THE BUSINESS CASE FOR THE BOMBARDIER CSERIES

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AirInsight

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CONCLUSIONS

The business case for the Bombardier CSeries is sound. Although Bombardier is pursuing a narrow market segment, 100-149-seats, this is hardly an inconsequential market. There is an estimated market of more than 6,000 aircraft over 20 years, accounting for traffic growth and retirements/replacements. Airbus and Boeing are trending toward up-gauging their airplanes, which means largely abandoning this market segment to new competitors such as Bombardier and Embraer and potentially AVIC, Mitsubishi and Sukhoi.

Skeptics have questioned the CSeries business case for a variety of reasons and assertions:

- The 100-149-seat market is a dying market;
- Bombardier has no experience in this segment;
- The CSeries has few orders;
- The CSeries has had false starts;
- The CSeries 2x3 seating is a mistake;
- The CSeries doesn't have the range of the A319 and 737-700;
- Bombardier has no experience in working with advanced materials;
- Airbus and Boeing can under-price the CSeries with their A319 and 737-700; and
- The A320 family New Engine Option will destroy the business case for the CSeries.

Some of these items are indeed cause for skepticism. Others are pure hyperbole aimed at undermining the CSeries at the behest of competitors and uninformed or biased observers.

Proponents of the CSeries have highlighted its advantages:

- 15% lower cash operating costs;
- 20% lower fuel burn than 737-700 and A319;
- 20% lower maintenance costs;
- Significant improvements in emissions;
- Significant improvements in noise;
- Utilization of advanced materials and 21st century technology; and
- The first new technology narrow-body trunk liner since 1988.

It is clear that the CSeries is projected to be the most efficient aircraft in its class when introduced in 2013. The key question is can Bombardier deliver on these promises.

We will address these and other issues in this new Study. Our conclusions will be questioned and criticized by some, but there are two points to be made that are irrefutable and which, in our judgment, demonstrate beyond any doubt that the business case for the CSeries is sound and that Airbus and Boeing don't doubt it. These two points come from Airbus and Boeing officials:

> "*We don't want to make the same mistake that Boeing did with Airbus and not take Bombardier seriously*."—John Leahy, Chief Operating Officer-Customers, May 2010.

Leahy further asserted in May and at the 2010 Farnborough Air Show that if Airbus re-engines the A320 Family, "there is no business case for the CSeries." Upon launching the NEO program December 1, 2010, Leahy once more repeated this view.[1] We not only disagree with this assertion, for reasons we will discuss in this Study, Leahy's focus on the CSeries clearly demonstrates that Bombardier is on the right track with this airplane.

> "*Boeing is considering increasing the production rate of the 737 so we don't drive orders to the CSeries*."—Jim Albaugh, Chief Executive Officer of Boeing Commercial Airplanes, at the 2010 Farnborough Air Show.

Albaugh continued this theme in a September 27, 2010, interview with a Seattle newspaper, in which the reporter wrote: "*…Albaugh said that part of the reason he's increasing the 737 production rate…by 2013 is to…leave less of an opening for the CSeries*."

BACKGROUND

In December 2009, AirInsight published a short Report, *The Coming Narrow-Body Re-Engining Programs for the A320 and 737NG Families*[2]. Based on information current as of the fourth quarter 2009, we concluded then that "Airbus and Boeing are virtually certain to launch re-engining (RE) programs…because customers are increasing pressure to provide dramatic Specific Fuel Consumption (SFC) improvements in the near term, preferably within the next five or six years." This timeline suggested an RE Entry-into-Service (EIS) by 2014-15.

The 2009 Report recognized the emerging competitors as factors facing Airbus and Boeing. These competitors are the COMAC C919 from China, the Irkut MS-21 from Russia and the Bombardier CSeries from Canada. The former two compete with the A320/A321 and B737-800/900. The latter competes with the popular A319 and 737-700, the struggling A318 and the dormant 737-600[3].

While we do not underestimate the long-term potential of the Chinese and Russian aircraft industries, we currently regard the C919 and MS-21 are largely home-market aircraft that will at best have limited sales outside China and Russia. Although the CSeries has struggled to achieve large numbers of sales, we regard this as much a matter of timing—launching the Authority to Offer (ATO) just ahead of the worst global economic recession since the Great Depression—as it is the difficulty of any new entrant gaining traction against well-established incumbents. We have long viewed the CSeries as a threat to Airbus and Boeing, recognizing this as far back as 2005[4].

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[1] "A320neo kills business case for CSeries." http://www.flightglobal.com/articles/2010/12/01/350389/a320neo-kills-business-case-for-cseries-leahy.html

[2] Except where specific sub-type references are made, the terms "A320" and 737" shall refer to the A318/319/320/321 and the entire 737 Next Generation family.

[3] The Embraer E-190/195 also competes with the A318 and, nominally, the 737-600. Boeing hasn't sold a 737-600 since August 2005 and only 69 have been sold. Boeing technically continues to offer the airplane for sale. The A318 hasn't performed much better. Just 83 have been sold through August 2010, including 23 business jet orders. The corporate version currently accounts for the entire A318 backlog of 10 aircraft

[4] Seattle Times, March 31, 2005, "Look Out Boeing, Here Comes Bombardier."

During the intervening period between our previous Report and this Study, much has transpired to prompt us to not just update our previous Report but to expand this into a much broader Study. Instead of confining the current effort to an update of the 2009 Report, it became clear that the "update" was evolving into a full examination of the Business Case for the CSeries because of the repeated Airbus assertion that "there is no business case for the CSeries if we re-engine the A320."

We disagree with this assertion;[5] the business case remains, the threat to Airbus (and to a lesser extent, Boeing) from the CSeries is real and it is clear that Airbus (and for different reasons, Boeing) do not underestimate the threat. Accordingly, we expanded our intended update to include a full review of the CSeries business case.

WHAT CHANGED IN THE YEAR SINCE OUR EARLIER REPORT?

- Airbus announced December 1, 2010, it will proceed with an RE program called the New Engine Option (NEO);
- Airbus has engaged in a campaign to sow doubts about the Bombardier CSeries, the 110-149-seat new technology aircraft utilizing the Pratt & Whitney (P&W) PurePower PW1000G Geared Turbo Fan, with a promised entry-into-service of 2013;
- Boeing hasn't discontinued its RE studies but current indications are that it will not elect to proceed with a 737RE;
- Neither, does it appear, will Boeing launch a 737 replacement aircraft in the near-term; a Replacement Study (RS) continues;
- Boeing seems content to proceed with more incremental enhancements of the 737;
- Boeing is upping 737 production partially to quell sales of the CSeries;
- Republic Airways Holdings announced an order for up to 80 CSeries (February 2010), with a portion intended to replace Airbus A319s at Republic's Frontier Airlines subsidiary; and
- Oil prices continue to vary with economic conditions

Perhaps the most interesting element of these events, and the ramifications from it, is the Republic order for the CSeries. This had a greater effect in driving the market, and the Airbus/Boeing response, than did the original launch order from Lufthansa Airlines. The Republic competition was the first direct head-to-head battle between the A319 and the CSeries, and Bombardier won, with the customer planning to replace very young A319 aircraft upon delivery of the CSeries.

THE PLAYERS

The aerospace market, in recent years, has largely been two duopolies for jets: Airbus and Boeing for the large, >100-seat "mainline" jets and Bombardier and Embraer for regional jets. In the last three years, new entrants are emerging in both segments and Bombardier elected to move up into the "Big Leagues" with its proposed CSeries. Embraer is also evaluating moving beyond its traditional market, which currently tops out at 110-seats.

AVIC, COMAC , Irkut and the Japanese have massive government funding support. Bombardier will rely on launch aid, a highly controversial approach attacked by the US and Boeing with respect to

[5] In a snap poll by FlightGlobal on December 2, 2010, so do 55% of respondents. Just 21% agree with Leahy and 24% are waiting to see what Boeing does. Only 66 votes had been tallied by the time this poll data was viewed for this Study, however.

European government support for Airbus. The World Trade Organization ruled that "launch aid" per se is not illegal and Bombardier says its launch aid will comply with WTO rules[6]. The Brazilian government also provides major support to Embraer.

OEM	Aircraft	Advertised EIS	Our EIS Estimate	Size	Engines	Comments
Airbus	A320neo	2016	2016 GTF 2016-2017 Leap-X	125-200	PW GTF, CFM Leap-X	NEO remains well behind CSeries in Efficiency
AVIC	ARJ21	2009	2011	70-90	GE CF34	Not expected to compete outside of China and its political partners
Boeing	737RE	Unlikely				Open-rotor technology unlikely to be ready
	737RS	2019-2020	2019-2020	150-180-210	PW GTF, CFM Leap-X	
Bombardier	CSeries	2013, 2014	2014	100-145	PW GTF	Supply chain may delay EIS to 2014
COMAC	C919	2016	2018	160-212	CFM Leap-X	As China's first mainline effort, we expect major EIS delays; fallout on LEAP-X EIS a question
Embraer	E190/195	In Service		100-110	GE CF34	Both re-engining and new aircraft are under consideration. E190 family with PW GTF closes gap somewhat with CS100, but not entirely
	New Jet	No data	2017-2019	130-150	PW GTF, CFM Leap-X	
Irkut	MS-21	2014	2015-16	160-212	PW GTF, Aviadvigatel PD-14	Small export market with PW GTF
Kawasaki	YPX	No data	No data	100-150	No data	In studies
Mitsubishi	MRJ	2014	2014	70-90	PW GTF	Sophisticated entry at lower level to compete with E170-190
Sukhoi	SuperJet	2010	2011	70-100	Powerjet SaM146	Aircraft currently in certification testing for near-term EIS

Source: AirInsight

[6] Contingently repayable contributions from the governments of Canada, Quebec and the UK. The repayable contributions are fully compliant with the trade obligations and relevant WTO rulings in the prior dispute involving Canada and Brazil.

II. CSeries History

Initial Studies

The CSeries story is not unlike most major aircraft programs. Initial concepts in many programs change and in many cases, the end-product bears little resemblance to the first design. Programs often evolve from concept to concept, sometimes with antecedents from other programs or concepts.

For example, the Boeing 787 evolved from the Sonic Cruiser; the 747-8 went through several iterations that were proposed and discarded; and the Airbus A350 began as an extreme makeover of the A330 and went through five more iterations before the XWB was confirmed as the final offering.

Initial Evolution

The CSeries evolved in much the same way. Bombardier was working on the BRJX (Bombardier Regional Jet eXpansion) in 1998, and was evaluating a larger regional jet than the one it had, which was based on its Canadair Regional Jet. The BRJX was to have a wider fuselage with 2+3 seating and wing mounted engines. The BRJX was to seat 80- to 120-passengers. This put the BRJX in competition with small narrow-body airliners like the 2+3 McDonnell Douglas MD-95, the 2+2 Embraer E-Jets, the 3+3 737-600 and the 3+3 A318.

However, that program did not gain much traction and was shelved in mid-2000 in favor of stretching the CRJ700 into the CRJ900 and, ultimately, the CRJ1000. Shortly after this decision, Embraer's 80-seat E-170 came to market, and was followed by the 110-seat E-195. Both Embraer airplanes became best-sellers.

Alternatives

The concept of the 100-seat airliner has had merit but in recent decades has been poorly executed. The MD-95 (renamed the 717 after Boeing and McDonnell Douglas merged) met with some initial success. With obvious antecedents to the Douglas DC-9, the MD-95 essentially returned McDonnell Douglas to its original roots in the 100-130 seat segment. Douglas developed the DC-9 into a family of airplanes; it first flew in 1965 and the final model was produced in 1982 after 964 had been sold. The MD-95 was based on three generations of DC-9 derivatives. Embraer was a new entrant into the 90-110 seat market segment and also met with success with its E-Jets, which have sold well. Clearly there is demand for a 100-seat airliner.

Boeing and Airbus today are up-gauging aircraft size in their market forecasts as current (A320 and 737) and out-of-production products (757-200/300) age. Emerging competitors Irkut and COMAC are focusing on the 150-210 seat market. New entrants AVIC, Mitsubishi and Sukhoi are developing aircraft in the 70-100 seat segment. This leaves a major gap in the 100-149 market that currently has the aging 737-700 and A319 and the newer, but design-limited 108-seat E-195. The 100-149 seat segment still represents about 23%-25% of the 100-200 seat market and it is too large to ignore. It is this market that the CSeries is designed to exploit.

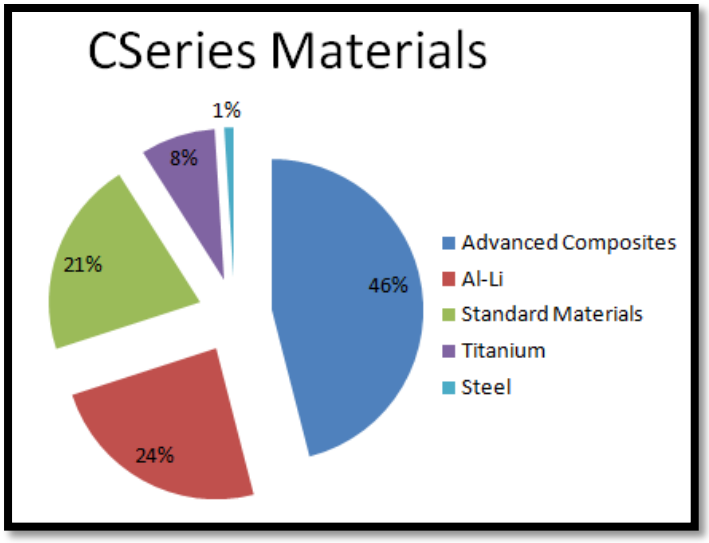
The demise of Fokker was another step in the evolving market consolidation of aircraft manufacturers. Just as the British and French aerospace industries had been through a long period of consolidation, with the creation of Airbus the end result, the elimination of Fokker—once a robust provider or regional turbo-props and small jets—Bombardier, ATR and Embraer emerged as the winners in consolidation of this market.

As fuel prices increased, it was inevitable that a strategic redirection of the product lines would emerge. Embraer was the first to exploit this with the development of the new E-Jets, superseding the cramped ERJs that had their roots with the Embraer turbo-props (sharing the fuselages). Bombardier's attempt to develop the BRJX may be considered by some to be a false start, but in reality is little different than the evolutions experienced by airliner OEMs in research and development.

By July 2004, Bombardier had come to a decision and announced the development of the CSeries family to replace the cancelled BRJX project. The CSeries would be larger than the Canadair Regional Jets, carrying 110- to 130-passengers, also making it larger than the BRJX. Bombardier would now be competing directly with models from Airbus and Boeing. Bombardier expected the aircraft to be available by 2010.

In March 2005, Bombardier's Board of Directors approved promotion of the airplane to customers for advance orders. Two models were announced: the C110 with 100-125 seats, and the C130 with 120-145 seats. The initial concept used conventional materials, drawing scathing criticism from respected aerospace consultant Richard Aboulafia of The Teal Group, among others. On January 31, 2006, Bombardier announced it would not go forward with the CSeries development after it failed to secure any orders. Bombardier kept a small team of 50 working on the CSeries marketing plan. With the CSeries on hold, Bombardier announced in 2007, that it would begin work on the 100-seat CRJ-1000 regional jet. This was to be the final stretch of their successful regional jet.

Bombardier continued R&D on the CSeries and in January 2007 revealed a revised proposal. The CSeries would now feature new fuel-efficient engines, composite wings, nacelles and tail, and aluminum lithium for the fuselage, resulting in the use of 70% in advanced materials. The approach is very similar to that Airbus (A350) and Boeing (787) were promoting for their new programs.



Source: Flight International

Bombardier secured agreements with the Canadian Government, the Provincial Government of Quebec, and the Government of the United Kingdom for support and loans for the CSeries project. The Canadian government committed $CDN350 million, the Provincial Government of Quebec $CDN 118 million, and the British government committed £134.37 million. The program was expected to cost about $3.5 billion, and Bombardier would fund the remainder.

The Bombardier Board of Directors provided the Authority to Offer (ATO) the airplane in February 2008 for an entry into service in 2013.

Engine Selection

Bombardier's selection of the P&W geared fan engine (GTF) was sporty and yet an excellent choice. As Boeing has discovered with new engines for its new 787 and 747-8 and Airbus with the A380 and the Rolls-Royce Trent 900, mating a new airplane with a new engine can prove challenging, to say the least. The selection of a GTF has come under its share of skepticism and criticism, but P&W has built more than 54,000 geared turbine engines for helicopters and turboprop airplanes and these engines have accumulated over 640 million flight hours. The GTF has been under development for 20 years.

P&W is the only engine manufacturer offering a step-change in fuel-burn, noise and emission aligned with CSeries 2013 EIS. CFM plans to have its competing LEAP-X engine EIS in 2016, if everything goes according to plan. The LEAP-X draws from technology developed for the 787/747-8 GEnx engines and uses new-technology materials but otherwise is a more conventional design than the GTF. It is also three years later than the GTF. For the CSeries, the GTF was not only a good choice, it was the only choice.

To be sure, P&W's gestation had its challenges. P&W first attempted a geared turbofan in 1998, then known as the PW8000. This was an upgrade of the conventional PW6000 and replaced the fan section with a gearbox and new two-stage fan. After several years of development the PW8000

disappeared, but the firm's engineers realized the concept was worth continuing R&D. This led to the GTF program that was based around a newly designed core jointly developed with MTU Aero Engines of Germany.

In July 2008, the GTF was renamed the PW1000G, the first in a line of "PurePower" engines. The PW1000G is advertised as 16% more fuel efficient than current engines,[7] as well as being substantially quieter and emitting far fewer CO2, NOx and other emissions. Indeed the engine's numbers are a key to the CSeries' success. As an airplane capable of flying into inner city airports, the 75% reduction in noise becomes crucial. Airports like London City, John Wayne (Irvine, CA), Washington Reagan (Washington, DC) and La Guardia (New York, NY) come to mind. With such a quiet engine, the CSeries is unlikely to experience anything like the current restrictions.[8] This applies particularly in noise-sensitive Europe.

In addition to the low noise, the engine is much simpler. It has 6,000 fewer foils making its MRO impact for an airline considerably simpler and lower cost. Indeed, Philip Meeson[9] noted his favorable view of the engine is based on the fact that his airline has to buy three tons of carbon credits for each ton of fuel they buy. Consequently every ton of fuel saved generates real benefits. Nico Buchholtz[10] noted that if he could save his airline even 1% of its annual fuel bill, the savings would be substantial, so with high double digit savings possible from this new engine, the case for its deployment is clear.

The engine has also been selected by Mitsubishi and Irkut for their new projects. Airbus' decision to proceed with the A320neo includes the GTF and the CFM LEAP-X. Airbus' Leahy is confident of the projected fuel burn, maintenance savings and reliability promised by PW. Moreover, we understand that Embraer is seriously considering the engine for its E-Jets.

[7] This is an "engine stand" figure. Installing an engine (regardless of who's it is) on an airframe lowers the installed fuel savings, typically by 1%-2%.

[8] http://europa.eu/legislation_summaries/transport/air_transport/l28068_en.htm

[9] CEO Jet2go.com

[10] SVP Corporate Fleet, Airline Strategies, Lufthansa AG

Program Production Timeline

On August 19, 2009, the first test article for the CSeries aircraft - a fuselage test barrel - arrived ahead of schedule at Bombardier's Saint-Laurent, Québec site from China. The test barrel is being used to demonstrate manufacturing and engineering structural concepts before the CSeries aircraft's final design phase.

September 15, 2009, marked a major milestone for the CSeries program when Bombardier did groundbreaking for the first CSeries aircraft building in Québec, Canada. Located at Mirabel, near Montreal, the Complete Integrated Aircraft Systems Test Area (CIASTA) is the testing and systems-proving facility that houses a virtual CSeries test aircraft. The CIASTA tests aircraft systems for reliability and functionality one year before the first prototype aircraft flies.

On November 17, 2009, Bombardier achieved another milestone in the CSeries program when construction started on its aircraft wing manufacturing and assembly facility in Belfast, Northern Ireland.

On March 24, 2010, there was a foundation stone-laying ceremony was held in Shenyang, China, to mark the start of construction of the facility that will build the fuselage for the CSeries. The facility will be operated by Shenyang Aircraft Corporation (SAC), a subsidiary of the state-owned aviation entity, China Aviation Industry Corporation (AVIC). SAC is a key supplier in the Bombardier CSeries aircraft program.

On March 30, 2010, Bombardier announced testing of the CSeries composite demonstrator wing was under way. The testing took place at the Belfast facility, which is responsible for the design, development and manufacture of the advanced composite wings for the CSeries. The demonstrator wing was successfully tested to ultimate load, replicating 150% of the most severe forces the wing is likely to face. In October 2010 the product development team in Montreal successfully test mated an advanced composite outer wing portion to a composite center wing box. This successfully established the manufacturing requirements for the aircraft well before production begins.

