Touch down at any heliport in the world today and there is a good chance that some of the local helicopters are showcases for Canadian technology.

For more than six decades, Canada has been the world’s second largest civil helicopter market – with nearly 3,000 in service today – but over the past 40 years, Canadian companies have also become important developers and producers of advanced rotorcraft systems.

The best known companies include Pratt & Whitney Canada, Bell Helicopter Textron Canada, Airbus Helicopters Canada Limited and CAE. But there are countless other Canadian companies making helicopter components and providing support services.

Early Rotorcraft in Canada

Canada’s first rotorcraft were a pair of Pitcairn autogyros imported in 1931-1932 by Fairchild Aircraft of Canada, based in Longueuil, Quebec, across the St. Lawrence River from Montreal. Three brothers – Douglas, Nicholas and Theodore Froebe – living in Homewood, Manitoba developed the first Canadian “helicopter” to get airborne in late 1938. The aircraft, powered by Gipsy engine from a Great Lakes biplane trainer, got all three wheels off the ground during a series of “hops,” reaching altitudes of up to three feet (1 m). (The Froebe helicopter is now on display at the Western Canada Aviation Museum in Winnipeg, Manitoba).

After World War II, Sikorsky and Bell Aircraft competed for the first helicopter sales in Canada. Canadian Pratt & Whitney Limited (as P&WC was then known) had been formed in 1928 and was a major producer of piston engines; it was also the post-war sales agent for Sikorsky Aircraft in Canada. In 1947, P&WC began delivering the first of seven Sikorsky S-51s to the Royal Canadian Air Force (RCAF) for flight training and search and rescue (SAR) use. Meanwhile, Bell Aircraft’s helicopter factory in Niagara Falls, New York was literally minutes from the border, and in 1947 it began delivering Bell 47Bs to Canadian civil customers.

In the 1950s, the Canadian civil helicopter fleet expanded with new models of the Bell 47 and the introduction of the Hiller 360, Sikorsky S-55 and S-58, as well as military deliveries of the Piasecki HUP-3, H-21 and H-44, and Sikorsky H-19, HO4S-3 and H-34. The first Sud Aviation (later Aerospatiale, now part of Airbus Helicopters) SE3130 Allouette II helicopter was delivered to a Canadian customer in 1958; it was Canada’s first turbine-powered helicopter.

Attempts to develop an indigenous helicopter development and production capability, however, were long stymied. In August 1945, Intercity Airways began...
development of the Sznycer-Gottlieb SG-VI Grey Gull helicopter, which flew for the first time July 9, 1947. It received a Canadian Certificate of Airworthiness on March 15, 1951, becoming the first helicopter designed, built and certified in the British Commonwealth. Two were built, but it was never put into production. (The surviving prototype is on display at The Reynolds-Alberta Museum, Wetaskiwin, Alberta.)

Efforts by Fleet Aircraft of Fort Erie, Ontario to enter the helicopter industry with Doman Helicopters of Danbury, Connecticut were short lived. The Doman-Fleet LZ-5 was developed and flown in Canada and was simultaneously Type Certified in the US and Canada in 1954, but it similarly never entered production.

However, when the Canadian government cancelled the ambitious Avro CF-105 Arrow supersonic interceptor in February 1959, it negotiated a US defense production sharing agreement as part of a commitment to buy American jet interceptors.

York Gears of Toronto (now part of Northstar Aerospace) won a contract in the early 1960s to build the forward and rear rotor transmissions for the Boeing Vertol Model 107 and Jarry Hydraulics of Montreal (today part of UTC Aerospace Systems) won a contract to design and build the landing gear for the CH-47 Chinook; after which, Canada placed an order for 18 Vertol 107 tandem helicopters to equip RCAF and Army units, known as the CH-113 Labrador. Piasecki Helicopter and later Boeing Canada operated a military helicopter maintenance, repair and overhaul (MRO) plant near Ottawa in Arnprior, Ontario from 1954 until 2004 when the CH-113 fleet was retired.

In late 1962, the Canadian government ordered the first of 41 Sikorsky CHSS-2 Sea King helicopters for the Royal Canadian Navy (RCN). The contract win meant that P&W had to become a helicopter manufacturer and develop and integrate a new weapons system, which was new for the engine manufacturer. The first four Sea Kings were manufactured by Sikorsky, but the remaining helicopters were built in Canada at Longueuil, and later St. Hubert, Quebec. The first Canadian aircraft to fly was RCN No. 4005 at Longueuil on April 9, 1964 – 50 years ago this year.

