt draws on his firsthand knowledge to offer insights into aviation safety, flight mechanics, and industry trends. He also launched the *Mentour 360* app, a community-driven platform for aviation fans featuring interactive learning tools and immersive 360-degree cockpit simulations that give users a realistic view of the pilot's experience.

Moreover, besides his YouTube channel, Hörnfeldt tries to find a possibility for all talented youngsters to acquire the necessary funding for Pilot Training.

Daniel: Hi Petter, I am a great fan of your YouTube channel and other social media inputs and insights regarding aviation. Always find them interesting and informative. That said, I am currently writing my thesis called The A220 a Game Changer. I state in the first sentence that this is arguably a true statement.

I am somewhat aware of the issues i.e. the PW1500G engine problems in warm temperate countries and sandy (Africa) countries. My thesis will then focus on airBaltic (FYI Scott Hamilton has contributed to my thesis with an interview coupled with two pilots, who wish to remain anonymous from airBaltic). airBaltic which is 97.97% owned by the Latvian government is perhaps seeking an IPO thus the reluctance to speak freely.

Could you kindly contribute your thoughts/insights and provide a few paragraphs about why the A220 is (or is not) such a game changer, why it is considered so good but Airbus has yet to make a profit on the plane.

And please give your thoughts about airBaltic as a LCC (hybrid) in niche markets but is up and coming due to its modern fleet of A220-300.

Finally, could you provide your thoughts on Boeing vs Airbus. I would greatly appreciate having you together with Scott Hamilton as sources for my thesis.

Sincerely,

Daniel Barbieri-Sandberg

Petter: Hi Daniel.

I’m on vacation in Sweden now until the middle of August. The questions you are asking are very wise-spanning and would likely take several pages of response.

I have made at least 3 videos on the topic of the A220 which you can use for reference and we can then take a call.

How does that sound?

Daniel: Hej Petter,

Fantastic and thank you. I realize this puts you in an awkward position, having holidays and trying to relax. I realize my questions are rather broad but if you have the time, then would gladly incorporate your input…this would really complement the thesis together with Scott.

Scott responded which I then had to put into descriptions and then quotes etc. Besides I purchased his book which is what he instructed me to do.

Anyway, look forward in receiving anything/everything you have when you have the time to contribute. A little background on me, I am currently enrolled in airBaltic Pilot Academy. This thesis is to finish off my university studies here in Helsinki.

Enjoy your holiday!

Best Regards,

Daniel Barbieri-Sandberg

Daniel: Hi Petter,

This is what I have. Note I am quoting you but need you to OK this. Plus, would need to find some sort of info about the PW1500G engine, besides google. Any ideas? I realize you are on holiday and also need to focus on family. When you have a moment please see text so far.

https://mail.google.com/mail/u/1?ui=2&ik=ffdd1673c0&attid=0.1&permmsgid=msg-a:r7475479005958440630&th=190dffc3ad3ec077&view=att&disp=safe&realattid=f_lyyicdir0

Best Regards,

Daniel Barbieri-Sandberg

Petter: Hey Daniel.

Please send this to my research lead - Spyros. He will be able to evaluate it quicker and more accurate than me.

Daniel: Hi Spyros,

Per Petter, could you kindly check this text which I plan to use in a thesis I am writing. Scott Hamilton has also contributed to this thesis, thus I approached Petter. That said, it is mainly based on 'Did Boeing give Airbus a free airplane' on YouTube.

If you have any other information that I could use, please feel free to share.

Best Regards,

Daniel Barbieri-Sandberg

Spyros: Hey Daniel,
Scott Hamilton and his work at Leeham News and of course his book, are excellent sources!

Here are some clarifications for your document: The reason it would have been easier for Boeing to absorb the CSeries into its lineup than Airbus, is because the supply chain for the aircraft is (mostly) American. This is mentioned in the second paragraph in your text.

Regarding the "A220-500" name and the naming of the A220 family in general: this information was correct when we made the video, but more recently Airbus has suggested that the longer A220 variant would actually be named the A221, suggesting that the entire A220 family will be renamed.
https://theaircurrent.com/aircraft-development/the-airbus-a221-begins-to-come-into-focus/

A small clarification about the quote beginning with "Later in 2020 Airbus then bought Bombardier's remaining stake in the program...": this IS correct as written. Here's a recent story about that: https://www.bnnbloomberg.ca/business/2024/07/23/airbus-a220-to-get-another-cash-injection-from-quebec-government/

That's it, I hope this helps a bit!
Best regards,
Spyros

Daniel: Spyros, thank you thank you and thank you. Perfect. I have included all your guidance into the thesis. Many thanks you Petter too. Please see attachment and give your thumbs up.

https://mail.google.com/mail/u/1?ui=2&ik=ffdd1673c0&attid=0.1&permmsgid=msg-a:r-6543654661419010004&th=190e5184d19e9490&view=att&disp=safe&realatt-id=190e517395686fbdc681

Br,

Daniel Barbieri-Sandberg

Daniel: Hi Spyros and Petter,

I hope you had a moment to check the changes I made per your clarifications. And I thank you for your input. I am trying to wrap my brain around understanding the aviation business and seem to be spinning my wheels. Perhaps you could explain/clarify. This would help simply understand the 'business of aviation purchases'.

My dilemma with my thesis is not so much the content but understanding the aviation industry in general. Specifically: Technology has advanced, but why does it take 5-10 years for a clean sheet plane to be certified (yes regulations, testing, parts being validated, multiple suppliers and sub-suppliers, more testing and approvals etc, then training and manuals).

By this I mean, by the time the orders by airlines for new commercial planes go in, they could be obsolete by the time of delivery or worse, political or economic, M&A etc changes may have

occurred rendering contracts mute. Clean sheet to certification/delivery, why has technology not sped things up compared to e.g. production of DC-3 and other planes Boeing 707 etc.?

Just reading the Farnborough news and all sorts of deals and sales, but by the time those orders are filled it will take years. Could you enlighten me please. Thanks.

Sincerely,

Daniel Barbieri-Sandberg

Petter: Hi Daniel.

This is indeed a conundrum and one where there is little to explain. We did a video, just a week or Teo ago about this where we have explanations to WHY it’s taking so long and what might be fine about it.

On top of this there is not much more we can do to further help your thesis but we are looking forward to hear what your theory is.

Best of luck

https://youtu.be/t7wIg8wfNzs?si=r5E0ykySkcAMm-r-

Daniel: Petter,

Thank you once again, I really mean it. Watched your recent video, and really liked the thought-provoking comment 'if you think safety is expensive, imagine what an accident will cost'. The wiring part is a no brainer, by this I mean common sense dictates that e.g. 3 wires that do more or less the same thing should indeed be place separate just in case. But that is what I am learning life, sometime common sense is lacking. Again, many thanks for your input and keep those videos coming, they truly are great and the presentation makes them even better. Simple and logically.

Best Regards,

Daniel Barbieri-Sandberg