First Orders

At a press conference prior to the opening of the 2008 Farnborough Airshow, Bombardier announced the launch of the CSeries, with a Letter of Interest for 60 aircraft (including 30 options) from Lufthansa. This was a crucial endorsement for the program. A Tier One customer with a big order was a major boost. On March 11, 2009, Bombardier announced their first firm order for the CSeries when Lufthansa firmed the LOI.

Bombardier signed its second CSeries order on March 30, 2009, with Lease Corporation International (LCI) of Dublin, Ireland, which ordered three CS100s and 17 CS300s, becoming the launch customer of the latter. LCI holds options for a further 20 aircraft.

Thereafter there was a long order drought, driven by the economic slump that caused airlines to park aircraft as traffic fell precipitously. In February 2010 Republic Airways Holdings ordered 40 CS300 aircraft with options for an additional 40. This order was a major boost to the program as

this was its first North American sale and the airplanes are planned to replace Airbus equipment, believed to be a key reason why Airbus reacted the way it did after this order. Crucially, Republic is also an Embraer E-Jet customer. Consequently this order spoke volumes of the CSeries' promise and its ability to compete directly with Airbus and Boeing.

Several airlines and lessors are evaluating the CSeries, including SAS, easyJet, United Airlines, Qantaslink, Air France and Air Canada. We know of two possible orders in China. Then there is the on-again off-again order from Qatar. This airline's mercurial CEO has said encouraging things about the airplane as he ponders an order – but has also said that an Airbus NEO would make the case for the CSeries moot[11], while other reports suggest he could launch the CSeries and the A320neo[12].

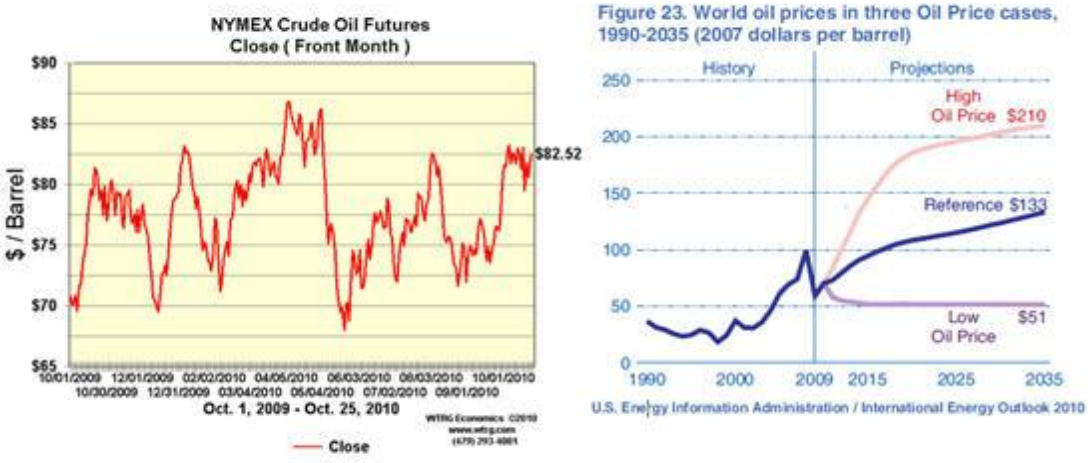
We see the market for airplanes between 100- and 149-seats to be lucrative, even if viewed as a niche market. The A320 and 737 replacement airplanes in the next 10-20 years are likely to start at 150-seats and go up, not down; and neither Airbus nor Boeing is likely to develop two replacement models for the A320 and 737 families to cover the entire segment between 100-240 seats. Boeing looks increasingly likely to bypass a 737RE and the A319neo simply cannot compete with the CSeries economically; Airbus (and Boeing) may well be able to undercut Bombardier on price, however, to suppress CSeries sales.

[11] ATW Online, October 14, 2009. http://bit.ly/bn1p6p

[12] Aviation Week September 21 2010 http://bit.ly/9LUKWC

III. MARKET DRIVERS

The unprecedented run-up in oil prices from 2005-2008, when global economic conditions and speculators pushed the price to nearly $150/bbl in 2008, clearly got the attention of the airlines. When the Boeing 787 was launched in December 2003 (then known as the 7E7, E for Efficiency), oil was at a then-unprecedented $33bbl. Despite a dramatic decline in oil prices following the 2008 peak that caught even master-fuel hedger Southwest Airlines on the wrong side, oil has crept back up and continues to show volatility in the 12 months to September 2010, with current expectations that oil will soon again approach $100 bbl.



Predicting future oil prices is all over the map, from a high of $200bbl in 2030 to a low of $50bbl and a middle ground of $130.

Clearly, airlines must have more efficient aircraft and this has been the driver for the incumbent and emerging aerospace companies to design and produce more efficient engines and airframes.

Bombardier was first with the CSeries. In 2004, the company announced plans to develop a 110-130-seat airplane that was directly competitive with the A318 and 737-600. Embraer was already in this market with the slightly smaller E-190/195 offering. Bombardier's original CSeries concept fell short in the use of advanced materials and in size. Subsequent concepts adopted extensive use of advanced materials and increased capacity to 145 in reasonably comfortable single-class pitch. The products were renamed the CS100 (110-seats) and CS300 (130-seats) in one-class configuration, or 125 and 145 in high density class. This made the CSeries directly competitive with the A319 and 737-700. While neither the A319 nor the 737-700 is the most popular models of their respective families, these nonetheless represented significant market shares at about 25% of the total single-aisle market segment, or some 6,500 aircraft over the next 20 years according to the average of market forecasts of the Big Four OEMs.

While many correctly point out that the 100-149-seat market is a shrinking segment, it nonetheless remains too big to ignore. Bombardier has a history of identifying and successfully pursuing markets. Bombardier invented the regional jet with its CRJ series, albeit using a derivative of a business jet to pursue it. Bombardier has refined the Dash 8 series into the highly efficient Q400 and continues to dominate the turbo-prop market duopoly with EADS' ATR joint venture[13]. While Bombardier was slow to respond to Embraer's E-Jet Series, which in the largest E190/195 version remains at the lower end of the 100-149-seat market, Bombardier's CSeries is large enough to provide a direct threat to Airbus and Boeing mainline aircraft.

Given Bombardier's history of successfully identifying and capitalizing on niches, there is no reason to believe it cannot successfully design an efficient, viable airplane for the 100-149-seat segment. The *threat* to Bombardier, however, is provoking the response that it has from the Big Two OEMs.

The CSeries incorporates 21st Century technology for its systems, airframe and the choice of the P&W PW1000G. The GTF is the first entirely new engine for a mainline jet in some 30 years, and the geared approach has been subject to criticism from CFM International (which is developing the competing LEAP-X) and Rolls-Royce (developing the competing RB285). The CFM and RR developmental engines are traditional two- and three-stage turbo-fans respectively, using new technologies. Setting aside the debate of which approaches are best as being largely outside the scope of this Study, there is no denying that Bombardier's choice of the GTF has been one of the key elements to the market-driving impact of the CSeries.

Suffice it to say that the GTF has been selected by Bombardier, Mitsubishi for its 70-90 seat MRJ regional jet, Irkut for the 150-210 seat MS-21 and Airbus for the A320neo. Airbus has also selected the LEAP-X as another engine option for the A320 and China's COMAC selected the LEAP-X for the 150-210 seat C919. CFM agreed to a joint venture with COMAC's parent, AVIC, to develop an indigenous Chinese engine and nacelles and other parts for the C919, and undoubtedly this had a bearing on the choice of the LEAP-X to power the C919.

The launch of the CSeries by Lufthansa for its Swiss Air subsidiary did not spur Airbus (and by extension, Boeing) to seriously consider an RE. The program launch was announced at the Farnborough Air Show 2008[14]. The program launch was a curiosity: Lufthansa signed a "Letter of Interest," which did not even rise to the more common Letter of Intent or Memorandum of Understanding that is typical of aircraft orders. Lufthansa subsequently firmed the order, with

[13] Bombardier's heritage of identifying niche markets goes to its DeHavilland roots and the development of the Beaver, Otter, Twin Otter and Buffalo airplanes—and in a bow to Airbus' John Leahy's famous put-down, yes, Bombardier's founder invented the snowmobile.

[14] Repeated assertions in the blogs that the program was launched six years ago, or in 2004, and has been one continuous sales effort are simply incorrect. These assertions are irresponsible distortions of the facts. The original studies and concepts date to then, with an ATO, but the program was shelved and restarted a year later. The ATO for the current version of the CSeries did not occur until 2008.

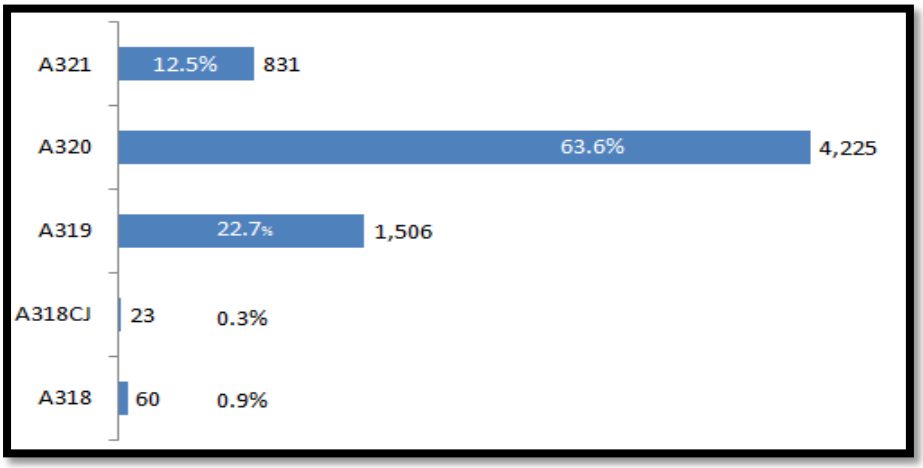
deliveries starting in 2014. At the same show, Airbus' John Leahy dismissed any interest in an A320RE and ridiculed the Letter of Interest obtained by Bombardier from Lufthansa.

A subsequent order by lessor LCI of Dublin also failed to impress the market because the lessor, while credible, did not have the "brand name" of an International Lease Finance Corp., GECAS, CIT Aerospace or Aviation Capital Group[15].

It was the order from Republic Airways Holdings, parent of Midwest Airlines, Frontier Airlines and several regional carriers, for 40 firm and 40 option CSeries that caused Airbus to take notice. Frontier was at the time an exclusive Airbus operator (save for a handful of Bombardier Q400s for feeder services)[16], and Airbus competed for the order. Republic intends to replace the existing A319 fleet, which is quite young, with the CSeries[17].

AIRBUS NEO

The loss of the Frontier (Republic) order clearly spurred Airbus into action. Although the A319 is in a market segment that is far smaller than the 150-200 seat segment, Airbus has sold more than 1,500 of the type through August 2010, or 23% of the A320 family.



The A319 represents 23% of A320 family sales from model sub-type launch through August 2010. Source: Airbus.

[15] ILFC and CIT were then adversely affected by financial difficulties at their parent companies; GECAS will not order airplanes equipped with engines from competitors to sister company GE Aviation; and Aviation Capital only has ordered Airbus and Boeing popular mainline jets, avoiding the A318 and 737-600.

[16] Since the combination of Frontier and Midwest Airlines under the Frontier banner, Frontier also now operates E-Jets.

[17] Since deliveries aren't until 2015, the airline has time to assess market demand and other factors. The CSeries could be used for replacement, growth, or a mix, depending on what makes the most sense.

Based on information deemed to be reliable, we believe the A320 family is the most profitable aircraft in the Airbus line. The A330 is more profitable on a plane-by-plane basis, but the sheer quantity of the A320 family makes this the cash cow for Airbus. The A340 is a dead program and the A380 is still four or five years away from being profitable, according to Airbus[18]. Thus, Airbus is particularly motivated to protect A319 sales[19]. Any encroachment by Bombardier on the A319, which had an average list price of $74.4 million in 2010 (estimated $55.8 million after 25% discounts) is a substantial revenue, cash flow and profit hit to Airbus on its cash-cow family. The 180 firm and option orders for the CSeries represents $5 billion in revenue diversion to Airbus at the 25% discount, assuming the roughly 50-50 historical split between the A319 and 737-700. With a list price of $63 million for the CS300 and a suggested premium of $6 million for the NEO, Airbus will have to engage in some deep discounting to offset the anticipated actual, discounted sales price of the CSeries.[20]

Bombardier forecasts that it will capture 50% of the 20-year 6,700 unit market for the 100-150-seat segment, a figure that is, in our judgment, optimistic with four players (Airbus, Boeing, Bombardier and Embraer) today and prospectively more in the next 20 years[21]. From a simplified approach, if Bombardier captured only one-quarter of this market, this would be 1,675 sales denied Airbus and Boeing, which historically have split the 100-149 segment about 50-50. With the A320 family being the Airbus cash cow, the motivation to destroy the business case for the CSeries is readily apparent.

At the same time, because the A380 and A400M programs continue to be substantial cash drains on Airbus, and with research and development funding soon to be peaking for the A350 XWB, Airbus cannot afford to undertake a new airplane program any time soon. Officials say technology doesn't exist today and is unlikely to exist until 2025 or later to support development of an entirely new airplane. Boeing disagrees, as will be discussed below. The alternative, then, is for Airbus to re-engine the A319/A320/A321[22] at minimal cost. Airbus plans to have 95% commonality of the A320neo with the current fleet.

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[18] A380 program profitability is a relative term in this context. Airbus at one point projected break-even at some 425+ aircraft, and even in five years Airbus will be a significant distance from this figure. Asked for clarification on the five year forecast in May 2010, Airbus officials said that is after the multi-billion dollar write offs for the program, which effectively "reset the clock" on profitability.

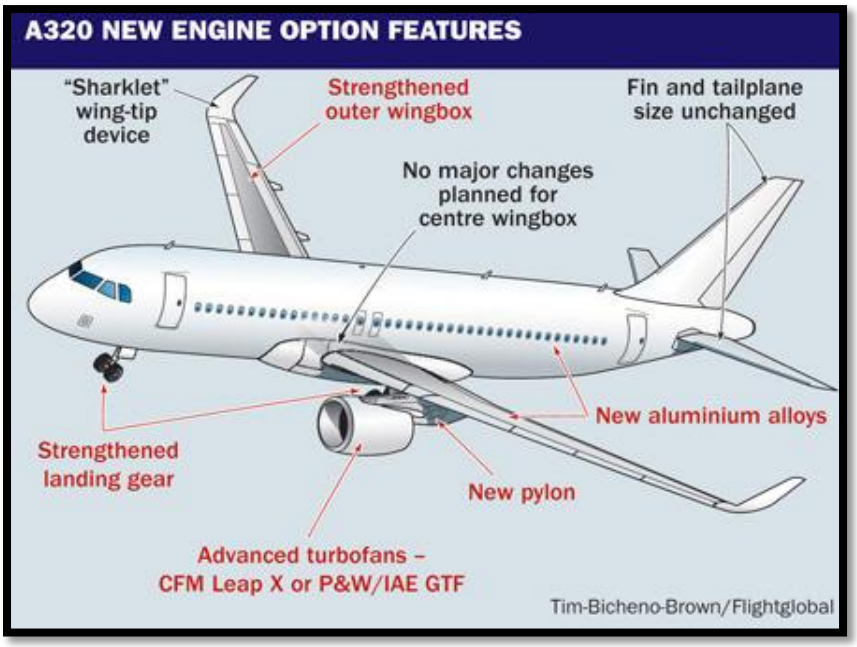
[19] The A318 is largely a non-issue. Through August 2010, 83 have been sold, including 23 to Corporate Jet users. The collapse of Mexicana, which operated A318s, the bankruptcy of Frontier and reorganization decision to dispose of its A318s, and the decision by Lan Chile to dispose of its A318s, has glutted the market. A two year old A318 has already been scrapped. This is testimony to the unattractiveness for this inefficient double-shrink of the A320.

[20] Airbus would have to discount the A319NEO by 41% just to *match* the projected CS300 discounted price.

[21] We assume that Mitsubishi, Sukhoi and AVIC will grow the MRJ, SuperJet and ARJ21 to at least the lower-end segment in the 100-149 market.

[22] Airbus currently says it will not re-engine the A318, but may at a later date. In our view, this is another indicator of the unwanted step-child nature of this airplane. Airbus will offer the sharklet on the A318.

This is both good and bad. It is good in that maintenance, parts and training commonality is retained. It is bad in that the A320 is a 1980s design with 20th Century technology, and therefore the A319neo will be competing with the 21st technology CSeries.



Airbus's John Leahy, COO-Customers, says the A320NEO will have 95% commonality with the current A320 family. Flight Global shows the prospective changes to the NEO.

The A320neo will also compete with the COMAC C919 and Irkut MS-21, both designed in the 21st Century. It is, however, unclear, precisely how advanced these airplane truly will be. In any case, as the first products of newly formed aerospace companies, we are not convinced these will be fully competitive even with the current A320 and 737, despite the age and technological differences. There is no question that Airbus and Boeing have the worldwide customer support infrastructure that COMAC and Irkut do not have and will not any time soon.

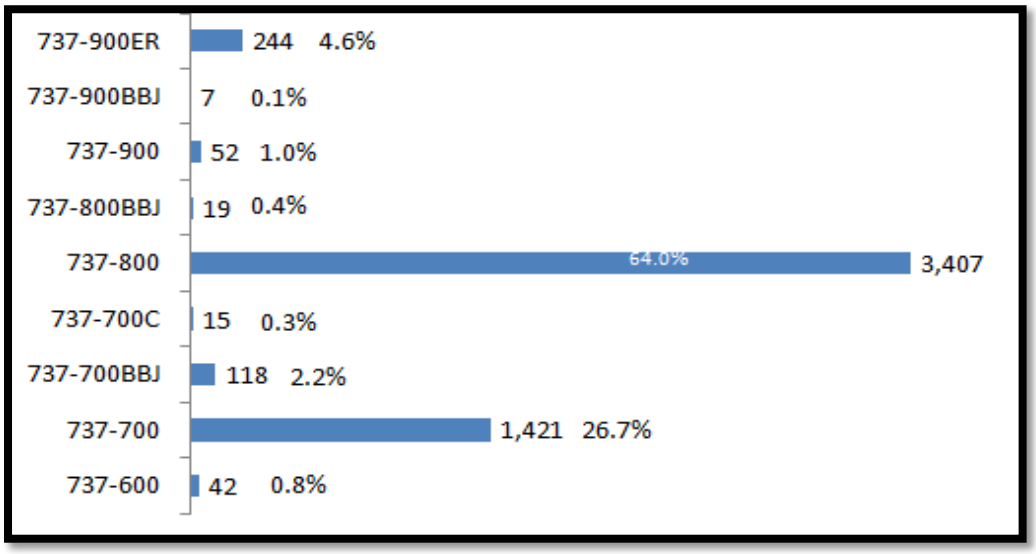
Thus, in the 2015-2030 period at least, we regard COMAC and Irkut to be largely home-market airplanes with limited threat to Airbus and Boeing. (The home-market threats should not be underestimated, however.) Beyond 2030, as COMAC and Irkut mature, we believe these new companies may well be more competitive threats to Airbus and Boeing than is currently generally

recognized[23]. Bombardier, on the other hand, and Embraer, have well-established global customer service networks and we believe represent a more immediate competitive threat.[24]

Airbus believes the Direct Operating Cost (DOC) "delta" between its A319neo and the CSeries will not be great enough to offset the commonality benefits of an all A320-fleet. The DOC debate will be discussed in our Economics section, where we will also discuss economic issues beyond DOC that airlines and lessors will weigh, not the least of which is the CS300ER will probably be around 18,800 lbs lighter than the A319neo, an advantage when it comes to landing fees.

Boeing 737

Spurred by Airbus' new-found interest in an RE program and customer desire for significant fuel reduction sooner rather than later, Boeing undertook serious studies whether to re-engine the 737 (737RE), accelerate a replacement program (737RS) or to do nothing (737DN). Early on, Jim Albaugh, the CEO of Boeing Commercial Airplanes, said the 737DN was not an option.



The 737-700 commercial version represents 27% of total 737NG sales over the life of the program, through August 31, 2010. 737-700BBJ sales are 2%; 737-600 sales are negligible. Source: Boeing.

A 737RE is technically feasible, but much more costly than the A320neo. Airbus estimates the NEO R&D will be $1.3 billion-$1.5 billion (1 billion Euros); Boeing loosely estimated the cost of a 737RE at $2 billion-$3 billion; one internal Boeing study suggests the price could be as high as $4 billion. Because of the lower ground clearance and larger diameter fans of either the PW GTF or the CFM

[23] COMAC finally received firm orders for the C919 at the Zhuhai Air Show (Nov. 16-21), but the quantity was far less than the "hundreds" the Chinese suggested would be forthcoming. There were just 55 firm orders and 45 options. The Big Three airlines, Air China, China Eastern and China Southern, placed only five firm orders each. Other orders came from Hainan Airlines, GECAS and the China Development Bank. All-in-all, the showing was quite disappointing.

