

Battle for the commuter jets market

With deliveries of more than 130 commuter jets in 2010, an order book of more than 350 aircraft, Bombardier and Embraer – the two western manufacturers - are about to see significant market changes the coming years.

Other competitors for the same market segment (commuter or regional aircraft with 50 to 100 or even a few more seats), are the turboprops. Turboprops have a market share close to 45%. Bombardier and ATR dominate the market. There are no signs of new turboprop developments, although stretches and upgrades of current aircraft are a possibility. Turboprops will not be part of the present article. They may be subject of a future and more specific article

The demand for commuter jets is expected to increase the coming years. Some forecasts point to more than 3000 small jets entering operation on the next 20 years. India alone forecasts that their fleet will be close to 1000 aircraft by 2025. Typical operation for commuters is as feeders to main hubs and low density routes, where larger capacity aircraft are not economical to operate.

We will divide the commuter jets in four blocks: in service but not produced anymore, in service and in production, entering service now or in short time and, finally, aircraft in development/planned development. To close the subject, some considerations are made about possible revival and updates of aircraft classified in the first block, as some forecasts and prices.

Aircraft with seating capacity up to 50 passengers are not included here. There are basically two families in this category, the Embraer ERJ-135/145 and the Bombardier CRJ-200. Both models sold hundreds of aircraft but demand for these small jets has reduced to just a few per year, with the strong sales for the aircraft with 70 to more than 100 seats.

IN OPERATION, NOT IN PRODUCTION

McDonnell Douglas DC-9, MD80, Boeing 717

The DC-9 and the derived aircraft (MD 80 and Boeing 717) is the most successful family of small jet aircraft for short to medium range ever. The total number of aircraft produced for this family passed the mark of 2400, being second only to the Boeing 737 (6500) and Airbus A320 (4500). Considering all variants, seat capacity was from 90 seats (DC-9 10) to 172 (MD 81, MD 82, MD 83 and MD 88).

The development of the DC-9 started in 1962. First flight and commercial operations started in 1965 (with Delta Airlines). The original DC-9 originated the MD series, with a new wing, stretched fuselage, improved cockpit, upgraded avionics and new engines. McDonnell Douglas was working in the third generation of the DC-9 (designated MD 95) when it merged with Boeing. The last member of the family got a new name – Boeing 717 and more 156 aircraft were produced.

Although production finished decades ago, DC-9's are still in service, as also the evolutions of the original design. With a reputation of reliability and efficiency, this remarkable design will still be seen on airports for many years. Its legacy is not finished yet. The Comac ARJ21 has much of the DC-9. It is manufactured with the fuselage tooling of the MD-90. Fuselage cross section, nose profile and tail are the same of the MD 90.



FOKKER 100

The Fokker 100 (F28 Mk 0100) is an updated version of the Fokker F28 “Fellowship”. The design is based on the original F28 with a modified wing, modern avionics (in relation to the F28), new engines and a longer fuselage, accommodating up to 107 passengers. Development started in 1983. First flight of the prototype was late 1986 and the first delivery (to Swissair) on February 1988. The configuration is similar to the McDonnell Douglas DC-9 with T-tail and two turbofan engines mounted on the rear fuselage. The Fokker 100 has no slats on his wing.

The aircraft was a good design and had a good position on the market but Fokker could not make it profitable and was closed by their parent company, Daimler Bens

Aerospace, after producing 283 aircraft. Most of these aircraft are still in service around the world.

On many occasions since production ceased, there have been announcements of possible revivals of the Fokker 100, the last occasion just this year. If this will materialize, it's something to be seen.



BAe 146 (Avro RJ)



The BAe 146 (renamed Avro RJ in 1993) is a family of regional jets initially developed by Hawker Siddeley and completed by British Aerospace, with first flight in 1981.

Certification and first deliveries were in 1983. It has a unique configuration of high wing and four wing mounted turbofan engines. The last of the 395 delivered entered service in 2002.

The family is composed

of 3 models, BAe 146-100 (Avro RJ70), BAe 146-200 (Avro RJ85) and BAe 146-300 (Avro RJ100). It can accommodate, depending on variant and configuration, from 82 to 112 passengers. Advanced variants, designated RJX were shelved in 2001. The BAe 146 is one of the few aircraft that can operate at the London City Airport that has a high approach angle.