While P&W was assembling the Sea Kings in Longueuil, across the St. Lawrence River in Cartierville, a suburb of Montreal, Canadair was developing the innovative CL-84 tilt wing aircraft. The prototype CL-84 made its first hover on May 7, 1965. Three additional, improved CL-84-1s were built in the early 1970s. All total, the CL-84 made more than 700 flight test and military evaluation flights in Canada and the US, but ultimately lost out to the enthusiasm growing for the tiltrotor, instantiated in the XV-15. The counter-rotating tail rotor technology of the CL-84, however, was used by Canadair (now Bombardier) in the 1970s to develop the CL-227 Sentinel VTOL unmanned aircraft system (UAS), and the evolved CL-327 Guardian in the 1990s.

The PT6 – The Core of Canadian Power

In 1957, P&W hired a small team to develop new small gas turbine engines. The first engine the team designed was a small turbofan, which was taken over by the parent company in the US and put into production as the JT12 (J60); the turboshaft version, the JFTD12 (T73), powered the Sikorsky CH-54 Tarhe and S-64 Skycrane.

The PT6 was the next engine developed by the P&W team. The engine was designed as a free turbine so that it could be utilized in helicopters and fixed-wing aircraft. The first helicopter (or aircraft for that matter) to fly solely with PT6 power was the military-focused Hiller Ten99 in July 1961. It was followed in early 1962 by the high-speed, experimental Piasecki 16H-1 Pathfinder helicopter, the rigid-rotor Lockheed XH-51A helicopter in late 1962, the twin-engine Kaman K-1125 helicopter in early 1963, and the Lockheed Model 286 helicopter (the planned civil production version of the XH-51) in 1965. None of these aircraft, however, went into production.

P&W’s entry into the commercial helicopter business was the PT6T-3 Twin-Pac engine developed in the late 1960s with the support of the Canadian government, which wanted a twin-engine version of the Bell UH-1. The Twin-Pac entered service in the early 1970s, powering the Sikorsky S-58T, Sikorsky CHSS-2 No. 4005 was first Canadian-assembled Sea King for the Royal Canadian Navy. It made its first flight at Longueuil on April 9, 1964. Test pilots Seth Grossmith (RCN) and W. Ross Lennox (P&W) are at left. (Photo by W. Ross Lennox/author’s collection)

This Boeing Vertol 107 – known as the CH-113 Labrador in Canadian service – was used for search and rescue from 1964 to 2004. Several of the components were made in Canada.
Bell 212, Agusta-Bell 212, military UH-1N Twin Huey, and the AH-1J Sea Cobra attack helicopters sold to the US Marine Corps (and pre-revolutionary Iran). The Twin-Pac-powered Bell 412 entered service in 1981.

P&WC developed the PT6B-36 turboshaft for the Sikorsky S-76B in the mid-1980s. The S-76B was originally developed for “hot and high” military operations, but most were sold for executive use where passengers valued the PT6’s outstanding reliability.

Creating a Canadian Helicopter Industry

In the mid-1970s, the Canadian government bought Toronto-based de Havilland Canada from Hawker Siddeley and Montreal-based Canadair from General Dynamics to protect their manufacturing capabilities and develop new export products, such as the Dash 8 airliner and Canadair Challenger business jet, respectively. The government in Ottawa also began to explore opportunities to increase Canadian manufacturing participation in the helicopter industry to offset imports of more than 150 helicopters a year that were used to support natural resource development.

A market study recommended that Canada seek a “world product mandate” to build light twin helicopters in Canada for domestic and export use that could also launch development of a new P&WC turboshaft engine.

In late 1983, Ottawa announced that it had accepted proposals by Bell Helicopter Textron and Messerschmitt-Bölkow-Blohm (MBB) to establish light twin helicopter factories in Quebec and Ontario respectively, with the financial participation of the two provincial governments.

Unfortunately, the large forecast demand for light twin helicopters in the 1980s failed to appear after the world oil price collapse of 1986 that grounded hundreds of helicopters working the oil and gas sector (see “Offshore Canada,” Vertiflite, Jan-Feb 2014). This dampened demand for new aircraft, but led to the development of more fuel-efficient models of helicopters and engines.

PW200 Turboshaft Success

In 1983, P&WC’s announced plans to build a high power engine with low fuel burn for the emerging light twin market. The aim was a new generation turboshaft in the 400 – 500 shp (300 – 375 kW) range, though this was soon increased to 500 – 800 shp (375 – 600 kW). The goal was to achieve a 10% to 12% lower fuel burn than existing engines, and a 15% to 20% reduction in fuel burn compared to a PT6B of similar power.