[24] Some market sources criticize Bombardier for poor customer support, which Airbus and Boeing may use to discourage CSeries sales.

LEAP-X, Boeing has to raise the nose and undertake some modest structural changes in order to accommodate the new engines. Less recognized is that because the basic 737 systems architecture dates to the 1960s, systems upgrades will be required to meet FAA regulations. None of these upgrades is a showstopper, however, but it does add to the cost that Airbus does not face because the A320 already complies with the newer regulations.

CEO Albaugh believes that a 737RS with new technology is available for a 2019-2020 EIS, a view that contrasts sharply with the Airbus position that the technology will not converge until 2025-2027 or even later. Airbus clearly is betting the open rotor, or Unducted Fan (UDF), is a key answer and that composite fuselage technology has not advanced far enough for "downsizing" to the 150-200 seat airplane. Albaugh disagrees, believing second or third general composite fuselage technology advances will be ready in time for a 2020 EIS. Boeing does not appear to favor the open rotor, instead believing the GTF and LEAP-X technology and advances will offer the fuel savings goals of 26%-30% by 2025 without the challenges unique to the open rotor.

While Boeing has not discontinued studying the 737RE, officials have said the prospects of proceeding down this path appear slim. It is Boeing's conclusion that the DOC difference between the current A320 and the A320neo is a mere 3%-4% and that an A320neo and the 737-800 will only be on par. Not surprisingly, Airbus disagrees.

Boeing declined to elaborate on how it reached its DOC conclusion. However, a third party with ties to neither Airbus nor Boeing; provided this back-of-the-envelope analysis.

> "*Fuel is (as of today) about 40% of COC. If you save 15% fuel with a better SFC you lower your COC by 40%*15%=6%. Depending what your capital costs are, (DOC=COC + capital costs), the 15% fuel savings could result in DOC savings of 3-4%….*"

This same neutral source, who requires anonymity because of his position in the industry, added:

> "*Remember this is without maintenance costs, and in a world with low margins 3-4%, lower DOC can decide between life and death over the long run. And if oil goes up, savings go up, too. The CSeries, by the way, as it is not a re-engine program but a new aircraft, it has better savings, as engine and aircraft are optimized (as will/would be MS-21, C919, MRJ). This is why an A319neo cannot compete with the CS300*."[25]

Boeing is in a different cash-and-revenue position than Airbus in its considerations on the 737's future. The 737 and 777 programs are producing well, so Boeing has a bit more cushion for its cash

[25] *Airline Fleet* magazine, November-December 2010. In the same article, Nico Buchholz, fleet planner for Lufthansa Airlines who placed the order for the CSeries, also says his analysis concludes the 737RE or the A319neo cannot compete with the CSeries.

flow—but, perhaps, not much more. The 787 and 747-8 programs continue to be a major drag on Boeing. Absent more, substantial delays, both will begin delivery in 2011 (or certainly by 2012), whereas the A350 is not scheduled for delivery until late 2013, when according to the Ascend database only five are listed for delivery. Boeing's cash flow recovery from the 787 and 747 programs should be well underway by then[26].

This means Boeing could, if it chooses, roll the dice and proceed with a 737RS. But the greater need appears to be with the 777, facing the new competition from the A350. Boeing's resources, therefore, are more likely to be directed toward a 777 enhancement rather than a 737RE or 737RS.

Does this mean Boeing's answer to the CSeries is a 737DN? The answer, we believe, is "No." Boeing appears to be headed toward a 737NG+, which will try to cut weight and further achieve other enhancements to narrow, if not close, the gap it sees as just 3%-4% DOC differential between its airplane and the A320neo. This would, however, still leave the 737-700 at a significant disadvantage to the CSeries.

Furthermore, a decision by Boeing to enhance the 737 yet again, foregoing the 737RE and putting off the 737RS decision for a few more years, means **Boeing will be the only global manufacturer without a new airplane offering in the 100-149 and 150-200 seat markets.** This is a sobering thought.

Thus, we believe we have definitive proof that Bombardier's concept, design, 21st Century technology and engine selection for the CSeries has had a much more profound effect on commercial aviation than orders and perception initially suggest.[27] The fact that the CSeries EIS will, if achieved, pre-date the A320neo, 737RS and A320RS by years also provides a net present value advantage that will be hard to beat.

EMBRAER

Embraer operates at the lower-end of the market segment. Its large airplanes are the E-190/195 seating a maximum of 108. There has been talk of an E-195X (130-seats), but this project was put on the backburner. However, there is credible information that the project is back in consideration. Clearly Embraer cannot give up growth prospects--whatever is making the market attractive to Bombardier applies equally to Embraer.

[26] On November 9, 2010, Boeing encountered another 787 program setback when test plane ZA002 suffered an in-flight fire and emergency landing in Laredo, TX. The source of the fire was quickly located. An electrical arc occurred in power panel P100, causing electronic flight control software to fail. The back-ups kicked in but not as designed. Contractor Hamilton Sundstrand must redesign the panel and write new software coding. At this writing, the extent of delays have not been determined, but consensus among aerospace analysts ranges between 4-6 months from the February 2011 projected first delivery to All Nippon Airlines..

[27] A FlightGlobal poll ending November 4, 2010, with 8,281 respondents reveals 63% consider the CSeries the decade's most promising narrow-body option. The A320neo was selected by 22%, the Boeing 737NG+ by 9% and a prospective 737RE by 4%.

The table below lays out the company's E-Jet program through September 2010. As can be seen the larger models account for 54% of deliveries and 56% of sales. This indicates the popularity of their larger airplanes.

Model	Firm Orders	Options	Deliveries	Backlog
170	191	47	180	11
175	173	278	130	43
190	456	356	301	155
195	95	66	60	35
	915	747	671	244

Source: Embraer

Embraer forecasts a requirement for 6,875 new jets in the 30- to 120-seat capacity segment over the next 20 years with a total market value estimated around $200 billion[28] .

Segment	2010-2019	2020-2029	2010-2029
30-60	50	425	475
61-90	1,140	1,375	2,515
91-120	1,705	2,180	3,885
30-120	2,895	3,980	6,875

Source: Embraer

The view from Embraer underscores the growing perception that in terms of commercial jet airliners, the 100-149 seat segment is likely to see a lucrative if narrow segment of activity. Indeed, Embraer says that aircraft in the 61- to 120-seat category are improving overall industry efficiency by right-sizing larger narrow-body jets, replacing old equipment, developing new markets and helping airlines grow gradually from smaller regional jets[29].

But the approximate 100-seat segment has been a minefield for OEMs.

UNSUCCESSFUL 100-SEATERS

Skeptics of the CSeries like to point to previous airplanes in the 100-125 seat segment and the economic failure of these aircraft. These skeptics are absolutely correct about the previous aircraft: the Airbus A318, Boeing 737-600 and Boeing 717 (nee MD-95) were not successful airplanes. To a certain extent, the E-190/195 has done better but still has its limitations.

The reason is simple: the A318 is a double shrink of the A320 and the 737-600 is a shrink from the 737-700[30]. The A318 and the 737-600 were Airbus and Boeing responses to kill the MD-95, the last gasp of McDonnell Douglas, which by then was already down to a mere 7% market share. The

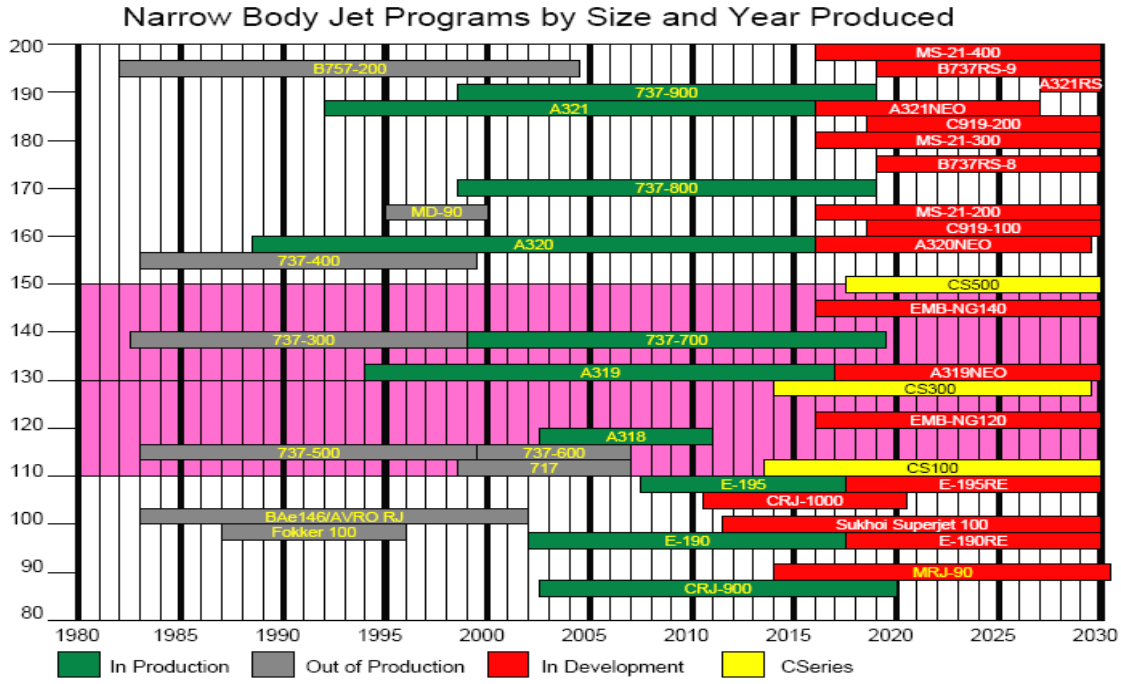
[28] Embraer 2010 Market Outlook

[29] Embraer 2010 Market Outlook

[30] We do not consider the 737-600 to be a double shrink because the -700 was the baseline aircraft. The 737-900 is a double-stretch.

Fokker programs shut down in part because European governments saw any competitor to Airbus as a threat. When Fokker left the industry, so did Fairchild-Dornier and British Aerospace. But their ideas did not die with them. The Sukhoi SuperJet bears a striking resemblance to the Dornier 728 and the Antonov 148 bears a striking resemblance to the BAe RJX. Finally, the Fokker airplanes might yet make a comeback under the reverse and clumsy name of Rekkof[31]. This company has already received some Dutch government funding to attempt a comeback with Next Generation updates of the F-70 (XF-70; 70 seats) and F-100 (XF-100; 100-seats).

This segment may be a graveyard, but largely because it has been the bastard step-child of Airbus, Boeing and McDonnell Douglas. The E-190/195 is a double-and triple stretch of the E-170/175. The E-190 has proved popular but the somewhat larger E-195 has had limited sales, perhaps demonstrating once again that design optimization rules. The CSeries is the first airplane specifically designed for this segment since the DC-9-30, 727-100 and 737-200, each of which enjoyed considerable sales success.



Source: AirInsight

After Boeing and McDonnell Douglas merged, Boeing lost little time in discontinuing the entire MD-Series, renaming the MD-95 the Boeing 717 and continuing production long enough to fulfill existing orders.

The E-190/195 are stretches of the E-170/175; the 190 series required a new wing. This series has been stretched about as far as it optimally can. The aircraft has a comfortable 2+2 seating, but

[31] http://www.rekkof.nl

stretching the capacity to 150 means an extra five rows. A more efficient approach for Embraer to compete in the 130-149 seat segment (or 130-160 seats) is an entirely new airplane, with all the risks and rewards attendant to a clean-sheet program.

This, of course, puts Airbus and Boeing in a quandary. Boeing's Jim Albaugh believes the "sweet spot" for the 737 class is now 180 seats, or nearly the size of the 737-900.[32] Boeing's Scott Fancher, head of the 787 program, told reporters in a pre-Farnborough press briefing that Boeing is most interested in the 150-240 seat segment (737-800 to 757-300) for the next single aisle airplane. Airbus hasn't been specific, but generally agrees that airplane size is moving up.

Airbus and Boeing must either abandon the 100-150-seat market or create two airplanes to cover the 100-240 seat segments. Airplane designs must be optimized and generally can accommodate one shrink and one stretch around the optimized design. The A320 is optimized design, with the A319 and A321 being successful one-step shrinks and stretches. Although the 737-700 was initially based on the original 737-200/300, and the 737-500/600 is a single-step shrink from the -700, the -600 derivative was not successful. The 737-800 is now the optimized design. The double-stretch from the -700 to the 737-900 was not successful. The 737-900ER has enjoyed more success, but this has been limited.

In plotting the future replacement airplanes, whether EIS is c. 2020 or c. 2027, neither Airbus nor Boeing can cover the 100-240 market segment with one airplane. Based on the optimized design principal, and the single-shrink or single-stretch approach, future airplanes based on the 180-seat "sweet spot" would be 160/180/200 seats, or at perhaps 150/180/210 seats.[33] To accommodate a replacement for the 757-300 (at 240 seats maximum), the typical line-up would be 200/220/240 or 180/210/240. Either configuration leaves the 100-150-seat market vacated or requiring a second new airplane. With Bombardier's CSeries EIS goal of 2013 for the CS100 and 2014 for the CS300, Bombardier would have a long lead advantage.

[32] The 737-900 to date is not a good example of a successful airplane. The initial 737-900 was a straight-forward stretch at the request of Alaska Airlines. It is exit-limited, thereby failing to take full advantage of the additional cabin space for maximum seating capacity. Range is less than the 737-800 because of the additional weight. The 737-900ER corrects these deficiencies but it is a double-stretch of the baseline 737-700 and has a highly concentrated customer user base. Overall sales of the -900 Series have been limited.

[33] The Irkut MS-21 is 150, 181 and 212 seats.

The Slow Start

We believe that the global recession, the worst since the Great Depression, the resulting financial strains and uncertainties on the airlines, and the timeline to EIS three and four years hence combined to produce slow sales since the 2008 ATO. Airlines were also waiting to see what Airbus and Boeing will do with the future of the 737-A320 programs.

With the economic recovery proceeding, a decision by Boeing that appears to favor bypassing a 737RE and finally a commitment to proceed with the A320neo, we believe that Bombardier will begin seeing more orders in 2011.

IV. Technical Data and Capabilities

Description of the CSeries

The CSeries is an advanced technology narrow-body airliner optimized for the 110-149-seat size range. As the first all new technology narrow-body trunk liner since the introduction of the A320 family in 1988, the CSeries will provide a number of innovations that will provide a strong competitive advantage over current Boeing and Airbus offerings, whether re-engined or not.

The CSeries utilizes a traditional design, with two engines mounted under wing. However, it executes that design, much like the Boeing 787, utilizing high technology materials and systems to optimize performance.

Advanced Materials

The CSeries utilizes advanced materials in its construction, including an Aluminum-Lithium (Al-Li) fuselage and composite wing. Unlike the Boeing 787, which utilizes carbon fiber composites for its fuselage construction, Bombardier chose an Al-Li alloy after evaluating trade-offs between these materials.

These new alloys are about 10% lighter than traditional aluminum construction, bringing weight reduction close to that offered by composites, which would require additional plies to provide the damage tolerance needed for narrow-body operations, negating some of the weight advantage. With only a small weight penalty, other properties, including maintainability and repairs came into play to swing the decision to the new technology metals.

For high cycle operations, these alloys have several advantages over composites. A key element is that they are damage tolerant, and that any damage to the materials can be easily discerned and repaired. Composite fuselages, which are subject to "ramp rash" from baggage handling and other service equipment hitting the fuselage, can mask damage that occurs under the surface. As a result, inspections with x-ray equipment is necessary to determine a "ding" has damaged the material internally that would require a repair, which then requires a more sophisticated repair process. The metal alloys, while lightweight, can easily be repaired using the established and proven patching process, in which new material covers the damaged area.

Second, and an element not traditionally spoken about, is that aluminum alloys behave differently from composites should a crash occur. Composites are quite rigid; the fibers within the plastics remain strong, while the resin elements tend to shatter. Lightweight aluminum alloys tend to crush, providing additional impact absorption through crumpling during a crash.

Third, price is a factor, with Al-Li alloys being less expensive than composite materials. That advantage may extend through the life of the product, as Al-Li is easily recyclable, while separating

carbon fibers from plastics in cured composite materials is more difficult, making recycling more expensive.

While Bombardier chose Al-Li alloys for the passenger cabin, it also chose carbon fiber composites for the wing. Carbon fiber composites lend themselves to advanced aerodynamic shapes, and form the optimized supercritical wing design for the CSeries. Using advanced computational capabilities, the wing has been design both power off and power on for optimized performance and integration with the PW1524G engines. The carbon fiber technology utilized for the wing incorporates proprietary technologies developed at Bombardier's former Short Brothers facilities in Northern Ireland, which has more than 50 years experience with advanced composites.

The net result is that Bombardier's CSeries will be built with 70% advanced materials; 46% advanced composites, 24% Al-Li, 21% standard materials, 8% titanium, and 1% steel.

AERODYNAMICS

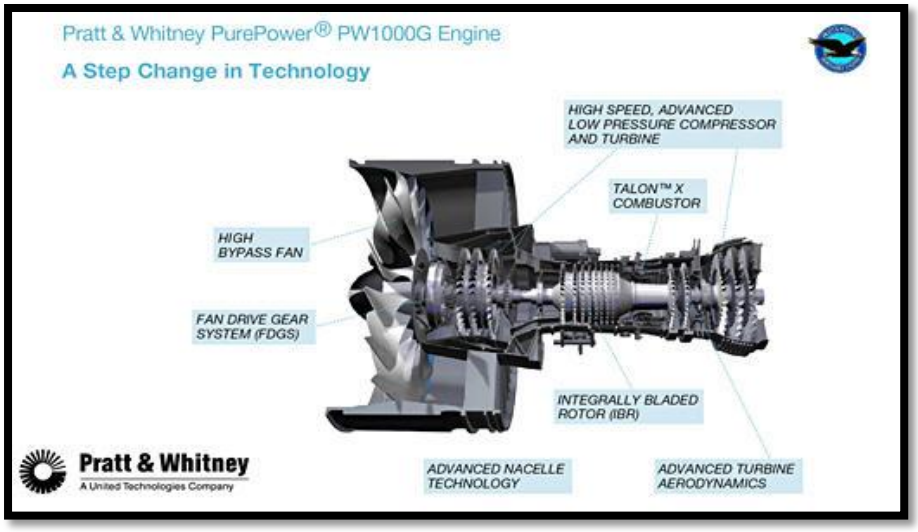
The CSeries was designed taking full advantage of today's computational capabilities and optimized for performance with the PW1000G engine in its basic design. The CSeries has been designed with state-of-the-art computation fluid dynamics capabilities, with 10^5 times more computing power than available for the design of the initial CRJ 20 years ago. This computation power enables the use of Navier-Stokes equations to compute the velocity of airflow over the design, and thereby aerodynamic drag associated with design alternatives, and enables engineers to optimize wing design at various aircraft power levels. This technology also enabled optimization of thrust reversers used on the PW1000G engines.

Wind tunnel testing was performed at several facilities including the European Transonic Wind tunnel (ETW) using cryogenic temperatures to simulate flight conditions and optimize the Flight Reynolds Number, which measures aerodynamic drag, during the development of the aircraft design.

The net result is that the CSeries has the most efficient aerodynamic design of any narrow-body aircraft in production.

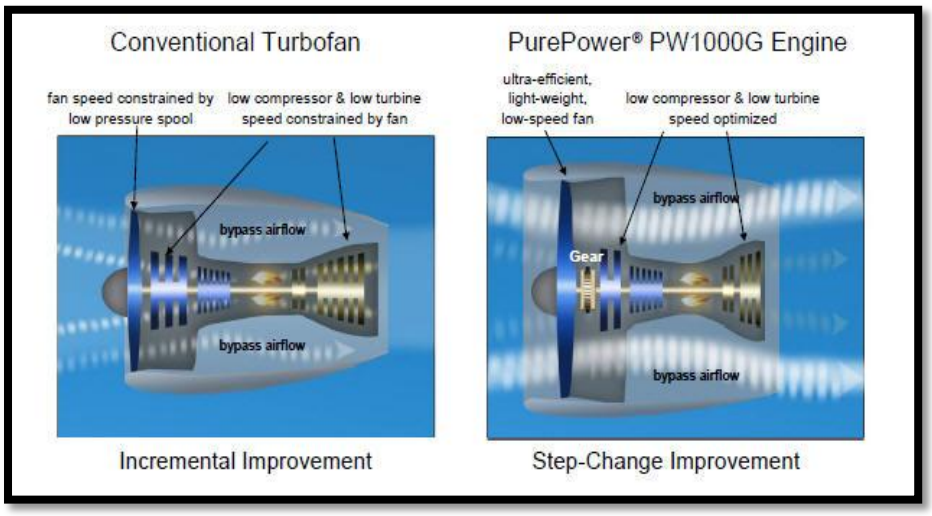
ENGINES

The CSeries is the launch customer for the P&W PW1000G "PurePower" Geared TurboFan (GTF) engine. This engine, which utilizes a gearbox to operate the fan and low pressure section of the engine at different speeds to optimize performance, will provide an immediate fuel burn decrease of 16% over current engine technology. P&W also plans future upgrades using this technology to reach a 30% savings by 2025 (the forecast EIS of an open-rotor engine) over today's engines, a level near those projected for open rotor designs, but without the negatives related to size, noise, and lower speed. The GTF engine appears to be poised to be the industry leading technology for the next generation of aircraft engines.