IN OPERATION AND IN PRODUCTION

Bombardier CRJ

The Bombardier CRJ family started with the 50 seats CRJ100, superseded by the CRJ200. The aircraft was based on the Challenger 610E. The program was launched in 1989, with first flight in 1991 and initial deliveries in 1992. From this basic design, Bombardier developed the CRJ700, CRJ900 and the CRJ1000, with a seating capacity from 70 to 100 passengers.

Derived from the CRJ200, the CRJ700 received a new wing, with leading edge slats, a stretched and slightly modified fuselage and new engines. It can carry from 66 to 78 passengers.

The CRJ900, a stretch of the CRJ700 seats 76 to 90 passengers and the last stretch, CRJ1000 has 100 seats. From 2008 on, the series received improvements and the designation NextGen.

Counting only the CRJ700, CRJ900 and CRJ1000, more than 800 aircraft have already been produced.



Embraer E-170/E-190

The **Embraer E-Jets** is a family of commuter aircraft with a seating capacity from 70 to 122 passengers. It is composed of the E-170/175 and E-190/195 jets. With high commonality between the E-170/175 and the E-190/195, the later have a stretched fuselage, larger wings, larger horizontal tail surfaces and a new engine. Contrary to the approach of Bombardier, that based their larger jets on the 50 seats model, Embraer developed a new design for 70 to 100 seats capacity. They are not stretched versions of the E-145 family and have a completely different configuration, with engines on the wings and conventional tail surfaces, similar to the Boeing 737 and the Airbus A320

The program was announced in September 1999 and the first flight was in February 2002. Initial deliveries started on March 2004. This jet aircraft family series has been a success (more than 700 delivered), as the previous smaller jets ERJ-135/145 (35/50 seats) with more than 1100 delivered and still in production. In 2010 more than 90 E-170/E-190 jets were delivered to operators.



ENTERING SERVICE

Antonov An-148

The Antonov An-148 project started early 90's but first flight was only in 2004 and certification by Russian Certification Authority (MAK) in 2007. Service entry was

in 2009. The design is from the Antonov Design Bureau (Ukraine). It can carry from 68 to 99 passengers (99 for the stretched version named An-158) and presents a configuration similar to the BAe 146 (but with two, instead of four, engines). The similarities are the high wing, T-tail, engines on wing and main landing gear retracting on the fuselage. The order book is in excess of 200 aircraft but less than a dozen have already been delivered. Some characteristics of the design, as high wing with good engine ground clearance, integrated stairs and APU (Auxiliary Power Unit), allow the operation on minimum support airfields. The An-148 is equipped with fly-by-wire control systems, glass cockpit and advanced flight and navigation systems. The order book shows that the great majority of the orders are from Russia and former Soviet Union countries.

With engine and avionics from local suppliers, the An-148 will dispute the market with the Sukhoi Superjet. Western airlines tend to prefer aircraft with systems and engines of traditional suppliers, with a support network covering their area of operation.



Sukhoi SuperJet 100

The Sukhoi SuperJet 100, seating 75 to 90 passengers was developed to compete with the Embraer ERJ 175/190 (it has the same configuration) and the Bombardier CRJs. The project is of Sukhoi with collaboration of the Italian aerospace group Finmeccanica (that owns 25% of the civil aviation division of Sukhoi). Sukhoi and Finmeccanica created a company – SuperJet International – for supporting sales, marketing, and aircraft delivery for Europe, America, Africa, Australia and Japan.

The project incorporates advanced fly-by-wire controls, significant number of systems from western suppliers and an engine developed by a company called PowerJet (a joint venture of the French Snecma and the Russian NPOI Saturn). Deliveries, that were originally planned for 2008, have been postponed and only in February 2011 the Russian certification authority (IAC IR) gave the SuperJet the type certificate. EASA certification is scheduled for the end of 2011. First revenue flight of the SuperJet happened as the article is being written, on 21st April 2011. The operator is Armavia. Engine issues seen to be the main reason for delays. The first aircraft in production are two metric tons heavier than expected.

The SuperJet order book counts with 170 firm orders and close to 60 options, most from Russian companies.

Although SuperJet International is based in Venice, Italy, Alitalia opted for the Embraer E-Jets.

With political influence of the Russian government (that considers this as a top priority project), operators in Russia and countries under its influence will buy the SuperJet. Western airlines tend not risk operating aircraft designed by companies that have no tradition on civil aircraft design and construction, with an engine that is new, has no history of reliability and delayed the program for a few years. In its home market, it will compete with the Antonov An-148 and the An-158.



