# True Strength of the Canadian Aerospace Industry

What I saw at the three major manufacturers of aircraft, FFS and engines.

The aerospace industry critic **Toshitomo Aoki** visited Canada, where many large- and small-scale aerospace industry companies are located. Here is his report from the frontline of the industry on his visits at Bombardier and CAE located just outside of Montreal and the testing centre of GE located in Winnipeg airport.

Photos and text by Yoshitomo Aoki

Canada is, it goes without saying, one of the top countries in the aerospace industry. According to the Aerospace Industries Association of Canada (AIAC), which oversees this industry, the total annual sales of the industry is approximately Can $27.7 billion (2,354.5 billion yen), with approximately 700 member companies employing approximately 18,000 people. Of various products, Canada is ranked the first in the world in the numbers of commercial flight simulators and small-sized engines (turbofan and turboprop) produced, and the second in the world in the numbers of regional passenger aircraft and commercial general aviation aircraft (business jets, etc.) produced.

The companies in these manufacturing sectors that come to mind immediately are Bombardier, Pratt and Whitney, General Electric, CAE, among others, and in addition to these OEM companies, Canada is the home of many companies that form world-class supply chains including tier 1 companies, small and medium sized enterprises and small businesses (clusters) .

## Home of C Series: Mirabel factory

Of various aerospace companies in Canada, Bombardier is the one that is actually producing aircraft and its major products are the business jets Challenger and Global Series, the regional turboprop Q400 and the regional jet CRJ Series. In addition, it is currently developing C Series, which is a completely newly designed 110/130 seat passenger aircraft with a capacity larger than the CRJ. I visited this time Bombardier's Mirabel factory where C Series is being produced. Taking photographs in the factory is in principle prohibited, but FTV 7 was offered for a photo op.

Of the family of C Series, as you well know, CS100 (Bombardier BD-500-1A10) received its Transport Canada Type Certification on December 18 of last year, and is currently going through testing processes in order to obtain certifications from the US Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA). The testing is going smoothly and on March 3, CS300 (BD-500-1A11)'s second aircraft (FTV 8) was flown for the first time, and route proving testing flights have started in Europe using the same aircraft.

There is no change in the plan of delivering first mass-produced aircraft of C Series to Swiss International Airlines, and C Series will be introduced as the successor of Avro RJ100. Certifications by the FAA and the EASA are expected to be obtained in the first half of 2016, and Bombardier explains that the delivery and the commencement of the service will be around June 2016 since they will be after the certification by the EASA.

When I visited the company in early March, Bombardier had booked orders and commitments for 678 C Series aircraft, which included firm orders for 243. Regarding the production plan for the near future, the company says that it plans to produce 15 to 20 aircraft and deliver them in 2016, increase the production and delivery number to 30 to 35 in 2017, and thereafter increase the number every year.

Regarding C Series, which was designed and is being produced as 110 to 130 seat aircraft, Bombardier claims that it is a product that has been optimized as a newly designed aircraft and is confident that it can deliver the efficiency that cannot be achieved by aircraft produced by enlarging smaller aircraft or downsizing larger aircraft. The company also claims that the market for its current passenger aircraft models (Q400 and CRJ700/900/1000NextGen) and C Series combined for the next 20 years is approximately 12,700 aircraft and that 7,000 or so of the total number will be C Series aircraft, indicating that C Series will be the core of its passenger aircraft products.

One special feature of C Series that Bombardier points out is the main wings that are made of carbon fiber reinforced polymer (CFRP) and, including the main wings, approximately 45 per cent of the body frame structure is made of CFRP, and thereby the reduction of 2,000 pounds (907 kilograms) of the structural weight was made possible.

[Captions for the Bombardier photos]

1. Number 7 aircraft for testing (FTV 7) that was seen in the state of full completion at the Mirabel Factory. It is the first aircraft of CS300 and is used for flight characteristics tests as well. The nose that is visible in the back is that of 5008, which is the third of mass-manufactured CS100.
2. Seen behind FTV 7 is the tail of CS100 (FTV 2). FTV 2 is used for testing the passenger cabin and took its first flight on January 3, 2014. The body of this aircraft is not treated with finish coating.
3. Inside FTV 7. Ballast tanks were placed in the cabin in rows to change the centre of gravity.
4. The cockpit of FTV 7. It is a glass cockpit, which utilizes Pro Line Fusion, and installed above the flight control system operation panel are two sets of display units to monitor flight test data.

## The world's largest provider of flight simulators

CAE, known among aircraft enthusiasts as one of the top two producers of full flight simulators (FFS), manufactures FFSs for business jets and helicopters in addition to its main products of passenger aircraft full flight simulators. Beside hardware, it offers training programs for pilots and cabin crew and virtual flight training for air force personnel.

CAE's products are used in training facilities in over 160 locations around the world, and in Japan, it is conducting projects in cooperation with Japan Airlines. The number of pilots who are trained with CAE's FFSs in a year is over 120,000, and every year over 1,000 pilots obtain their license. Airlines' demand for pilots is continuously growing and CAE expects the commercial airlines' training demand will increase sixfold over the next several years.

Outside of the aircraft sector, growth is expected in the area of medical training simulators. CAE is also pouring resources in this sector and offering simulators that respond to various scenarios such as emergency, resuscitation, treatment and child-birth.

[Captions for the CAE photos]

5. An FFS for Airbus A350XWB in the state of near completion. Because the real aircraft is a state-

of-the-art model, the FFS is also part of a state-of-the-art simulator series. The FFS has, it goes without saying, the freedom of 6 axes.

6. An FFS for Boeing 737-700, of which CAE's Saint-Laurent factory has started the production. As the first phase of the production, the cockpit frame is being constructed.
7. An FFS for Bell 412, which is a notable example of a non-passenger-aircraft FFS. This is the latest full-option model equipped with a radar and a digital wireless panel.

## Engine test rig where seven large fans turn

One of the companies that have established testing facilities to take advantage of Canada's special features is the engine manufacturer General Electric.

This time I visited the GE Aviation Engine Testing, Research and Development Centre (TRDC) located in an isolated area within Winnipeg Airport. Various tests of turbofan engines are conducted at this facility. A similar facility is also located in Mirabel, but while in Mirabel the front structure where the fans specialized for cold weather testing is made of concrete and fixed, the one here is movable, and with compressed air bottles attached to the bottom surface of the base, it can be used for ingestion tests of birds, hail, etc. in addition to cold weather testing.

This facility was built with an investment of approximately US$54 million (6.2 billion yen), and completed in 2011. Currently, it can handle thrust of up to 380kN and the seven large fans installed on the front structure can send air to the engine attached to the test rig in the back at the rate of 1,365 kilograms per second. Behind the test rig is a porous wall, which absorbs and silences noise.

Various engines tested at this facility so far include GEnx, Passport, HF120 (for HandaJet) and LEAP. The facility will be renovated for US$26 million (3 billion yen) with the planned completion date of 2017 and, when the renovation has been completed, it will be able to test GE9X, which is the large turbofan engine for Boeing 777X. The maximum thrust capacity after the renovation is designed to be 670kN.

At the time of this visit, an engine was attached to the test rig, but the photographing of the engine itself was not allowed (the reason seem to have been that the interior of the engine was visible to a large extent). The engine that was attached then was LEAP-1A for Airbus A320neo family, and was MSN022.

[Captions for the GE Aviation TRDC photos]

8. The front structure of the GE's TRDC. The seven fans can generate wind at the maximum speed of 104kt (53m/second).
9. The full view of the TRDC's test stand. After completing the testing of LEAP-1A currently under way, it will be renovated to increase its capacity to be able to test GE9X.