Source: Pratt & Whitney

The GTF provides a step-change in efficiency; it dramatically increases the bypass ratio and engine efficiency through optimization of the fan speed, which works best at low speed, and the compressor and turbines, which work best at higher speeds. In traditional engines the fan, compressor and turbines turn at the same speed, compromising the efficiency of each section.



Source: Bombardier

While the concept of a geared turbofan is not new, P&W has achieved a proprietary technological breakthrough in gearbox design and weight to make its use feasible in large commercial engines. The technology risk associated with this advanced technology is the gearbox, which is also used in every turboprop and helicopter engine application. P&W has experience with more than 54,000 engines with gear boxes that have operated over 640 million hours, providing confidence that they will be able to successfully deal with that innovative technology.

A key benefit of the GTF technology is lower maintenance costs. The increase in efficiency in the GTF engine enables the engine to run with fewer stages, which translates to fewer blades and life-limited components. The net result is that fewer parts result in lower maintenance costs. The GTF promises 20% lower maintenance costs than today's engine technology, a significant improvement.

AVIONICS

The CSeries will be a state-of-the art fly-by-wire aircraft that utilizes side stick controllers, and incorporates full envelope protection and speed software. The cockpit was designed to reduce pilot workload with enhanced ergonomics, in includes a standard glass cockpit with five large 15.1" LCD displays, auto throttle, full Cat IIIa Autoland capabilities (IIIb optional), dual flight management systems, electronic check-lists, data links and printers. Optional equipment includes heads-up displays and Class 2 electronic flight bags, as the capabilities of a Class 3 are already incorporated into the avionics.

Importantly, the CSeries will have telemetry[34] of in-flight data, which will avoid the loss of a flight data recorder under circumstance similar to the tragic Air France Flight 447 disappearance over the South Atlantic. The CSeries will be the first airplane so-equipped.

MAINTENANCE TECHNOLOGY

The first real-time interactive maintenance system will broadcast data from the aircraft to ground stations to provide both prognostic and diagnostic information about the aircraft to optimize the maintenance process. Should a fault occur, diagnostic information is streamed real time to enable mechanics at the next station to be ready with whatever parts and procedures are needed to expedite repairs. More routinely, prognostic data related to on-condition performance of components on the aircraft will be provided to alert an airline of performance degradation that can be used to prevent a potential fault before it occurs, thereby maximizing up-time.

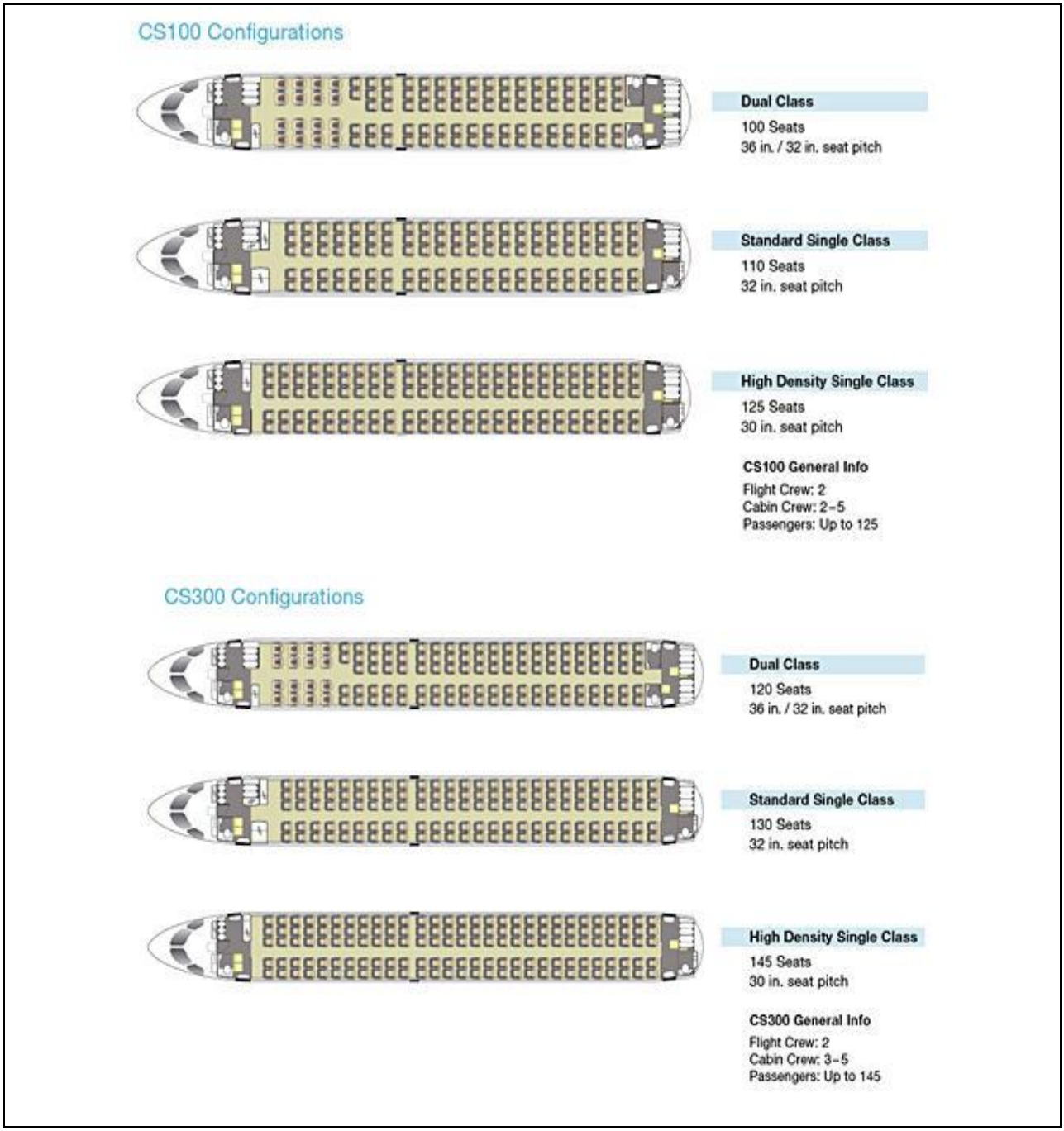
The decision to exploit continuous Internet access serves to demonstrate that aircraft maintenance might be in reality the best reason for an airline to install the equipment. In-flight Internet access has proven to not be reaching the usage levels airlines had hoped for as an ancillary revenue stream. But exploiting the bandwidth for operations certainly changes the economics and may provide airlines with justification for this investment. A further boost to this decision is the fact that Embraer's Mauro Kern described to us in a recorded interview[35] that his firm's next new airplane would be "intelligent" and act as a node on a network, not just reporting to its owners and operators, but also networking and communicating with other aircraft in the sky near and around it. In addition, with the A350, Airbus will provide as standard equipment SBB communications capabilities. There is every reason to believe Airbus will migrate this to its other aircraft in due course.

[34] The CSeries will be able to transmit data on an event triggered based system via various customizable means selected by operators (i.e. wireless on ground, datalink, Satcom, SwiftBroadband under consideration).

[35] http://iagblog.podomatic.com/entry/2010-04-21T11_28_50-07_00

Interiors

The CSeries will utilize new lightweight interior components in a design that provides more storage space per passenger, larger windows, and wider seats than today's aircraft. The CSeries, with a 2+3 seat design in the coach cabin, will be unique in offering a middle seat that is one-half inch wider than the adjacent window and aisle seats to provide additional comfort.



Source: Bombardier

The CSeries will also utilize wide-body style pivoting overhead bins to provide the capability to store larger carry-on items, and accommodate roller-bags wheels first to increase capacity. LCD mood lighting, stand-up lavatories, and advanced entertainment systems provide the CSeries with state-of-the art interior technologies.

TECHNICAL DATA

The CSeries is offered in two basic models, the CS100 and CS300. Basic dimensions for the aircraft are shown in the table below:

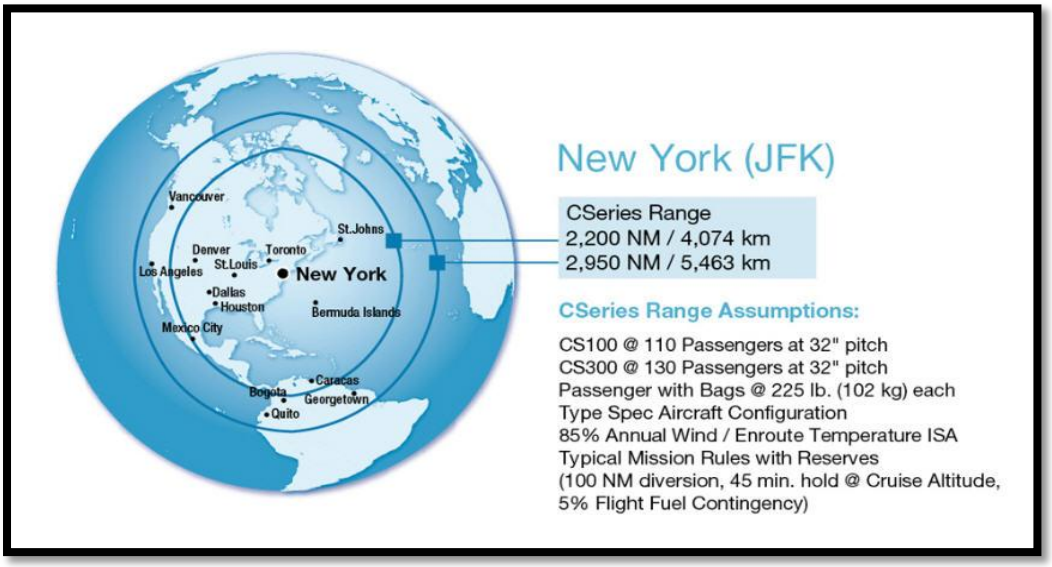
	CS100	**CS300**
External		
Length	114' 6"	124' 10"
Wingspan	115' 1"	115' 1"
Wing Area (net)	1209 sq ft	1209 sq ft
Height	37' 9"	37' 9"
Fuselage Max Diameter	12' 2"	12' 2"
Internal		
Cabin Length	74' 7"	84' 11"
Cabin Max Width	10' 9"	10' 9"
Cabin Width (floor)	10' 1"	10' 1"
Cabin Aisle Height	7'	7'
Cabin Aisle Width	20"	20"
Seat Width (aisle, window)	18.5"	18.5"
Seat Width (middle)	19"	19"
Overhead Bin Vol/Pax	2.4 cu ft	2.4 cu ft
Cargo Volume	819 cu ft	1058 cu ft
Floor Area	750 sq ft	855 sq ft

The CSeries is offered in five models, CS100, CS100ER, CS300, CS300XT, and CS300ER. The base CS100 and CS300 models utilize the baseline 21,000 lb. thrust engine. The XT (for extra thrust) model utilizes the 23,300 lb. thrust engine. The extended range models offer additional fuel capacity in addition to 23,300 lb. thrust engines.

Bombardier CSeries					
Characteristics & Performance	**CS100**	**CS100ER**	**CS300**	**CS300XT**	**CS300ER**
Max Ramp Wgt (lbs)	122,100	129,200	132,800	132,800	140,600
MTOW (lbs)	121,000	128,200	131,800	131,800	139,600
MLW (lbs)	111,500	111,500	122,000	122,000	122,000
Max Payload (lbs)	32,100	32,100	38,200	38,200	38,200
Cargo (lbs)	8,190	8,190	10,580	10,580	10,580
Ceiling (ft)	41,000	41,000	41,000	41,000	41,000
Max Cruise (kts)	470	470	470	470	470
Normal Cruise (kts)	447	447	447	447	447
Range (nm)	2,200	2,950	2,200	2,200	2,950
Takeoff length (ft)	4,950	4,950	6,240	5,450	6,200
Landing length (ft)	4,430	4,430	4,750	4,750	4,750

PERFORMANCE

Both the CS100ER and CS300ER provide the capability for full US transcontinental operations, with a 2,950 nautical mile range. With a normal cruise speed of M.78, this aircraft is competitive with the A320 and 737NG families for such operations. The chart below shows the CSeries range from New York, from which Vancouver and Quito, Ecuador, are within range.



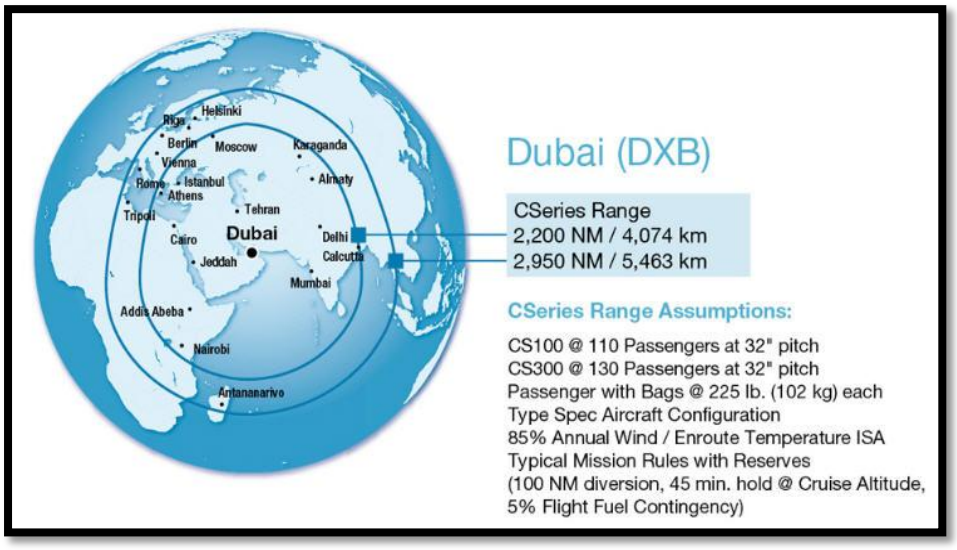
Source: Bombardier

Another important element for the CSeries is the ability to operate from more challenging airports. The CS100 can easily operate from London City Airport with adequate range to take full passenger loads as far as Moscow, Athens, Tripoli, Marrakech, or Reykjavik.

CS-100 Range from London City

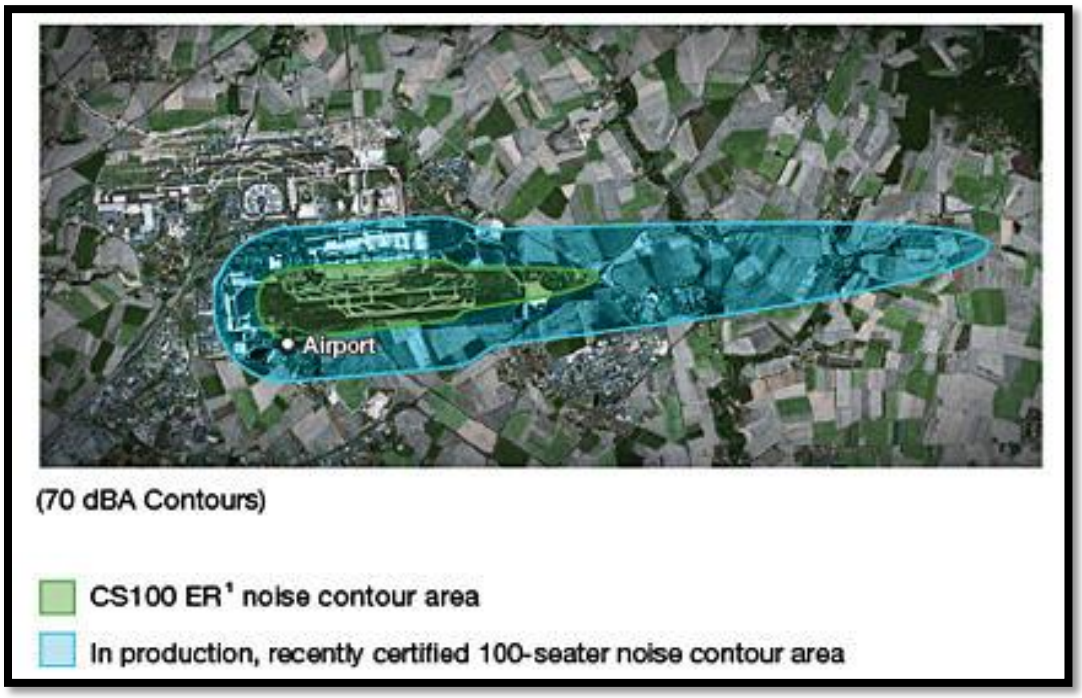
Source: Bombardier

In addition to short-field performance, the aircraft performs well under high and hot conditions, such as from Dubai or Doha to major destinations in Europe, India and Africa. These capabilities enable airlines to operate long, thin routes with capacity matched to the markets or increase frequencies to take advantage of high-yield business markets that require daily service.



Source: Bombardier

Environmental performance for the CSeries is significant, with strong margins to Stage 4 noise levels and CAEP6 emissions levels. The CS100 has a 21 EPNdB margin to Stage 4 levels, and the CS300 a 20 EPNdB margin. Because the decibel scale is logarithmic, this is 200% below Stage 4 levels. The CSeries is four times quieter than current 100 seat airplanes in-production competitors, as shown in the 70dBA noise contour chart below. To understand what this means in terms of noise impact – the CSeries should be as quiet as a turboprop at takeoff. A person standing at mid-runway will find the GTF's engine takeoff noise remarkably lower compared to current airplanes.



Source: Bombardier

Emissions for the CSeries are also well below CAEP6 levels, with a 56% margin levels for nitrous oxide (NOx) for the base versions, and 58% for the ER versions with higher thrust engines. Margins for both series will be 80% for smoke, 85% for unburned hydrocarbons, and 80% for carbon monoxide (CO). The net result is that the CSeries will easily exceed environmental limits today, and for the foreseeable future, and minimize the impact of environmental fees imposed, particularly for European operations.

Competitive Comparison

The CSeries from Bombardier is an exceptionally capable aircraft that is optimized for its particular size range. Designed to be a 100-130-seat, two-class aircraft, it is not subject to the "shrink" penalties associated that the single shrink of the 737-600 and the single- and double-shrinks the A318/A319 incur of the 737-700 and A320 respectively, from carrying extra structural weight associated with their larger brethren.

A comparison of basic dimensions and specifications follows for competitors in the 110-seat range, which include the 98-seat Sukhoi Superjet 100, 108-seat Embraer E-195, the 110-seat CS100, the 114-seat Airbus A318 and the 114-seat Boeing 737-600.

Competitive Comparison	SSJ	Embraer	Bombardier	Airbus	Boeing
Model	SSJ 100	E-195	CS100	A318	737-600
Seats (1 class 32" pitch)	98	108	110	114	114
Length	98' 3"	126' 10"	114' 6"	103' 2"	102' 6"
Wingspan	91' 3"	94' 3"	115' 1"	111' 10"	112' 7"
Height	33' 8"	34' 7"	37' 9"	41' 1"	41' 3"
Cabin Diameter	10' 7"	9'	10' 9"	12' 1"	11' 7"
MTOW (lbs)	101,150	107,564	128,200	130,000	145,500
Range (nm)	2,390	2,200	2,950	2,700	3,225

Competitors in the 130-seat range include the 129 seat Boeing 737-700W and 131 seat Airbus A319. The 737-700W is the -700 with winglets.

Competitive Comparison	Airbus	Boeing	Bombardier
Model	A319	737-700W	CS300
Seats (1 class 32" pitch)	131	129	130
Length	111'	110' 4"	124' 10"
Wingspan	111' 10"	117' 5"	115' 1"
Height	38' 7"	41' 2"	37' 9"
Cabin Diameter	12' 1"	11' 7"	10' 9"
MTOW (lbs)	141,100	154,500	139,600
Range (nm)	3,350	3,440	2,950

A319neo specifications and dimensions will remain similar to the base A319 but with an empty-weight increase of about 3,000 lbs for the larger engines and structural changes required. Embraer is considering both 130- and 150- seat new aircraft models, which would compete directly with the CS300. However, we have no information that is reliable enough to share on this potential new aircraft, for which a program launch decision is due in 2011.

V. PRODUCTION MODEL

This is a potential Achilles heel for CSeries, as it has been for Airbus and Boeing. The experience from the Big Two OEMs has clearly translated into concern that if they were subject to these problems, then Bombardier simply has to be expected to face the same trouble. On the face of it, a jaundiced view appears perfectly rational.