Comac ARJ21

Development of the Comac ARJ21 started in 2003 and first flight, after a series of delays, occurred in November 2008. No aircraft has been delivered up to now (April/2011). The order book has accumulated, in firm orders and options, more than 250 aircraft. Chinese airlines are the main clients but the American leasing company GECAS ordered fifty of the commuters. The smaller version (ARJ21-700) can seat 78 to 90 passengers and the stretched version (ARJ21-900) 98 to 105.

The ARJ21 resembles the venerable DC-9 and not by coincidence. Not only the configuration is the same of the DC-9 family (and Fokker 100, Embraer ERJ 145, and Bombardier CRJs'), but also Comac is manufacturing the aircraft with tooling that McDonnell Douglas provided for license-production of the MD-90. The ARJ21 has identical tail, cabin cross section and nose profile of the DC-9, MD's and Boeing 717. The ARJ21 has the heritage of a successful airframe and systems from traditional western suppliers (General Electric CF34 turbofan, Rockwell Collins avionics, Honeywell fly-by-wire system and others). The recent agreement of cooperation between Comac and Bombardier may help sales primarily outside China, with Bombardier's client support network. Exactly how his cooperation will work in practice, is not known, as the ARJ21 is a direct competitor of the CRJs.

Before entering full production, Comac has to fix the wing (designed and calculated by the Antonov design bureau) that failed in static tests. As result, limitations on the flight envelope of the prototypes was imposed by China's certification authorities. This limitation will result in delay on the flight tests, certification and initial deliveries.



IN DEVELOPMENT/PLANED DEVELOPMENT

Mitsubishi MRJ

The Mitsubishi MRJ regional jet program started in 2008 and is scheduled for entry into service by launch customer All Nippon Airways in 2014. With two variants, it will seat 70 passengers on the MRJ70 and 90 on the larger MRJ90. Configuration is similar to the Embraer 170/190, Bombardier CSeries and Sukhoi SuperJet. The MRJ was initially planned to have a high composite content. This was changed in the development. The wing will no longer be composite but manufactured in aluminium alloy with integrally machined stringers.

As other programs in development today, it will be fly-by-wire, last generation avionics and the new Pratt & Whitney PW1217G geared turbofan, the same that will power the Bombardier CSeries. A total of 65 aircraft are already sold and Mitsubishi is opening a subsidiary in Europe to boost sales for the region (second largest market for regional aircraft, second only to the USA).

Mitsubishi is promising an aircraft with operational cost 30% lower than the aircraft in the market today. If this figure materializes and the competition do not offer options with similar operating cost, the project has good chances of commercial success, even with Japan having no history of commercial aircraft development.



Bombardier CSeries

The program was launched in 2008, after previous tentative attempts to start a new jet seating from 100 to 145 passengers. The CSeries will be sold in two versions, CS100 with 100 to 125 seats and the CS300 with 120 to 145 seats. Bombardier decided to incorporate in its new design a high content of composites (46%) and aluminium lithium (24%), on the footsteps of Boeing on its 787 and Airbus on the A350. Also cabin altitude will be lower, what is an extra confort for passengers. The CSeries will be offered only with the Pratt & Whitney PW1500G (Geared Turbofan). Configuration is conventional, with two engines mounted on the wings, as the E-170/190, Boeing 737 and Airbus A320

Bombardier is announcing significant reduction in operating and maintenance costs for its CSeries. In relation to what is not clear. If they are comparing with current aircraft on the 130-150 seat capacity, all are larger aircraft without last generation engines (Airbus A318, Boeing 737-400). A new design, using new engines, will naturally give an economy on the range announced (15%), even without “extensive” use of advanced materials. If the comparison is to MD aircraft, Boeing 717 and Fokker 100, all these are old designs with old engines.

The CS100 is planned to be on the market on 2013 and the CS300 on 2014. Bombardier forecasts a market (next 20 years) of more than 19000 small jets and plans to have 50% of it with the CSeries. Up to the moment that we are writing this article, less than 100 were sold, showing that the market is not convinced yet of the advantages of a high-tech airframe for small jets.