Bombardier is fully aware of these issues. The creation of the CSeries program is a much larger risk than the company has ever undertaken. Consequently, even without the Airbus and Boeing lessons, Bombardier has to tread very carefully. As the Airbus and Boeing experiences demonstrated, when the industry's leaders stumble they lose tremendous credibility, incur huge cost overruns, and pay large customer penalties leading to rising shareholder dissatisfaction.

Mindful of the production model risk, Bombardier has attempted to manage risk wherever possible. In the following section we dissect the supply chain. Note that of the program suppliers, more than half are North American-based.

An obvious source of concern is Alenia, whose quality control and production rate has bedeviled Boeing on the 787 program. We discuss this below.

Bombardier's program development plan is designed to from the start with an eye to EIS. The program development schedule at launch was 63 months in length, the longest ever for a Bombardier new aircraft development program. This timeline nonetheless is shorter compared with some Airbus and Boeing programs, with seven year launch-to-EIS, and gives rise to skepticism, particularly in light of the delays to the A380, A400M, 787 and 747-8. It is certainly true that A400M delays are related to a military program and those with the commercial A380, 787 and 747-8 do not have common threads. Nonetheless, customers, suppliers, analysts and shareholders are understandably concerned that Bombardier will not be able to meet its proposed EIS. We remain skeptical that 63 months may not be long enough, but at this stage, have no information to translate general skepticism into outright concern—other than the reliance on Alenia for the entire tail section.

The CSeries program will start proofing all new technology and in-service components well in advance of the flight test program. Examples of CSeries aircraft advance proofing and progress:

- The test fuselage barrel arrived in Montreal in August 2009 and this aluminum lithium component is currently being used as a technology test demonstrator;
- The completion of a series of wind tunnel tests confirmed the CSeries aircraft's overall performance benefits;

- The demonstrator wing assembly development program has been completed and successfully tested in Belfast. In November 2009 Bombardier announced construction began on the site's new wing manufacturing and assembly facility; and
- Bombardier benefits from lessons learned from the CRJ1000 CBW Rudder development to assist in further enhancing its CSeries full FBW system development.

WHAT IS DIFFERENT FROM BOEING OR AIRBUS?

- Bombardier is one of the first OEMs to master an integrated supplier program. Starting with the Global Express in late 1991, the company uses integrated a fully international, stable and known, supply base;
- When Bombardier started development of the Global Express, it developed an approach of defining performance and interfaces as part of system requirements, rather than just defining components specifications; and
- Since then Bombardier has been developing strong relationships with its suppliers by sharing best practices and the knowledge required for any new program development.

While this experience does not guarantee a hiccup-free process, it reduces risk.

CIASTA

The CIASTA (Complete Integrated Aircraft Systems Test Area) is one of several buildings to house the CSeries test program. It is a testing and systems-proving facility that will house up to six different aircraft test rigs. CIASTA permits integrated systems and software testing across the entire CSeries program one year before the first flight. This is a major initiative aimed at ensuring the CSeries aircraft meets its reliability targets at EIS.

Testing systems for high cycles well in advance of first flight, CIASTA should mitigate potential risks from deploying leading-edge technologies and processes. It is also the first time Bombardier's customer support engineers and field service representatives will be able to collect data to prove CSeries 99% dispatch reliability before the actual aircraft flies.

Bombardier expects to mitigate risk by testing the first aircraft in the CIASTA buildings to reduce, as much as possible, development flying and this should assist to achieve a 12-month flight test program.

CIASTA is all about reducing risk–proofing systems and software a year before the first test flight. Risk mitigation plans are based on Bombardier and industry lessons learned, technology and material selected based on rigorous trade studies process and Life Cycle-Cost model and extensive up-front testing program including CIASTA.

Supply Chain

Bombardier selected a broad range of suppliers. The immediate response to this is a red flag because of the complex supply chains used by Airbus and Boeing. In fact, Boeing's Randy Tinseth made comments along these lines[36]. But even as concern over program complexity is appropriate, it is important to realize that Bombardier has been working with a global supply chain for a long time. So even as there is risk, the company has mitigated against this as much as it can.

The project has over 60 major suppliers located in Austria, Belgium, Canada, China, Czech Republic, France, Germany, Italy, Netherlands, N. Ireland, Spain, Sweden, UK and USA, . Fifty three percent of the aircraft content is being supplied from the US. There are a few areas where program critics see weaknesses. These would be Alenia in Italy and Shenyang in China.

Bombardier has a lot of experience in supply chain developed and refined over years and multiple programs. Its first key international supply chain experience was the Global Express program launched in 1991.

Alenia

The Alenia concern is driven by that firm's industrial partnership to Boeing 787 program, which has been a source of frustration, delays, workmanship and poor quality control for Boeing from the start and continuing to this day. Alenia's 787 program performance has been questioned numerous times[37]. Alenia remains such a source of concern with the 787 that Boeing is likely to bring in-house the production of the 787-9 sections that would otherwise be Alenia's responsibilities[38]; Airbus has elected to not choose Alenia for the A350 program. Bombardier's selection of Alenia for the CSeries is not at all comforting and will remain a major area of concern, as noted by The Teal Group's Richard Aboulafia.

Alenia makes the horizontal stabilizer for the 787. On the CSeries, it will make the horizontal and vertical stabilizers equipped with hydraulic, electrical and flight control systems, lights and antennas. To keep tabs on Alenia (and all other suppliers), Bombardier undertook a rigorous supplier selection process developed over many years and multiple aircraft programs. Risk assessments on supplier's experience, technical skills, resources knowledge, financial health, lessons learned from past contracts in the industry, etc., are standard elements of this due diligence exercise.

In contrast to the initial Boeing approach on the 787 program in which Boeing oversight was lacking (a point subsequently acknowledged by Boeing), Bombardier follows a policy of continuously communicating with all suppliers, including Alenia, through a strong governance

[36] http://www.montrealgazette.com/Turbulence+seen+CSeries/3476731/story.html

[37] http://www.flightglobal.com/blogs/flightblogger/2010/06/gaps-in-787-horizontal-stabili.html

[38] http://seattletimes.nwsource.com/html/businesstechnology/2013215262_boeing21.html

process including daily meeting at the work-package level, weekly program status, regular Program Management Reviews (PMRs) and twice-yearly all suppliers event. Key performance indicators are reviewed during these governance meetings to ensure proper execution on technical requirements and program schedule. If a new potential risk or issue is identified, high-level management is informed, timely and risk mitigation plans developed and corrective actions taken.[39]

That being said, and based on the historical and current performance on the 787-8, we find the selection of Alenia to be the greatest single program risk facing Bombardier both in terms of execution and subsequent promised entry-into-service. We simply do not have confidence in Alenia, and it is for this reason we conclude the EIS of the CS100 may slip from 2013 to 2014.

CHINA

The Shenyang (SAC) concern is based on experience and distance from the Mirabel factory. Bombardier and SAC inked their agreement on the CS program in July 2008. This agreement was a follow-on to another deal signed with AVIC 1 in April 2007. (AVIC owns SAC). What is forgotten by critics of AVIC and SAC is that Bombardier has had a relationship that predates the CSeries. Bombardier has a 25-year relationship with SAC. In July 2006, Bombardier entered into an agreement which stipulated SAC would manufacture certain structural aircraft components for the Q400 that were previously sourced from Mitsubishi Heavy Industry in Japan. Consequently, SAC (and AVIC) is a known quantity to Bombardier and its Q400 deliveries have proven to be exactly what was expected from them. Therefore, the risk from China is manageable. The test hull supplied by SAC for the CSeries now being worked on by Bombardier by all appearances met the standards expected.

FLY-BY-WIRE

Another issue mentioned by CSeries critics is the fly-by-wire (FBW) program. Bombardier started the development of FBW control laws back in 1990 with the BRJX and with the Active Control Technology (ACT) program and performed flight testing on a Challenger in 1996. In July 2008 Bombardier contracted with Parker Aerospace for the development of a FBW system for the CSeries. The contract was set to run for a decade. Subsequently Parker sub-contracted to TTTech of Austria (an A380 supplier) for an integrated communication solution based on time-triggered protocol for Parker's generic fly-by-wire actuation platforms. This platform will be used on both on the Bombardier CSeries and Embraer Legacy 450/500 aircraft programs. Bombardier is also using lessons learned from the CRJ1000 CBW Rudder development to assist in further enhancing its CSeries full FBW system development.

In selecting Parker, Bombardier is utilizing a firm that provided fly by wire for the F-22 and F-35 programs. Subsequently, in April 2010, Parker won the contract to be the primary FBW flight control actuation system provider for the new COMAC C919. Parker is also a vendor for

[39] In an interview with Flightblogger, Bombardier executives detail their recognition of Boeing's Alenia problem. See this interview to get the full flavor on Bombardier's position:
http://www.flightglobal.com/blogs/flightblogger/2010/11/bombardiers-cseries-chief-has.html

Bombardier's Global Express and Q400, AVIC's ARJ-21, Hawkers 4000, Boeing's P-8 and Embraer's 170/190 programs.

Advanced Materials

The CSeries will utilize the latest in aerospace materials. The lightest and strongest are being used—but the design is not following the full carbon fiber route used by Boeing. Fully 70% of the airplane will exploit advanced materials.

Bombardier successfully tested the third generation Aluminum-Lithium (Al-Li) and validated the improved mechanical properties of the materials. Alcan announced at Farnborough 2010 the material would be called AirWare™. The current challenges faced by carbon fiber projects perhaps shows that Ai-Li is a good decision. It is clearly lower risk and is very close in weight while being much easier to work with.

The forward and main fuselage are Al-Li because of aircraft vulnerability to impact by ground vehicles (ramp rash), while its nacelles, belly fairing, radome, wing, rear fuselage, tail cone, horizontal stabilizer and fin are all composite. Its structural repair manual (SRM) is being developed with the aircraft and, since it will fly short sectors, impact repairs are likely to be bolted Al-Li sheet metal.

VI. Previous Re-Engine Programs

The recent history of commercial aircraft includes only a few re-engining programs undertaken by aircraft manufacturers on production aircraft. The only basic re-engining programs undertaken by manufacturers include the Boeing 737-200 to 737-300 and on the Airbus A320neo family.

Other programs have utilized the same airframe, with both upgraded systems and engines to create new models that are derivatives with new engines plus other improvements. These include the 737NG from the 737-300, the MD-90 from the MD-80 (originally DC-9 Super 80), the Boeing 717 (MD-95) from the MD-80/87 and more recently the Boeing 747-8 from the 747-400. However, for these aircraft, the other improvements have been significant, with substantial changes to the airframes, systems, and interiors in addition to engines.

A number of re-engining programs have also been attempted for out-of-production aircraft in the aftermarket, most with limited success.

The Success or Failure of Re-Engining Programs

Looking back, only the Boeing 737-200 to Boeing 737-300 model provides basically the same aircraft with new engines being the primary technology driver. This program was quite successful, given compatibility with existing operators, and demonstrated that under certain market conditions, a design with a new engine and no other significant changes can be successful.

Today, Airbus is providing the second example of such changes with the proposed A320neo, offering the P&W PW1000G Geared Turbofan and the CFM International LEAP-X engines to provide a significant reduction in fuel burn. Based on the ground tests of the engines, a 15%-16% decrease in fuel burn can be projected, which during A340-600 test-bed flight demonstrated that an A320 installation will translated to 10%-12% on the airframe, as unlike a new design, the existing airframe cannot be optimized to the new engines. With the addition of sharklets (Airbus term for winglets), an additional 3.5%-4% should be added, providing an expected on wing reduction in fuel cost of 15%, according to COO Leahy.

This 15% reduction in fuel burn, which accounts for approximately 40% of an airline's direct expenses, would generate a 6-7% reduction in operating costs. When the differential in price for the new engines, $6 million at list prices (which are typically heavily discounted) is factored in, the net gain in cash operating costs appears to fall between 3%-5% versus today's aircraft. At this number, Boeing does not believe the Return on Investment, either for the OEM or the customer, is worth it[40]. This small figure also does not compare favorably to the CSeries, which promises a cost reduction of 15% in cash operating costs over today's aircraft. The jury remains out as to whether the Airbus NEO will offer enough of an economic benefit to keep customers within the Airbus family from switching to the CSeries.

Recent statements from potential customers, including Steven Udvar-Hazy, former head of ILFC and

[40] Airbus disputes this figure but does not provide its own analysis, regarding this as proprietary. Bombardier also does not accept the Airbus claim of 15% better fuel burn from the sharklet/NEO combination.

now heading a new leasing firm, and Pierre-Henri Gourgeon, head of Air France-KLM, indicate that customers may want a more sophisticated offering from Airbus than the NEO.

Nico Buchholz, the head of fleet planning for Lufthansa, states that his analysis shows an A319neo is not competitive with the CS300.[41]

One benefit of keeping changes to the aircraft at a minimum is commonality. Airbus, with cockpit commonality across its entire fleet, has made it simple for customers to change between one Airbus aircraft and another, and the A320neo has been designed to fit well within the fleets of existing Airbus customers. The trade off for those customers is essentially between the additional costs of adding a new fleet type (provisioning, training, maintenance tooling) and the economic performance differential between the two aircraft. Airbus is hoping that the reduction in operating costs with the NEO moves the economic parameters closer to its favor to somewhat offset its relatively small gain in cash operating costs.

Derivative Models with New Engines have Mixed Market Results

In a number of cases, airframe manufacturers have incorporated both new engines and other improvements to existing airframes, with mixed success. The most successful of these programs has been the 737NG or New Generation series. While a derivative of the 737-300 and a fuselage design dating back to the 1967 entry into service of the 737-100, the 737NG family has about 80% new parts, and is quite different from older models in terms of systems, wings, avionics, and other technologies. Underneath the same basic shape, the aircraft has been completely updated. Currently Boeing's best selling aircraft; the 737NG has been highly successful. However, given the economics of the CSeries, the 737-700 is under threat, with the CSeries offering 20% lower cash operating costs than its similarly sized counterpart.

Other derivative programs have lagged in the market. Currently the Boeing 747-8, a re-engined derivative of the 747-400 with new a number of new technologies, is languishing in the market and is not expected to break even as a program, given the lack of market interest.

The Boeing 717, formerly MD-95, was a derivative of the MD-80/90 that had only modest market success, with just 156 produced. This aircraft was fundamentally a new technology DC-9-30-sized aircraft, with modern Rolls-Royce BMW engines, but was too heavy and inefficient to effectively compete against the more modern Embraer 190 series, which offers significantly superior economics.[42]

[41] A reminder to the reader: Airbus does not currently plan to re-engine the A318, leaving the 110-seat market open to the greater advantages of the CS100. Airbus will offer the sharklet for the A318.

[42] We are not convinced, however, that the market rejected the MD-95 on its own merits. McDonnell Douglas was clearly on its last legs by this time and the MD-95 was an "orphan," without a family of airplanes to support it. In any case, once Boeing and MDC merged, it was clear the MD-95/B717 was toast.

The MD-90 derivative of the MD-80, which utilized the International Aero Engines V2500 engine, was not successful in competing against the more efficient Airbus A320 and Boeing 737NG families, and failed in the marketplace after only 116 aircraft were produced[43].

The Bottom Line: Derivatives of existing models that are re-engined do not typically fare well in the marketplace when they face new competition. The 737NG faced the existing A320 family at the time, and proved to have a very slight edge in economics, with the manufacturers playing leap-frog with winglets, sharklets, and incremental improvements over the years. The NEO may be the latest small hop in the game of leap-frog between Airbus and Boeing using existing technology. In the meantime, Bombardier's large leap forward with the CSeries places those aircraft at risk of economic obsolescence in a high fuel price environment.

Most derivative programs, such as the 717 and MD-90, faced superior competition and were market failures. The 747-8, a four engined aircraft in a two-engined world, and continuing development problems, appears a failure as a passenger aircraft and may only be rescued because it is the only remaining ultra-large freighter in production.

The Airbus NEO faces superior competition for the A319 in the CSeries, which also competes well with the larger A320 and A321 models. The question is, will the A320 family's large established base enable the CSeries to succeed?

Aftermarket Re-Engining Programs

Aftermarket re-engining programs have typically not been successful, with only the Cammacorp re-engining of the DC-8-60 series and the Convair 580 re-engining of the 340/440 being compelling enough to capture most of the market.

The Cammacorp program re-engined the Douglas DC-8 Super 60 series with CFM-56 engines, creating the DC-8-70 series. That program was quite successful, replacing low bypass first and second generation engines with higher bypass ratio third generation engines, and dramatically improving performance and economics for the aircraft. There were 110 aircraft converted in this program, including 53 -71 models, seven -72 models and 50 -73 models. A major benefit of this conversion was noise reduction, extending the operational life of these aircraft as regulations changed without the efficiency penalty normally associated with hushkits.

The Convair 240 and 340/440 were twin engine piston aircraft aimed at the short-haul market as DC-3 replacements and produced between 1947 and 1958. With turboprop technology being introduced, several companies attempted to re-engine the Convair liners, and Allison and Pacific Airmotive developed a conversion program for the Convair 580 (340/440). This program was quite successful, with more conversions than competing programs with the Rolls Royce Dart (Convair 600/240 and 640/340) and Napier Eland (Convair 540/340) engines. The step change in technology dramatically improved the performance of the Convair aircraft, replacing maintenance-intensive piston engines with more reliable turbines.

[43] As with the MD-95, the MD-90 was largely a last-gasp effort by McDonnell Douglas. In explaining why he rejected the MD-90 for American Airlines, which had purchased 250 MD-80s, then-CEO Robert Crandall acerbically said the MD-90 was "old technology."

Other aftermarket re-engining programs did not fare as well. The Valsan program for the Boeing 727-200, which replaced two of the three original P&W JT8D-17R engines with the higher bypass JT8D-219 series utilized on the MD-80 was a market failure, with only a handful of conversions. While this conversion allowed the 727-200 to meet Stage 3 noise requirements, hushkits became more economical than re-engining for that application.

A re-engining program for the 727-100 was undertaken by United Parcel Service using the Rolls-Royce Tay engines, which proved technically successful for their fleet of 81 aircraft, but was not taken up by other customers.

Bottom Line

Re-engining programs seem to work best when combined with other technology improvements in addition to new engines. While the 737-200 to -300 change worked well, the other successful programs that derived from earlier models all included new elements in airframes, wings, aerodynamics, interiors, avionics or other factors that improved performance in multiple dimensions, rather than simply fuel burn.

Of course, with fuel costs projected to approach $100 per barrel, it is important for airlines to minimize their fuel expense, which re-engined aircraft can do. But when new technology alternatives are projected within a decade, and competing new technology is ready for introduction, residual values for what would be an interim aircraft will not remain as robust as those for a new aircraft.

For certain models, like the Airbus A321, the NEO provides enough additional range to change the mission profile for the aircraft, enabling it to replace the Boeing 757 on some transatlantic routes. Increasing the flexibility of an aircraft can result in a significant market impact. However, for other models, such as the A319, with direct competition from the CS300, those changes fall short of what customers are looking for.

We project mixed success for the A320neo family, which will be sandwiched between new technology offerings from Bombardier, Irkut, COMAC, and the 737NG series that Boeing will not update, opting instead for a replacement.

VII. THREATS

There are threats to each of the Big Four OEMs in the current "RE/NEO", "RS," "DN" and CSeries environment.

AIRBUS

Proceeding with a NEO program has already received tepid response from several quarters. Typical of aerospace analyst concerns, JPMorgan Cazenove, in a September 23 report on Airbus parent EADS, writes: "*We remain luke-warm on the A320neo, but would not expect this to have any impact on the A320 delivery rate rise over the current forecasting horizon. Incremental R&D on the programme is already contained in current guidance. The intention to make minor upgrades to the A320 platform sounds very similar to the original intentions for the A330 upgrade (prior to the launch of the A350) and we struggle to see how an aircraft that is expected to be delivered for ten years or so will add value to shareholders (notwithstanding a premium pricing and a very keen engine supplier). We also see a risk that the introduction of an A320 replacement could have a negative impact on aircraft residual values that lead to a crystallization of contingent liabilities over the years ahead. Airbus has yet to make a decision on whether to go ahead with the new aircraft development, but in light of the current stretched engineering resource, we would consider a decision not to go ahead as being of greatest benefit to the group*."

Although JPMorgan raised the possibility of a contingent liability with respect to residual values, COO-Customers John Leahy says that Airbus will not be providing residual value guarantees for the NEO.

Appraisers and lessors are also concerned about the affect of the NEO for RVs on the current fleet; and that the eventual replacement for the A320 will shorten the RV on the NEO, as an interim airplane. Airbus discounts all these concerns, but appraisers in particular—a group with which Airbus has an historically testy relationship—consider the prospect that the A320 will have four engine choices will harm RVs all the way around. Lessors, financiers and airlines all are worried that substantive negative effects on RVs could result in impairment charges that will have adverse impact on the balance sheet or loan-to-value ratios in financings.

R. Stephen Hannahs, CEO and Group Managing Director of Aviation Capital Group, speaks for many lessors: "*I think [re-engining] will create an odd aircraft, a mini-fleet if you will…. Compared to the 737s and A320 aircraft, this is a small production and it will have a negative effect on the existing fleets' residual value. Additionally, the consequence is that lenders will be more cautious on financing the existing products*."[44]

Finally one has to consider the complexity the NEO program will bring to Airbus. Airbus intends to offer four engine choices; V2500, CFM-56, PW GTF and LEAP-X. There is a perception that some customers will want the current technology engines even when the new engines are available.

[44] *Airline Fleet* magazine, August-September 2010

Boeing did not give the customers a choice when it upgraded the 737-200A from the JT8D-17 to the 737-300/400/500 with the CFM-56, while retaining basically the same systems on the aircraft. This lack of definition and clarity could backfire on Airbus.

BOEING

Boeing continues to talk about the 737RE and 737RS with customers, stating publicly on several occasions that its customers are not favorably disposed toward an RE but prefer a new airplane.

Boeing has, from an engineering standpoint, determined how it can equip the 737 with either the P&W GTF or the CFM LEAP-X[45] despite the lower profile of the 737 compared with the A320. This is only one of many concerns with a 737RE, however. In additional to the modest structural modifications that would be required to accommodate either engine, systems architecture upgrades would be required to meet FAA regulations adopted since the 737 first entered service in 1968. None of these upgrades is a "show-stopper" nor inordinately expensive, but collectively they do add to the cost and thereby diminishes the value proposition to the customer.

Boeing believes, contrary to Airbus, that technology exists to develop a viable new airplane concept with an EIS for 2019-2020. Airbus believes Boeing would be "silly" to introduce a new airplane in 2020 only to be superseded by a radically advanced A3XX in 2027, the current date most used by Airbus for its concept airplane with open rotor engines.[46]

Due to the huge cost overruns and customer penalties associated with the 787 and 747-8 programs, which remain challenging and face the possibility of even more delays than those announced to-date, and with the need to upgrade the 777 to meet competition from the A350 XWB, Boeing may decide to proceed with further enhancements to the 737, called the 737NG+. Boeing believes that the DOC benefit for the A320neo is reduced to 3%-4% when all factors are considered, and that the 737 fuel efficiency still can be improved by this much to remain competitive while a 737RS is developed for EIS c.2020. As previously noted, Airbus disagrees with Boeing's claim. Airbus claims a 15% fuel burn reduction but does not disclose its projected DOC improvement. Bombardier rejects Airbus' 15% claim but merely says its CSeries will have double-digit DOC advantage over the A319neo. Credit Suisse in a note issued December 1, 2010, after Airbus launched NEO estimated the A320neo DOC improvement at between 5% and 10%.

Just as Airbus thinks Boeing would be "silly" to pursue a new airplane in 2020, Boeing believes Airbus will be "silly" to proceed with NEO and a 2016 EIS if Boeing plans a 737RS by 2019-2020.

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[45] An exclusive contract with CFM to power the 737 means a 737RE would be powered by the LEAP-X. A 737RS has a good shot at being a dual source with the PW GTF and LEAP-X.

[46] Pratt & Whitney and CFM each believe that improvements in their GTF and LEAP-X engines, billed as 15%-16% more efficient than today's engines, will gain about 1% efficiency a year from EIS (2013 GTF, 2016 LEAP-X) so that by 2027, the GTF and LEAP-X will meet or exceed suggested efficiencies of the open rotor 2027 EIS. CFM, however, continues work on an open rotor in addition to the LEAP-X program. The debate on this topic is outside the scope of this Study.

If Airbus is right about the 2027 radical concept, then it is right about Boeing being silly. If Boeing is right about a viable new airplane in 2019-2020, then Boeing is right about Airbus being silly. We tend to agree with Boeing that a replacement for the 737 is feasible in 2019-2020 and that waiting until 2025-27 isn't necessary.

It is a very risky gamble by both companies. But in either case, Bombardier is confident its CSeries has the NPV and SFC advantages that neither Boeing nor Airbus can match with a re-engine program, nor a new airplane with either a 2020 or 2027 EIS—a view that is the foundation of Lufthansa's analysis when it ordered the CSeries. This doesn't mean Bombardier is without risk, however.

BOMBARDIER

The biggest threat to Bombardier as it tries to sell its CSeries is the pricing power possessed by Airbus and Boeing that it cannot remotely begin to match. The full family of airplanes offered by Airbus and Boeing give them the ability to price the A319 and 737-700 as loss-leaders (should they choose to) or to wrap discounts into larger models and the twin-aisle airplanes. This ability conceivably can reduce the capital cost to the customer to such a low point that the relative fuel inefficiency vis-à-vis the CSeries may be rendered largely moot. The plans by Airbus and Boeing to increase A320 and 737 production to ~40 per month also gives the companies the ability to significantly lower the cost of these families, providing more pricing flexibility than Bombardier will have.

What is true for the current generation A319 is equally true for the A319neo. Airbus has the ability to price the A319neo at a loss if it is wrapped into a much larger transaction so that any such loss would not be readily apparent. This approach would be more challenging given that Airbus has put a premium of $6 million on the NEO list price. With the 2008 A319 list price average at $74.4m, this airplane is priced nearly $20m more than the CSeries. Airbus will have to discount the A319neo dramatically to undercut Bombardier.

Concern remains in the industry that Bombardier may be offering an airplane that is too small in the CS100 and CS300. Noted aviation consultant Mike Boyd of The Boyd Group International and some airlines believe Bombardier will have better success if the family includes a 150-seat CS500 (at 32 inch, single-class pitch). We concur. Such a plane (with 149-seats; 150-seats requires one more flight attendant) would be ideal for Southwest Airlines. Bombardier's single-class 130-seat CS300 at 32 inches actually has seven fewer seats than Southwest's 737-700.

It is therefore of great interest to note that Bombardier recently trademarked CS500 and CS900 names. Indeed, the idea of growth model of the CSeries is now openly discussed in the market, although Bombardier is not promoting such talk[47], [48].

The inclusion of Alenia as a key industrial partner is also a major concern and a major risk. Program execution to meet an aggressive EIS is cause for skepticism.

EMBRAER

Embraer has a special challenge in deciding how to respond to the CSeries: the E190 (98 seats vs. CS100 at 110-seats) and E195 (108 seats, vs. CS300 at 130 seats) are relatively "new" programs. The first flights of the E-190 series were flown in 2004 with EIS shortly thereafter, and are straight-forward derivatives of the E170/175 (with a new wing) that had their first flights in 2001 and entered service in 2004.

Through July 2010, 660 models of the four sub-types have been built, presuming a profitable program but one that has hardly met the standard sales targets of a mature program that normally runs 20+ years before obsolescence. Embraer has not published any data that provides guidance on break even for the E-Jet program. Indeed, when speaking with the company we were advised that since partner OEMs had participated in development costs, no such data has been made public.

Thus, Embraer is faced with the prospect of having a young program surpassed by a superior product in the 100-130-seat category. The choices are similar to Boeing: do nothing, do an enhancement, do a re-engine or do a clean-sheet airplane. These are not enviable choices for an airplane program that is not yet 10 years old.

We understand that Embraer has requested data from PW and GE. Although Embraer has publicly been cool to the benefits of a re-engine program, we know from our sources an E-Jet RE has not been ruled out. We also understand that Embraer continues to consider an entirely new airplane design for the 130-150-seat range in dual class. If Embraer proceeds with this program, the CSeries at 110-130-seats in dual class will be at a disadvantage.

There can be no doubt that any success the CSeries garners will be a loss to Embraer's E-190/195 program. Embraer has followed a similar course to that of Airbus and Boeing, by questioning the CSeries. For example, Embraer follows a highly predictable path of saying that the percentage improvement the CSeries offers is likely to be marginal and that this benefit has to be weighed against program risk of a new design[49]. Obviously this is plausible approach—but at the same time Embraer has to hedge its bets because the CSeries might in fact offer better numbers than

[47] Aviation Week: Is Bombardier Working on A 150-Seat CSeries? Things With Wings The Commercial Aviation Blog June 1, 2010

[48] In fact, we generally believe the CSeries may be better served with 110 seats and 130 seats in two-class, rather than single-class, and 150 seats in single-class, 32-inch pitch.

[49] The Montreal Gazette, July 18, 2008

competing OEMs expect and Bombardier's conservative production process may have reduced risk considerably.

TIMELINE

Airbus says the performance difference between an A319neo and the CSeries will be marginal that CSeries won't have a significant advantage. We disagree, and furthermore if Bombardier meets its promised EIS dates, the net present value analysis will give the CSeries an additional advantage over the NEO, 737RS and A320RS.

2013	2014	2016	2017	2019-2020	2025-2027
CS100	CS300	A320neo A321neo	A319neo	737RS	A320RS

Projected EIS dates for CSeries: Company data; Projected EIS dates for others: market sources, company data, AirInsight estimates.

This timeline works in Bombardier's favor, particularly if development of the LEAP-X runs into any delays as engine options for the NEO or the 737RS.[50] Airbus seems to be placing its bets on successful development of the Open Rotor for the A320RS, a bet with which we are not at all comfortable. We believe technical challenges for the Open Rotor remain that will persuade the airframe OEMs to retain conventional high-bypass engines in the form of the GTF or evolved versions of the LEAP-X. Should Boeing make the decision to proceed with a 737RS by 2019, we believe Airbus will conclude it advisable to advance the A320RS with the GTF and LEAP-X as options, rendering the NEO obsolete.

While ambiguity at Airbus and Boeing has served as a detriment and to cast doubts about the CSeries, there is now clarity with the A320neo program. Bombardier will now have a firm airplane to compete against instead of shadowboxing. As for competing against Boeing, the market appears to accept Boeing's statements for the moment that it is disinclined to proceed with a 737RE. We do know that RE studies continue, but we believe the greater obstacle for Bombardier in competing against the 737NG will be Boeing's pricing power and production strength.

Having said this, we also believe the point is fast approaching where the previous vacillation by Airbus and Boeing will shift in favor of Bombardier. Airlines will not be willing to wait indefinitely to make equipment decisions for fuel, environmental and noise requirements that are rapidly approaching.

[50] CFM says the program is on time.

VIII. ECONOMICS

The most compelling element of the CSeries business case is economics, as the aircraft, using advanced technologies, has 19%-21% lower operating costs than its key competitors, and a full 20% Cash Operating Cost advantage over today's similarly sized competitors from Airbus and Boeing. The CS300 has a 19% advantage over the 737-700 and a 21% advantage over the A319 on aircraft mile basis, and a 20% advantage over each on a seat-mile basis, and will retain an 11% and 12% advantage over the A319neo on a seat-mile and aircraft mile basis, respectively.

In the past, that level of a difference in Cash Operating Costs, combined with environmental improvements, has led to the economic obsolescence of the older model aircraft once the newer model was introduced. With weakening order books for the smallest Airbus and Boeing products, the market has begun to recognize that inevitability, and we expect orders for the smaller A319 and Boeing 737-700 to continue to shrink, despite increasing orders for their larger A320 and 737-800 brethren, as the CSeries comes closer to market entry.

The CSeries is the first truly new technology narrow-body aircraft in the 110- to 149-seat range since the introduction of the A320 in 1988. Accordingly, the CSeries benefits from new technologies that provide benefits in a number of areas. Larger competing models from Irkut and COMAC, each of which will utilize new technology engines, are not expected to be as advanced technologically as the CSeries, which is breaking new ground in several areas, including extensive use of advanced materials. As the launch customer for the next generation of aircraft engines with the PW1000G geared turbofan, the CSeries will benefit from a step-change in fuel efficiency.

OPERATING ECONOMICS

The CSeries represents a step-change in economics for narrow-body aircraft, and "moves the line" significantly over the current state of the art. In this section, we analyze aircraft mile and seat mile cost estimates for the CSeries and competing aircraft from Embraer, Airbus and Boeing. The CSeries has a significant advantage over today's existing aircraft. It also compares favorably over the much larger A320 and 737-800W models on a seat-mile basis.

Fuel consumption represents a significant portion of the CSeries benefits, but only half of the economic improvements, with the other half provided by improvements in maintenance costs, crew costs, and environmental fees.

SPECIFIC FUEL CONSUMPTION

Fuel consumption for the CS100 and CS300 provide a significant advantage over competitors, approximately 20-21% lower on average for a 500 nautical mile mission. With advanced materials and lightweight structures, the CSeries obtains lower fuel consumptions from two sources.

The first is the P&W PW1000G engines that offer an initial 16% gain in fuel efficiency when compared to current engines. These engines, according to P&W, are expected to improve by

approximately 1% per year post-introduction. This means they ultimately have the capability to reach levels 30% below those of today's engines, a level equivalent to projections for open rotor technologies without the size, noise, speed and safety issues. As a result, the CSeries should grow economically more competitive as the GTF engine from P&W matures with continuous product improvements. We estimate that by 2020, the CSeries engines will provide an additional 7% improvement in fuel burn over levels achieved at introduction, which are not factored into the initial estimates shown below.

The second is from a combination of technologies, ranging from a composite wing, lightweight Aluminum-Lithium alloy fuselage, fly-by-wire controls and advanced avionics. These technologies combine to provide half of the projected fuel burn gain projected for the aircraft. Bombardier has been conservative in quoting a 20% plus reduction in fuel burn. With expected evolutionary improvements in the P&W GTF engine, we expect a 27% improvement by 2020 in fuel burn compared with today's aircraft.

This fuel efficiency provides a significant advantage over today's aircraft, and other aircraft that utilize the P&W GTF engine but lack the efficiencies generated through new systems and materials. The Airbus A320neo series, which will be, according to John Leahy, 95% compatible with the existing models, lacks the composites, advanced materials and advanced systems to achieve equivalent fuel efficiency. By 2016, Airbus projected fuel efficiency gains of 15% will compete with an equivalent 24% savings in the CSeries, which will maintain an 8-9% lead over the PW GTF version of the A320neo family.

Comparing the CS100 and CS300 to their closest competitors with respect to fuel burn leads to the following results on both an aircraft mile and seat-mile basis.

FUEL BURN		Gals. Fuel	Mission	Per Sseat	Cost @
500 NM Mission	Seats	500NM	Comparison	Comparison	$2.25/gal
Bombardier CS100	110	740	datum	datum	$ 1,665
Embraer 190	98	840	114%	127%	$ 1,890
Embraer 195	108	898	121%	124%	$ 2,021
Sukhoi Superjet	98	810	109%	123%	$ 1,823
Airbus A318	114	930	126%	121%	$ 2,093
Boeing 737-600	114	950	128%	123%	$ 2,138
Boeing 737-500	114	995	132%	127%	$ 2,239
McDonnell Douglas MD-87	120	1275	172%	158%	$ 2,869

One-class seating, 32 inch pitch; Sources: Bombardier, Embraer, Sukhoi, Airbus, Boeing, AirInsight estimates.

The CS100 beats its closest competitor, the Embraer 195, by 24% on a seat mile basis and by 21% on an aircraft mile basis, and the A318, for which there will be no NEO, given its poor sales history, by 21% on a seat mile basis and 26% on an aircraft mile basis. This substantial gap in fuel burn provides a strong advantage for Bombardier over its competitors, and is one reason that Embraer is evaluating a re-engining of its relatively young E-Jet series.

FUEL BURN		Gals. Fuel	Mission	Per Sseat	Cost @
500 NM Mission	Seats	500NM	Comparison	Comparison	$2.25/gal
Bombardier CS300	130	805	datum	datum	$ 1,811
Airbus A319	131	985	122%	121%	$ 2,216
Airbus A319NEO	131	880	109%	108%	$ 1,980
Boeing 737-700W	129	960	121%	122%	$ 2,160
Boeing 737-300	129	1075	127%	128%	$ 2,419
Airbus A320	158	1015	125%	103%	$ 2,284
Airbus A320NEO	158	910	112%	92%	$ 2,048
Boeing 737-800W	170	1080	133%	102%	$ 2,430
McDonnell Douglas MD-83	146	1385	171%	152%	$ 3,116

One-class seating, 32-inch pitch; Sources: Bombardier, Airbus, Boeing, DOT Form 41 data, AirInsight estimates.

The CS300 provides strong performance over existing aircraft, and retains a 9% advantage on an aircraft mile basis and an 8% advantage on a seat-mile basis over the re-engined Airbus A319neo of similar size. Compared with the current 737-700 and Airbus A319, the CSeries maintains 21% and 22% leads in aircraft mile fuel burn and 22% and 21% advantages respectively on an aircraft mile basis.

The CS300 also beats both its larger current competitors, the 737-800 and A320, with a 2% and 3% advantage on a seat-mile basis. Of course, the CSeries has markedly lower aircraft mile costs, being a much smaller aircraft. Typically, aircraft mile fuel costs rise with aircraft size, and seat mile cost decrease with additional seats. The CS300 has such a strong fuel burn advantage that it reverses the rules of thumb with respect to existing competitors.

The A320neo, when equipped with the new PW1000G or LEAP-X engines, will beat the CSeries with approximately 8% lower fuel costs on a per seat basis, which would be expected for a larger aircraft with similar engine technology.

Bottom line: The CS300s fuel burn advantage is significant, results from both the airframe and engine technology, and is the major factor in the economic advantage for the aircraft.

Maintenance Cost

The CSeries is expected to cost 28% less to maintain when compared with today's aircraft. As previously noted, a significant portion of that savings is attributable to the new technology engines from P&W, which will have a 20% lower maintenance cost than today's engines, and contribute 12% of the total reduction for the aircraft.

The simplicity of the P&W design contributes to lower maintenance costs, as the Geared Turbo Fan eliminates several low pressure stages in the engine, and fewer parts means lower costs. With several thousand fewer blades to replace, maintenance and parts costs are markedly lower for the new technology GTF engine.

Another 11% reduction in maintenance costs will come from labor savings reductions based on the design of the aircraft. Components have been designed to be easier to remove and replace, and the

design for maintenance philosophy for the CSeries will result in significant benefits. The CSeries will require between 100-200 fewer maintenance days over an expected 20-year aircraft life, maximizing utilization and reducing down time. While the cost reduction in maintenance is factored into the economics, we have not factored in a corresponding increase in utilization in our estimates, which may understate the economic benefits of the CSeries.

An additional 4% reduction in maintenance costs will come from savings on off-aircraft parts and materials, and an additional 1% from the innovative Aircraft Health Management System. This AHMS will be the first commercial aircraft to provide real-time maintenance and performance information communicated to maintenance personnel to both anticipate potential problems and facilitate the rapid repair of problems identified in flight once the aircraft lands.

The CSeries is expected to have strong dispatch reliability out of the gate, in large part through CIASTA, the Complete Integrated Aircraft System Test Area. This facility will test an "Iron Bird" long before introduction as one of its six test stations, and ensure that integrated systems are well proven prior to introduction. Used for the Global Express, albeit with less sophistication than for the CSeries, these advanced testing techniques reduce risk and help ensure that aircraft development programs are completed on time.

With a 28% improvement in maintenance cost adding to significant fuel burn savings, the CSeries operating economics are quite compelling.

MAINTENANCE COSTS	1.55 Block Hours		Cost for	Aircraft	Per Seat
500 NM Mission	Seats	Cost/Hour	Mission	Comparison	Comparison
Bombardier CS100	110	$490.00	$759.50	100%	100%
Embraer 190	98	$550.00	$852.50	112%	126%
Embraer 195	108	$575.00	$891.25	117%	120%
Sukhoi Superjet	98	$630.00	$976.50	129%	144%
Airbus A318	114	$700.00	$1,085.00	143%	138%
Boeing 737-600	114	$730.00	$1,131.50	149%	144%
Boeing 737-500	114	$745.00	$1,154.75	152%	147%
McDonnell Douglas MD-87	120	$855.00	$1,325.25	174%	160%

Using a variety of data sources, we have estimated maintenance costs for a typical 500 nm mission for the CSeries and its major competitors, as shown in the tables below:

MAINTENANCE COSTS	1.55 Block Hours		Cost for	Aircraft	Per Seat
500 NM Mission	Seats	Cost/Hour	Mission	Comparison	Comparison
Bombardier CS300	130	$510.00	$790.50	100%	100%
Airbus A319	131	$740.00	$1,147.00	145%	144%
Airbus A319NEO	131	$651.20	$1,009.36	128%	127%
Boeing 737-700W	129	$740.00	$1,147.00	145%	146%
Boeing 737-300	129	$880.00	$1,364.00	173%	174%
Airbus A320	158	$950.00	$1,472.50	186%	153%
Airbus A320NEO	158	$836.00	$1,295.80	164%	135%
Boeing 737-800W	170	$830.00	$1,286.50	163%	124%
McDonnell Douglas MD-83	146	$860.00	$1,333.00	169%	150%

Landing and Environmental Fees

The CSeries, being lighter than its competitors from Airbus and Boeing, will have lower landing fees, which are based on maximum landing weight of the aircraft and apply in North America. In Europe, the CSeries will benefit from significant reductions in emissions and noise, and with operations becoming subject to emission trading schemes, provide better economics than competing aircraft.