India's NCA

India's National Aerospace Laboratory (NAL) is teaming up with local government agencies and searching for foreign partners for the development of an indigenous commercial jet (for 70 and 90 seats), that they are calling NCA (National Civil Aircraft). More than 800 Million US dollars have already been allocated for the program, considered by the government as a priority.

Their idea is to have a joint venture with government agencies and aerospace companies for development and production of the NCA. NAL has released information of a design with high content of composite, fly-by-wire flight controls and promising low operational and maintenance costs. Their selection of capacity is exactly the capacity of Embraer's E-jets. Configuration is also the same. Indian authorities forecast a market of 1000 aircraft for the next 15 years in India. Comparing development costs of recent and on going projects, the allocated budget is roughly 50% of what is necessary for design, prototype manufacture, production tooling, tests and certification.



IMPROVEMENTS TO OLD MODELS

Many times we have heard of a revival of the Fokker 100. Now, a company called NG Aviation, has been given support from the Dutch government to restart the assembly line of this model. They also signed an agreement with the government of a Brazilian state to establish an aerostructures manufacturing facility. The proposed Fokker 100 NG will take the basic airframe of the old model and add winglets, modern fuel efficient engines, avionics and interior. The development cost of a derivative like this is much smaller than

the development of a clean sheet design, so that the price can be competitive. According to the planning, the Fokker 100NG will enter the market in 2015. From the picture below, the noticeable difference to the Fokker 100 are the winglets.

For the MD 80 family of jets (and planned for the MD 90 and the Boeing 717), a company called Super98, formed by McDonnell Douglas and Boeing engineering veterans, developed a kit of aerodynamic improvements that will reduce the fuel consumption of these models of at least 3.5%. The kit consists basically of new fairings for flap tracks and seals that reduce the drag of the aircraft. Winglets will be offered also. As there are many of these models still in operation (and they will still be in operation for many years), some operators may be interested in improving the efficiency of their fleet and postpone costly acquisitions. Their target market is aircraft operated in the USA.



PRICE LIST

The table presented here is an estimate of the list prices of the aircraft that are in production and the new designs, based on sales and manufacturer data. These figures are a reference only, as the unit cost presents a large variation. Not only the number of aircraft that a particular airline is acquiring but also optional equipment, interior configuration, training, spare parts, ground equipment and other items affect the total value of the deal. To a launch customer, for example, manufacturers always give special conditions, as it is difficult to market a model that no one has bought yet.

What is clear from the figures on the table is the lower prices of the An 148, the SuperJet 100 and the ARJ21. As new players in the market, cheaper workforce and with

support of their governments, these aircraft have to present something attractive, in the case, lower price.

The CSeries, in both versions, are presenting the highest acquisition cost. If the economy of the operation of these models will compensate the initial investment, it will depend on each operator. The best aircraft (in the economical side) for an airline in Europe (Lufthansa, CSeries launch customer, for example) is not necessarily the same for a small carrier in other regions.

AIRCRAFT	ESTIMATED PRICE (*)
ANTONOV An148	23
BOMBARDIER CRJ700	37
BOMBARDIER CRJ900	40
BOMBARDIER CRJ1000	46
BOMBARDIER CSeries CS100	55
BOMBARDIER CSeries CS300	63
COMAC ARJ21	29
EMBRAER E170/175	33
EMBRAER E190/195	43
MITSUBISHI MRJ70	34
MITSUBISHI MRJ90	40
SUKHOI SuperJet 100	32

(*) MILLION USD 2011

MARKET FORECAST

Bombardier estimated that the fleet of jets from 60 to 149 seats will be approximately 15,000 aircraft by 2028, with circa 12,000 deliveries and 7,000 retirements.

Boeing does not share this opinion regarding the commuter jet market and believes that the market (for the next 20 years) will be something close to 800 aircraft in the USA, so that we can calculate circa 2,400 worldwide (considering that the USA represents 33% of the total). Boeing forecast for commuter jets in China is close to 500 units.

Embraer presents an estimated market of almost 6.900 small jets from 30 to 120 seats, worth about USD 225 billion.

Airbus forecasts do not include small jets.

The most likely scenario, in our view, will be something between 3,500 and 5,000 small jets, from 70 to 149 seats (with 150 seats it is necessary to have one more crew member). We reached this figure considering that there is space for more regional jets in the so-called BRIC countries, including the replacement of the current fleet. We believe also that the market share for the smaller jets (up to 70 seats) will gradually reduce in relation to the market of the 90 to 149 seats.

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