LANDING FEES					Aircraft	Seat
110 Seat Segment	Seats	MLW	Cost/1000 lbs	Mission Cost	Comparison	Comparison
Bombardier CS100	110	111500	$3.00	$334.50	100%	100%
Embraer 190	98	94700	$3.00	$284.10	85%	95%
Embraer 195	108	99208	$3.00	$297.62	89%	91%
Sukhoi Superjet	98	90300	$3.00	$270.90	81%	91%
Airbus A318	114	126800	$3.00	$380.40	114%	110%
Boeing 737-600	114	120500	$3.00	$361.50	108%	104%
Boeing 737-500	114	110000	$3.00	$330.00	99%	95%
McDonnell Douglas MD-87	120	130000	$3.00	$390.00	117%	107%

Landing fees, which we have included in the overall comparison of the aircraft for the North American market, are straightforward to estimate based on maximum landing weight. Those fees vary from $1.5 per 1000 lbs. to as much as $6 per 1000 lbs. at some airports, but tend to average about $3, which we have used for our calculations.

As expected, landing fees will be higher for the larger CS100 than the Sukhoi Superjet 100 and Embraer E-195, but lower than the heavier Airbus A318 and Boeing 737-600. On a seat basis, the differential is reduced considerably among the competitors.

Similarly, for the 130-seat segment, the lighter CSeries has an advantage over heavier competitors of similar size from Airbus and Boeing.

LANDING FEES					Aircraft	Seat
130 Seat Segment	Seats	MLW	Cost/1000 lbs	Mission Cost	Comparison	Comparison
Bombardier CS300	130	122000	$3.00	$366.00	100%	100%
Airbus A319	131	137800	$3.00	$413.40	113%	112%
Airbus A319NEO	131	140800	$3.00	$422.40	115%	115%
Boeing 737-700W	129	128928	$3.00	$386.78	106%	106%
Boeing 737-300	129	114000	$3.00	$342.00	93%	94%
Airbus A320	158	145500	$3.00	$436.50	119%	98%
Airbus A320NEO	158	148500	$3.00	$445.50	122%	100%
Boeing 737-800W	170	146300	$3.00	$438.90	120%	92%
McDonnell Douglas MD-83	146	139500	$3.00	$418.50	114%	102%

This advantage remains for similarly sized competitors on a seat basis, although the larger models have lower per seat landing fees for the North American Marketplace. In computing our overall economics, we have utilized an average fee of $3.00 per 1,000 lbs. maximum landing weight.

Environmental fees in Europe are assessed with a patchwork quilt of airport by airport regulations, with some airports focused on noise, and others on emissions. The EU emissions trading scheme, which will go into effect next year, will impact operators in proportion to their fuel usage, which also bodes well for the highly efficient CSeries.

In estimating environmental fees, we anticipate fees of between €25 and €40 per 1,000 kg of CO2 emissions will be an average fee under the new emissions trading scheme. The CSeries significant fuel burn advantage translates proportionately to CO2 savings. We have not, however, included these fees in our economic analysis.

Similarly, nitrous oxide emissions are regulated by the CAEP6 requirements, and we expect a fee between €2.5 and €5 per 1,000 kg of NOx emissions during the takeoff and landing cycles. The P&W GTF will have a 50% margin to CAEP6 standards, significantly reducing fees.

Noise regulations are currently Stage IV, and a Stage V is expected that will be approximately 10 EPNdB lower than current levels. As the CSeries has a margin of 20 EPNdB under the current Stage 4 limits, it should easily pass Stage V requirements when they are introduced. We anticipate, over the near term, fees to be established of about €100-€200 for operations at Stage 4 requirements, with reductions or no charges for those well under the limits. The CSeries, at Stage 4 -20 EPNdB, with a leadership position in noise, should be free of charges.

The net result, for European operators, is that the CSeries provides strong environmental performance vis-à-vis its competition, and should significantly reduce environmental fees. We have not incorporated these fees into our overall operating cost analyses, as such fees at present are regional in nature and rates have not yet been conclusively defined.

Crew Costs

Flight crews are another element of the cost equation, and differ from both types of operator (legacy and low fare carrier) as well as by the size of the aircraft operated. We have estimated crew costs for each type of aircraft as follows:

- Pilots: $360 per block hour for a 100-110-seat aircraft, and $425 per block hour for a 130-170 seat class aircraft.
- Flight Attendants: $40 per hour

Based on estimates of block hour performance for a 500 nautical mile mission, the following cost estimates resulted for the various aircraft in the 100 seat size, based on two flight attendants for the Superjet and Embraer and three for the CS100, A319 and 737-600

CREW COSTS	1.55 Block Hrs.							Aircraft	Seat
110 Seat Segment	Seats	Pilot Cost/Hr.	FA Required	FA Cost/Hr.	Pilot Cost	FA Cost	Total	Comparison	Comparison
Bombardier CS100	110	$360.00	3	$40.00	$558.00	$186.00	$744.00	100%	100%
Embraer 190	98	$360.00	3	$40.00	$558.00	$186.00	$744.00	100%	112%
Embraer 195	108	$360.00	3	$40.00	$558.00	$186.00	$744.00	100%	102%
Sukhoi Superjet	98	$360.00	3	$40.00	$558.00	$186.00	$744.00	100%	112%
Airbus A318	114	$360.00	3	$40.00	$558.00	$186.00	$744.00	100%	96%
Boeing 737-600	114	$360.00	3	$40.00	$558.00	$186.00	$744.00	100%	96%
Boeing 737-500	114	$360.00	3	$40.00	$558.00	$186.00	$744.00	100%	96%
McDonnell Douglas MD-87	120	$360.00	3	$40.00	$558.00	$186.00	$744.00	100%	92%

Similarly, our calculations for the 130-seat class aircraft resulted in the following:

CREW COSTS	1.55 Block Hrs.							Aircraft	Seat
130 Seat Segment	Seats	Pilot Cost/Hr.	FA Required	FA Cost/Hr.	Pilot Cost	FA Cost	Total	Comparison	Comparison
Bombardier CS300	130	$ 425.00	3	$ 40.00	$ 658.75	$ 186.00	$ 844.75	100%	100%
Airbus A319	131	$ 425.00	3	$ 40.00	$ 658.75	$ 186.00	$ 844.75	100%	99%
Airbus A319NEO	131	$ 425.00	3	$ 40.00	$ 658.75	$ 186.00	$ 844.75	100%	99%
Boeing 737-700W	129	$ 425.00	3	$ 40.00	$ 658.75	$ 186.00	$ 844.75	100%	101%
Boeing 737-300	129	$ 425.00	3	$ 40.00	$ 658.75	$ 186.00	$ 844.75	100%	101%
Airbus A320	158	$ 425.00	4	$ 40.00	$ 658.75	$ 248.00	$ 906.75	107%	88%
Airbus A320NEO	158	$ 425.00	4	$ 40.00	$ 658.75	$ 248.00	$ 906.75	107%	88%
Boeing 737-800W	170	$ 425.00	4	$ 40.00	$ 658.75	$ 248.00	$ 906.75	107%	82%
McDonnell Douglas MD-83	146	$ 425.00	3	$ 40.00	$ 658.75	$ 186.00	$ 844.75	100%	89%

Overall Economic Performance

The net result, when all of these factors are summarized, yields a significant advantage for the CSeries aircraft.

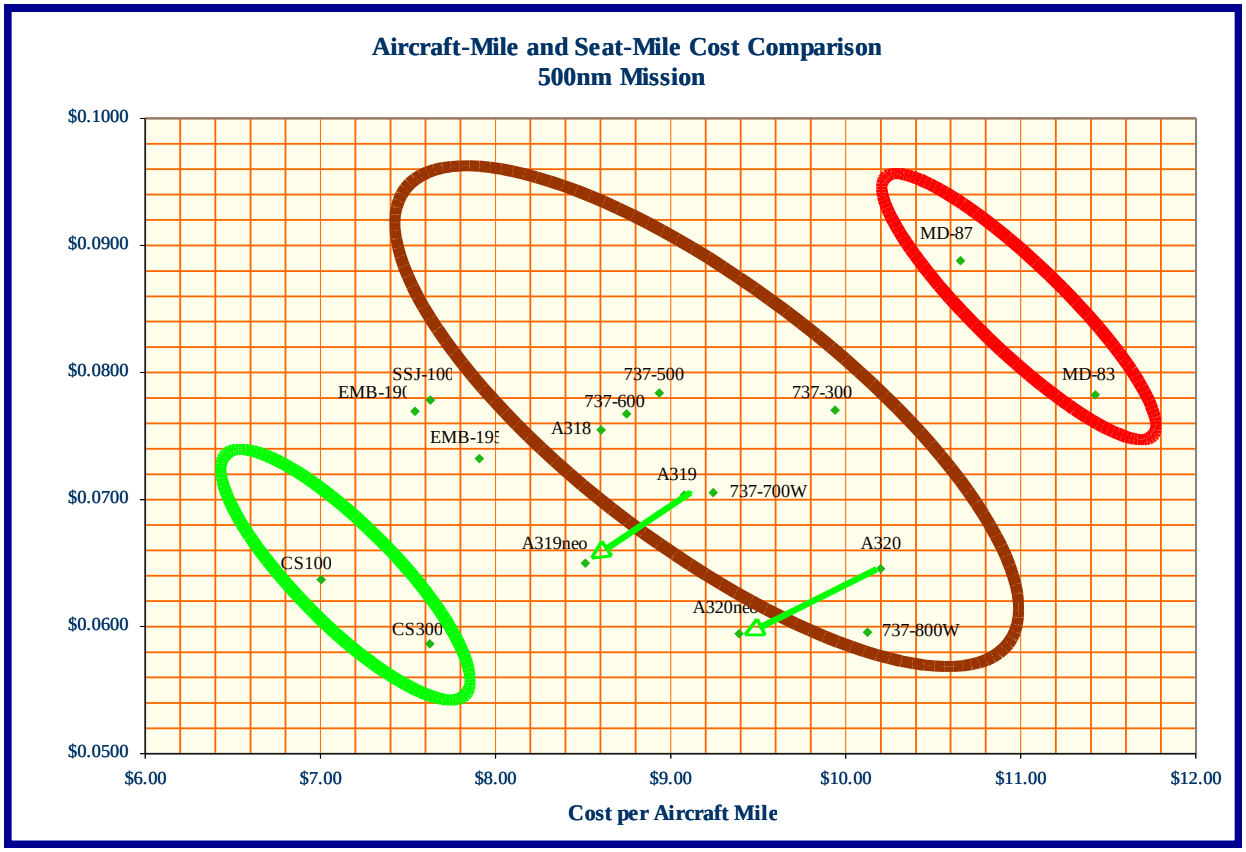
TOTAL COST							Cost per	Cost per
110 Seat Segment	Seats	Fuel	Maintenance	Landing	Crew	Total Cost	Aircraft Mile	Seat-Mile
Bombardier CS100	110	$ 1,665	$ 760	$334.50	$ 744.00	$ 3,503	$ 7.01	$ 0.0637
Embraer 190	98	$ 1,890	$ 853	$284.10	$ 744.00	$ 3,771	$ 7.54	$ 0.0770
Embraer 195	108	$ 2,021	$ 891	$297.62	$ 744.00	$ 3,953	$ 7.91	$ 0.0732
Sukhoi Superjet	98	$ 1,823	$ 977	$270.90	$ 744.00	$ 3,814	$ 7.63	$ 0.0778
Airbus A318	114	$ 2,093	$ 1,085	$380.40	$ 744.00	$ 4,302	$ 8.60	$ 0.0755
Boeing 737-600	114	$ 2,138	$ 1,132	$361.50	$ 744.00	$ 4,375	$ 8.75	$ 0.0767
Boeing 737-500	114	$ 2,239	$ 1,155	$330.00	$ 744.00	$ 4,468	$ 8.94	$ 0.0784
McDonnell Douglas MD-87	120	$ 2,869	$ 1,325	$390.00	$ 744.00	$ 5,328	$ 10.66	$ 0.0888

In the 110-seat range, the CS100 has a 8%-25% advantage over its competitors, and beats the smaller Sukhoi and Embraer competing aircraft that would be expected to have lower trip costs. On a seat-mile basis, the advantage widens to a 15-23% lead over its direct competitors, a significant advantage in cash operating costs.

On an overall basis, the CS300 has a similar economic advantage over its competitors, both on a trip and seat basis. The CSeries has a 19%-34% trip cost advantage over its current direct competitors from Boeing and Airbus respectively, and maintains an 12% lead even against the forthcoming A319neo. Similarly, on a seat-mile basis, the CS300 not only beats its current direct competition by a wide margin of 20%, maintains an 11% advantage over the A319neo, and even retains a slight 2% advantage over the much larger 170-seat 737-800W.

TOTAL OPERATING COSTS							Cost per	Cost per
130 Seat Segment	Seats	Fuel	Maintenance	Landing	Crew	Total Cost	Aircraft Mile	Seat-Mile
Bombardier CS300	130	$ 1,811	$ 791	$366.00	$ 844.75	$ 3,812.50	$ 7.63	$ 0.0587
Airbus A319	131	$ 2,216	$ 1,147	$413.40	$ 844.75	$ 4,621.40	$ 9.24	$ 0.0706
Airbus A319NEO	131	$ 1,980	$ 1,009	$422.40	$ 844.75	$ 4,256.51	$ 8.51	$ 0.0650
Boeing 737-700W	129	$ 2,160	$ 1,147	$386.78	$ 844.75	$ 4,538.53	$ 9.08	$ 0.0704
Boeing 737-300	129	$ 2,419	$ 1,364	$342.00	$ 844.75	$ 4,969.50	$ 9.94	$ 0.0770
Airbus A320	158	$ 2,284	$ 1,473	$436.50	$ 906.75	$ 5,099.50	$ 10.20	$ 0.0646
Airbus A320NEO	158	$ 2,048	$ 1,296	$445.50	$ 906.75	$ 4,695.55	$ 9.39	$ 0.0594
Boeing 737-800W	170	$ 2,430	$ 1,287	$438.90	$ 906.75	$ 5,062.15	$ 10.12	$ 0.0596
McDonnell Douglas MD-83	146	$ 3,116	$ 1,333	$418.50	$ 844.75	$ 5,712.50	$ 11.43	$ 0.0783

The Bottom Line: The economics of the CSeries provide a step change in economics, as shown in the following chart that contrasts both aircraft mile and seat mile costs with its competition. This step change in economics provides an industry leading position and a significant competitive advantage.



Source: AirInsight

As shown above, the CSeries, as the first adopter of new technology engines and 21st century aircraft technologies and materials, has opened a gap with the competition. Even the re-engined Airbus NEO series, with only new technology engines, cannot match the performance of the CSeries, as that is a compromise between new technology engines and an older airframe design. The economic advantage of the CSeries is its strongest calling card. With airline margins squeezed, the key question for many fleet planners will be to evaluate the tradeoff between the costs of adding an additional type to the fleet against the economic savings from the new aircraft. In the case of the

CSeries, the economic differential is large enough that costs for additional provisioning, training, and transition will be rapidly absorbed by the decrease in operating costs.

A 150-SEAT CSERIES

Credible observers, such as Mike Boyd of The Boyd Group, believe that Bombardier would find a broader market if a 150-seat dual-class version were offered. We concur. This also probably suggests a one-class seating of 160-170 seats, a size that would truly get the attention of Airbus and Boeing. The risks of entering this market segment would, in our view, go up exponentially for the retaliatory responses that would likely be engendered, and thus for a new entrant with more limited resources than either Airbus or Boeing, the risk may be too great.

Photo-Shopped rendering and theoretical specifications for the "CS500," origin unknown.

But we do believe that Bombardier should offer a 150-seat single-class airplane with 32-in pitch. Such a plane would provide a highly competitive aircraft for an airline like Southwest Airlines, which has nearly 175 Boeing 737 Classics (approximately 100 of which are not equipped with winglets: 25 737-500s at 125 seats and 73 737-300s). The CS300 is a good replacement for the 737-500s as is, but it carries seven fewer passengers than the 137-passenger -300s in Southwest's configuration.

A 149-seat[51] "CS500" would be a perfect replacement for the 737-300 and -300Ws. With the proposed merger of AirTran, Southwest will acquire 86 Boeing 717s (MD-95) that will carry 117 passengers in Southwest's configuration.

Southwest has a major fleet renewal challenge in the near- to mid-future with the large number of Classics, which will be exacerbated by the addition of the 717. If Bombardier stretches the CSeries to 149-seats at 32 inches, only Bombardier will have a new generation of airplanes optimized for

[51] 150 seats is, for Southwest, the magic number; another flight attendant is required at this point.

the 100-150 seat market available with an EIS from 2013. Furthermore, if Boeing proceeds with a 737 replacement optimized at the 180-seat "sweet spot" defined by BCA CEO Albaugh, Boeing will not have a product offering for the <150-market without creating a second design optimized for this segment—a prospect we consider highly unlikely. The same would hold true for Airbus. Embraer could emerge as a competitor to Bombardier if the Brazilians decide to create a clean-sheet airplane in the 130-150 seat market, above its current E-Jet series.

Observers like to note Southwest's historical fanaticism with fleet commonality, which will be broken by the AirTran 717 acquisition. Ignored is the fact that Southwest already fundamentally has two fleet types: the 737 Classic and the 737 Next Generation, which is some 80% different than the Classic. Setting aside this inconvenient truth, Southwest will be faced with introducing an entirely new airplane within the next decade anyway, as the 737RS will be a different airplane. Beginning a fleet replacement for the 737-500, the 737-300, the 737-300W and the 717 with the CSeries would provide dramatic net present value and operating cost savings, as the following analysis reveals.

Following the AirTran acquisition, Southwest will have 175 737 Classics and 86 717s. At a modest replacement rate of 26 airplanes a year (assuming at some point 737-700s also require replacement, accounting for perhaps 26 airplanes a year, or one a week for all types), it will take 10 years to replace the Classics and 717s. Double the procurement and the replacement time reduces to five years, in addition to 737-700 replacements. Any way one looks at it, Southwest is facing a long period of multiple fleet types and a likelihood Boeing won't be able to be a sole-source supplier of <150-seat and >150 seat aircraft in the future.

A comparison of the CS500 with competitors would demonstrate significant benefits. Economic performance would also be significantly better than its competitors, as it would gain a seat-mile cost advantage over the 130-seat range models.

Our projected costs for the CS500 show that such a model would be quite competitive with the A320neo and 737-800W, as shown in the tables below for aircraft mile and seat-mile operating costs:

ECONOMIC COMPARISONS 150 Seat Segment		**TRIP COST**				
Manufacturer		Airbus	Boeing	Bombardier	Airbus	Boeing
Model	% Total Cost	A319neo	737-700W	CS500	A320neo	737-800W
Fuel	50%	105%	114%	100%	108%	129%
Maintenance	20%	123%	140%	100%	179%	157%
Crew	20%	100%	100%	100%	107%	107%
Fees	10%	106%	97%	100%	112%	110%
TOTAL OPERATING COSTS/TRIP	100%	108%	115%	100%	122%	128%

On a trip cost basis, the CS500 would be 16% better than the A320neo and 24% better than the 737-800W based on our estimates. Similarly, the CS500 would have an 8% and 10% advantage over its competitors, respectively, as shown below.

ECONOMIC COMPARISONS 150 Seat Segment		SEAT COST				
Manufacturer		Airbus	Boeing	Bombardier	Airbus	Boeing
Model	% Total Cost	A319NEO	737-700W	CS500	A320NEO	737-800W
Fuel	50%	119%	132%	100%	102%	113%
Maintenance	20%	140%	161%	100%	149%	137%
Crew	20%	114%	116%	100%	101%	94%
Fees	10%	105%	98%	100%	92%	84%
TOTAL OPERATING COSTS/SEAT	100%	121%	131%	100%	110%	111%

Our estimates indicate that replacement of 737-700W with a 150-seat CS500 version would provide a savings of about 15% on an aircraft mile basis and 31% on a seat-mile basis, and 20% and 36% respectively for the 737-300W. These savings would be significant on an annual basis, with an estimated differential of approximately $400 per block hour over the 737-700W, $450 over the 737-300W, and $550 over the 737-300. Flying 3,250 block hours per year would yield annual operating cost savings of $1.3 million over the 737-700, $1.45 million over the 737-300W, and $1.77 million over the 737-300.

Southwest operates its 737-300 and -700 models at 137 seats. Replacing those aircraft with a 149-seat CS500 would yield 12 additional seats, or nine revenue seats at a 75% load factor. These nine revenue seats, earning a $.15 yield over 3,250 block hours at an average block speed of 325 knots per hour on short-haul operations would yield incremental revenues of $48.75 per block hour per seat. That translates to additional revenue of about $1.4 million per aircraft. Combining cost savings and incremental revenues from the CS500, Southwest would gain approximately $2.7 million over a 737-700W, $2.85 million over a 737-300W, and $3.2 million over a 737-300 through moving to new aircraft.

When capital costs are taken into consideration, at typical lease rates, it makes economic sense to replace the 737-700Ws that are leased with more efficient models. For the older 737-300 aircraft that are owned, with no capital costs, the advantage of fleet commonality with newer aircraft would mitigate the lower costs of maintaining an older fleet.

In addition, we believe the passenger preference for 2x3 seating over 3x3 seating would provide an additional benefit to Southwest, which would be able to accommodate 80% of its passengers in aisle or window seats, rather than only two-thirds today. Wide-body comfort for the seats, particularly compared with the 1950s seat-width of the 737, would be a major customer-service selling point for Southwest.

Similarly, a transition to a CS100 or CS300 to replace the Boeing 717 would then make sense from a fleet compatibility standpoint. The CS100, with the same seating capacity, provides a 13%

operating costs than the 717, about $270 per block hour, and would offer the benefits of fleet commonality with the CS500 while saving $875,000 annually per aircraft. Replacing the 717 with the CS300 would provide nearly equal block hour costs, but add an additional 20 seats for potential revenue, providing incremental revenue of $48.75 per block hour for 15 seats at a 75% load factor, or an annual differential of $2.3 million.

Based on our calculations and economic estimates for the CS500, we believe it would make sense for Southwest to replace its 737-300, -300W, 737-500 and 717-200 models with the CSeries. Based on its fleet, this could generate significant annual savings:

Southwest Annual Savings **$ millions**	**Prior to capital costs**				
Fleet Type	737-500	737-300	737-300W	717-200	737-700W
Number in Fleet	25	98	75	86	398
Replace with	CS300	CS500	CS500	CS100	CS500
Decrease in Operating Cost per Aircraft	$1.7	$1.5	$1.8	$0.9	$1.3
Increase in Revenue per Aircraft	$1.0	$1.4	$1.4	$1.4	$1.4
Total Benefit per Aircraft	$2.7	$2.9	$3.2	$2.3	$2.7
Total Annual Benefit	$66.3	$279.3	$237.8	$195.7	$1,074.6

The Benefits of Early Adoption

The CSeries is expected to reach the market three to four years prior to a re-engined competitor from Airbus, seven years ahead of a new aircraft from Boeing, and should Embraer choose to launch a new aircraft, have at least a five year lead. Thus, an early customer of the CSeries could expect a significantly higher competitive advantage during the period prior to new competing aircraft being introduced, and to remain competitive thereafter.

Bombardier's competitive advantage is that it will introduce new engine technology into the market that promises significant benefits in fuel efficiency along with lower maintenance costs.

COMPETITIVE COMPARISON 150-seat Segment				
Manufacturer	Airbus	Boeing	Bombardier	Airbus
Model	A320	737-800W	CS500	A320neo
Seats - 1 class 32" pitch	162	170	150	162
Length	123' 3"	129' 6"	135' 2"	123' 3"
Wingspan	111' 10"	117" 5"	115' 1"	111' 10"
Height	38' 7"	41' 2"	37' 9"	38' 7"
Cabin Diameter	12' 1"	11' 7"	10' 9"	12' 1".
MTOW (lbs)	169,755	174,200	151,00	172,000
Range (nm)	3,065	3,115	2,820	3,250

Evaluating the option of acquiring the CSeries shortly after its introduction versus waiting for a new competing aircraft in the 2020 time frame provides significant benefits. The operating cost advantage for a typical narrow body of 18% would translate to approximately $1.5 million in annual savings, assuming operations of 3,500 hours per year per aircraft.

An early operator of the CSeries, with a 2013-2014 EIS, could generate more than $9 million in annual operating savings before a new technology competitor would be introduced in 2019-2020, and likely receive a significantly higher residual value for an aircraft returned in 2014 than in 2020, providing additional cash. Using net present value calculations to evaluate the potential cash flow benefits from a CSeries aircraft replacing an existing technology aircraft of similar size, our calculations show a net present value benefit of approximately $46 million per aircraft over the period 2011-2030. While this does not incorporate transition costs, it is clear that the benefits of acquiring a new technology CSeries in 2014, versus holding an existing aircraft and acquiring a new technology aircraft in 2021, even assuming a 10% operating cost advantage over the CSeries. This clearly illustrates the economic benefit of being an early adopter of technology that creates an economic step-change.

IX. Business Case

The issue of the business case for the CSeries can be addressed from three perspectives – that of an airline customer, that of an aircraft lessor, and that of Bombardier as a manufacturer. The answer is that a solid case can be built for this aircraft from each of those perspectives, and that the Business Case for the CSeries appears sound.

The Customer Perspective

For an airline, a number of factors enter fleet planning decisions, but in an environment in which profits are squeezed in a highly competitive marketplace, economics and risk rise to the top of the decision parameters. The CSeries scores well on both factors.

Economically, the CSeries is head and shoulders ahead of existing competitors, and maintains a solid lead over the potential forthcoming Airbus A319neo, as additional savings result from high technology materials, advanced systems, and updated technologies maintain a significant advantage. Despite potential savings for existing Airbus operators through cockpit commonality and elimination of the need for the transition costs of introducing a new aircraft type, the economics of the CSeries are compelling enough to overcome those factors.

The CSeries will have an advantage of 23% in seat-mile costs over the A319 and 11% over the A319neo. With a three year plus lead on entry into service, if both manufacturers' schedules hold, the savings generated by a customer taking delivery of the CS300 in 2014 will provide a significant return on investment, particularly since the list price of the CS300 will be lower than the projected pricing for the A319neo.

With Boeing likely to make only incremental improvements to its 737NG series and waiting until 2020 for a new model, Boeing will not have a competitive model until 6-7 years after the CSeries introduction. At that point, the P&W GTF, already used by the CSeries, will be available to Boeing, but it is highly unlikely that new technology open rotor engines will be ready for service.

As a result, Boeing will need to utilize advanced materials and 21st Century technologies similar to those used on the CSeries in a 737RS aircraft, as a radical redesign will likely not be feasible until the 2025-2030 timeframe. Accordingly, the CSeries should remain close in economic performance to an all-new Boeing model, as the engine technology used by both will evolve with continuous improvements.

The second element from an airline perspective is risk. With seat mile costs for the CS300 slightly lower than those of the larger A320 and 737-800, an airline can operate a smaller aircraft on a route with variable demand and ensure consistently high load factors and profitability. This enables a carrier to enter smaller markets and exploit the higher yields typically associated with markets with lower frequencies.

Is there risk in being an early adopter of the CSeries? As with any new program, there is always risk. In the case of the CSeries, additional risk is provided by the combination of a new airframe with a new technology engine, particularly one with a highly advanced technological design like the

GTF from P&W. While some comfort can be taken in their 20 year development program and more than 640 million hours experience with engines that have gearboxes, elements of technology risk remain.

Both Bombardier and P&W have identified potential risks, and taken appropriate steps to mitigate risks associated with the respective program developments. Nonetheless, the risk of "unknown-unknowns" remains, and given recent experiences at Airbus and Boeing, the potential for a delay in the program remains a possibility. Both Bombardier and P&W, well aware of recent failures, and have taken lessons learned from the A380 and 787 programs into consideration in their development plans.

The Bottom Line for airlines: From an airline perspective, the cost advantage of the CSeries over both existing and re-engined narrow-body aircraft is significant enough to overcome benefits of fleet commonality, as from an economic perspective it would make sense for an operator to utilize a mixed fleet. Airbus and Boeing and justified in both their concerns and efforts to impede the progress of the CSeries in the marketplace.

The Lessor Perspective

An aircraft lessor is concerned both about the attractiveness of the aircraft, which drives the ability to market the aircraft in the near-term, and the residual value of the aircraft over time, which will drive both lease rates and long-term profitability of a leasing transaction. We believe the CSeries will eventually score well from this perspective, and while a threat to the residual values of the portfolio of older narrow-body aircraft in current fleets, appears an attractive aircraft for investment.

The short-term attractiveness of the CSeries results fundamentally from superior economics. In an era when a 1% reduction in cost can make the difference between profit and loss, an airliner promising a 15% reduction in cash operating costs should be well received in the industry, and therefore by leasing companies. While only one leasing company has ordered the CSeries, other lessors are monitoring the development of the program prior to placing orders, given recent experiences with A380 and 787, and will likely place orders when the program is 24-36 months.

From a residual value perspective, the CSeries, which is a new technology aircraft that provides a step-change in economics over its competition, should hold its residual values quite well. With an engine that promises continual improvements in fuel economy as it matures, advanced materials and systems, a technological leadership, the CSeries should hold its values quite well, particularly when compared with existing A320 and 737NG family aircraft and even the A320neo.

New models of existing Airbus and Boeing equipment, which are at a 15%+ cost disadvantage to the CSeries, will inevitably not hold their values as well as more efficient aircraft, as their ability to maintain profitable operations will be strained by competition once the CSeries enters the market. Airlines play in a perishable commodity market, in which the lowest cost producer typically is the most profitable. An aircraft at a 15% economic disadvantage will soon become out of favor in the competitive segment of the market, and lose value.

The order flow for the 737NG series has been virtually all for the more economic 737-800, and orders for the 737-700 have been slow and primarily fleet additions for existing customers replacing older -300 models. Similarly Airbus A319 orders have slowed from their prior pace, with significantly higher order volume for the larger A320. We believe that orders for the existing 737-700 and A319 models will slow dramatically as the introduction of the CS300 approaches.

The Airbus A320neo, on which Airbus placed a price premium, is expected to have a 10-year economic life prior to a replacement by Airbus in the 2027 time frame. Such a short economic life makes the aircraft more difficult to lease, as the lower residual value at the end of the lease term must enter into lease-rate calculations.

The Bottom Line for lessors: The CSeries will impact leasing companies, either profitably for those that acquire it, or negatively for those holding competing, less efficient Boeing and Airbus models in their portfolio. Our residual value forecasts for the 737-700 and A319 show a significant drop-off once the CS300 enters service, particularly in high fuel price scenarios that would render them, by comparison, economically obsolete. We believe that lessors will always embrace aircraft with superior economics and value, and should embrace the CSeries.

The Manufacturer Perspective

The second perspective for a business case is from the manufacturer's viewpoint. Bombardier has identified a seating capacity class between 110- and 149-seats in which there are currently no new technology airplanes, but only legacy competitors. The A319 technology dates to the 1980s and the 737-700 technology dates to the 1990s. Despite Product Improvement Packages for the A320 and 737 families, these are aging aircraft and re-engining one or both is only a band-aid.

With both of the major manufacturers plagued by delayed programs with significant cost overruns, capital is not readily available for a replacement aircraft in that category, and were replacements to be developed today, they would utilize the same new engine technology that Bombardier is introducing on the CSeries. And since engine technology paces aircraft development and drives economics, they are well positioned as a pioneer of the most modern and innovative engine technology, the P&W GTF.

More importantly, Airbus and Boeing are up-gauging their airplanes in their market forecasts and the "sweet spot" market segment is facing competition from COMAC and Irkut, where the greatest market opportunities are.

The question for Bombardier becomes how much of that market niche they can secure away from Boeing and Airbus, as each has large installed customer bases and significant backlog for their competing 737-700 and A319 models, respectively. Their market forecast for this segment is for 6,000 aircraft over the next 20 years, and Bombardier believes it can compete well with Boeing and Airbus for those orders.

Two factors are contributing to that market. The first is the growth in regional jets, a market with which Bombardier is quite familiar, has grown from 50 seats to 70 seats to 90-100 seats today, and is projected to further grow into the 110-149-seat category. Will this segment provide the demand

that fuels the CSeries, or will that demand come from the legacy and low fare carriers that have operated aircraft over 100 seats?

Existing carriers in the market appear to be reacting to highly competitive conditions by selecting aircraft that are slightly larger and offer better seat-mile economics, as discussed in the narrow-body order backlog below. Will these carriers choose an aircraft with slightly better seat-mile economics than the A320 and 737-800 in a smaller package with lower trip costs? While the jury remains out, we believe that the logic for choosing a more efficient aircraft is quite compelling.

The key question is whether Bombardier has targeted a shrinking market, or whether through superior economics, it can revitalize that market. The following table summarizes the backlog of industry orders at year-end 2000, year-end 2005, and mid-year 2010. It is quite clear that demand patterns have changed dramatically, with the proportion of orders in the 110-149 seat segment falling from just over 50% of the backlog to just under 18% over the last decade.

Single Aisle Order Backlog			
Undelivered	**2000**	**2005**	**2010***
110-149 seats			
A318	161	69	10
A319	383	446	248
717	107	5	0
737-600	48	16	0
737-700	374	374	487
Total	1,073	910	745
150-seats+			
A320	353	959	1,775
A321	206	178	204
737-800	389	693	1,334
737-900	46	33	186
Total	994	1,863	3,499
Total	**2,067**	**2,773**	**4,244**
110-149-seats	51.9%	32.8%	17.6%
150-seats+	48.1%	67.2%	82.4%

Source: Speednews *- through June

Despite the shrinking proportion of orders for narrow bodies in the 100-149 seat range, the overall market has grown, and the total backlog of the A319 and 737-700 programs stand at more than 3,337 aircraft in the 17 years since the first 737-700 order in 1993 and the first A319 order in 1994.

Boeing, in its most recent Commercial Market Outlook, projects demand for more than 21,160 single aisle airliners over the next 20 years. If the current proportion of 17.6% of 2010 orders were to be maintained, that would provide a market for 3,725 aircraft in the 110-149-seat size range.

Airbus, in its most recent Global Market Outlook forecast in 2009 projected 16,977 single-aisle aircraft over the next 20 years. Citing the trend of growth in seating capacity, they project single aisle aircraft to continue to grow in size. Airbus projects that 5,586 aircraft will be needed in the 100-125 seat categories by 2029.

Bombardier forecasts a market for 6,700 aircraft between 100-149 seats between 2010-2029. Embraer projects the market for 91-120 seat jets to be 3,885 from 2010-2029, and for 14,435 narrow-body jets between 120-210 seats over that same period. An average of the forecasts would yield projected demand for approximately 6,000 aircraft in the size range covered by the CSeries.

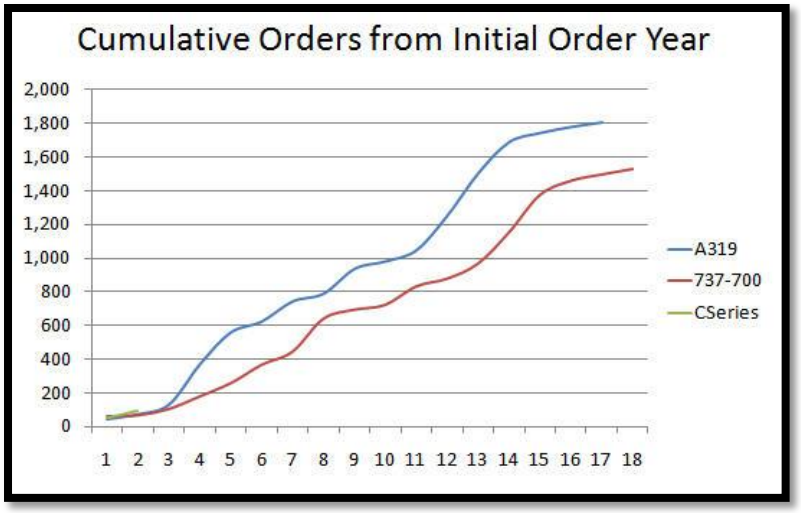
Boeing and Airbus replacement programs are likely to grow with models in the 160, 180 and 200 seat ranges. By maintaining economic superiority over existing models and not competing head-to head with new models, Bombardier could "skirt the competition" and pick up the largest share of orders in that category once Airbus and Boeing announce new models in the 2020-2027 time frame.

With Embraer likely to enter the market in that size range, four competitors will share the market between 110-149 seats, two with new technology and two with old technology. As one of the new technology competitors, we would expect Bombardier to gain a 30%-33% share of that market, which would provide Bombardier a successful program with 1,800-2,000 aircraft sales. However, Bombardier believes it can achieve a higher market share versus Airbus and Boeing, particularly if they continue to offer existing models, re-engined or not, in this size range, and take advantage of earlier market entry with new technology against Embraer.

Since Lufthansa firmed their order for the CSeries in 2009, orders for new 737-700 and A319 aircraft have continued to wane, while Bombardier has secured an additional bell-weather order from Republic Airlines. Bombardier has captured the leadership position in orders in the 110-149 seat class since January 1, 2009.

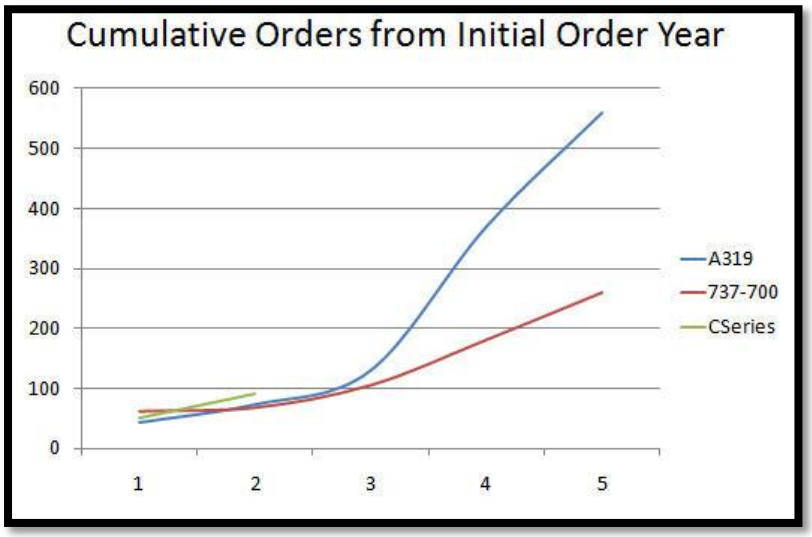
Comparative Aircraft Orders	CSeries	A318	A319	737-600	737-700	Total
Orders 2009	50	1	36	0	38	125
Orders thru 9/30/2010	40	0	27	0	32	99
Total	90	1	63	0	70	224
Share Jan 2009-Sep 2010	40.2%	0.4%	28.1%	0.0%	31.3%	

Of course, three orders do not constitute program success. However, at this point in the development of the program, Bombardier stands ahead of both the 737-700 and A319 on a historical basis, as shown in the chart below. Examining cumulative orders from the year the initial order was received, the pattern for new programs is typically one or two early orders, a slow ramp-up, and then acceleration of orders 2-3 years prior to market entry. For the CSeries, 2012 will be Year 4 in the chart, a critical period in which to evaluate whether the program appears headed for strong or more modest sales.



Source: AirInsight

This chart illustrates, in closer perspective, the first few years of historic order patterns. For Bombardier, the firm order from Lufthansa in 2009 was followed by a major order from Republic in 2010, Year 2 on this chart. The next two years will determine whether the CSeries can keep pace with the A319 and 737-700 initial order growth.



Source: AirInsight

While orders for larger models of the A320 and 737NG families have continued to be brisk enough for both Airbus and Boeing to raise production rates, it is evident that airlines are more carefully evaluating their options, and waiting to see what Airbus and Boeing will do to compete with the CSeries in the 110- to 149-seat class. With both manufacturers postponing decisions, the market has delayed decisions on the CSeries, as airlines want to fully understand and evaluate their options. As Airbus provides clarity on the A320neo family later this year and Boeing announces its decision early next year, the clarity in the marketplace should generate additional orders for the technologically and economically superior alternative, the CSeries.

Of course, airline customers would like to minimize the number of different aircraft in their fleet to achieve the benefits of commonality. Airbus has been masterful in taking advantage of commonality in its battle with Boeing for market supremacy. In that light, some airlines have been pressuring Bombardier to stretch the CSeries to accommodate 150-seats in a single class configuration. With Bombardier recently reserving the trademark for the CS500 designation, which would be ideal for a 150-seat aircraft, we expect an additional model will soon be in the works. Bombardier has also secured a trademark for the CS900, which would indicate a second stretch.

With the history of the CRJ-200 expanding to the -700, -900, and -1000, Bombardier has demonstrated a capability to stretch aircraft and increase the useful life of an airframe. Further expansion of the CSeries, once the order book begins to fill, is not, in our view, out of the question.

Bottom Line: Bombardier has secured a leadership position in a niche market that should generate 6,000 sales over the next 20 years.

In the last two years, the CSeries has secured a 40% market share in the 110-149 seat segment, which would translate to about 2,400 units if that share can be maintained. That would provide a successful and profitable program for Bombardier, and demonstrates a strong business case.

Overall Conclusion: With a positive business case for airlines, lessors, and the manufacturer, we conclude that the Business Case for the CSeries is sound, and we project a successful program if the aircraft can be delivered on-time and perform as promised.

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