The design that would become known as the PW200-series features three major rotating components: a single-stage turbine powered the single-stage centrifugal compressor, while a single-stage power turbine drove the front-mounted gearbox. At the heart of the PW200 is a high-speed 8:1 centrifugal compressor with an impeller rotating at 58,000 rpm to produce high pressure ratios.

The PW2058 first ran on February 7, 1987 and first flew on October 6, 1988 in the Bo 105LS B-1 testbed aircraft X-01 at MBB Canada in Fort Erie, Ontario.

P&WC’s huge technological investment eventually paid off when the PW200 was selected to power seven new light twin helicopters developed in the 1990s and 2000s. The first production helicopter to use the PW200 was the MD900 Explorer (PW206 and PW207E); the engine was also selected to power the Bell 427 (PW207D), Bell 429 (PW207D1), AgustaWestland AW109E Power (PW206C) and AW109S Grand (PW207D), Kazan Helicopter
Ansat (PW206C), and the unmanned Boeing A160 Hummingbird.

On the strength of MBB’s extensive evaluation of the PW200 on the Bo 105LS and Bo 108 research aircraft, the PW206 was selected as one of two engine options for the new EC135 (the other being the Turbomeca Arrius 2B).

**New Generation PT6-Powered Helicopters**

At the 1995 Paris Air Show, Agusta displayed a mockup of a new single-engine eight-seat helicopter called the A119 Koala that would use the cabin and rotor system of the A109E. P&W finally entered the single-engine helicopter market when deliveries of the 1,000 shp (750 kW) PT6B-37A-powered A119 Koala began in 1998.

Meanwhile, in 1997, Agusta began development of the 15-seat AW139 to fill a gap in the market between transport aircraft like the Bell 412 and Eurocopter Super Puma. To power the new aircraft, Agusta and its partner Bell selected the PT6C-67C to provide excellent Category A single engine performance. The prototype AB139 flew on February 3, 2001 at Vergiate, Italy and deliveries began in 2003. In February 2012, P&W celebrated the delivery of its 75,000th engine, a PT6C-67C delivered to AgustaWestland for an AW139.

During the Bell and Agusta collaboration, Bell/Agusta Aerospace Company also selected the PT6C-67A to power the innovative AB609 (now AW609) tilt rotor. For takeoff, the turboshaft is now being rated at 2,400 shp (1,800 kW), the highest rating of any PT6. The prototype 609 flew under PT6 power on March 6, 2003.

The Airbus Helicopters EC175 flew for the first time in Marignane, France on December 17, 2009, powered by a P&W PT6C-67E engine. This was the first time a P&W engine had flown on a brand new helicopter developed in France, and was considered a major commercial breakthrough. Like the AW139, the EC175 is targeted at the offshore oil and gas market where PT6 reliability is well established.

With an eye to capturing a slice of the Bell “Huey” upgrade market, Global Helicopter Technologies, in partnership with DynCorp, developed the UH-1H Global Eagle powered by the PT6C-67D. Temsco Helicopters subsequently acquired the rights to the PT6C-67D powered UH-1H and Bell 205A-1.

In the early 2000s, P&W identified an opportunity to develop a new member of the PW200 family in the 1,000 shp (750 kW) class for new generation intermediate and medium size helicopters. The PW210 was launched in February 2005 and incorporates technology from other P&W engines, such as a single stage compressor similar to that used on the PW600 turbofan.

The PW210 powers the Sikorsky S-76D (which first flew on February 7, 2009 and entered commercial service in early 2014) and the AgustaWestland AW169, which flew at the Cascina Costa plant in Italy on May 11, 2012 and will enter service later this year. Airbus Helicopters has also selected the PW210 engine (along with the Turbomeca
Arrano 1A) to power the next-generation X4 helicopter scheduled to fly in 2015.

The largest member of the P&W helicopter engine family is the PW127TS, a turboshaft version of the PW127 turboprop engine being developed by a Russian consortium to power the 30-passenger Mil Mi-38, which first flew on August 25, 2004. The PW127TS produces 2,500 – 3,000 hp (1,500 – 2,200 kW).

In May 1993, P&W opened an engine assembly plant in Lethbridge, Alberta. The PT6T Twin-Pac for the Bell 412 has been assembled here for many years and the PT6C family will be added in 2014.

Together, the P&W PT6 and PW200 helicopter engines have accumulated more than 50 million flight hours.

### Airbus Helicopters Canada Limited

In March 1984, MBB Helicopter Canada Limited (MCL) was established with a “world product mandate” to produce the “hot and high” Bo 105LS helicopter in Fort Erie, Ontario and develop a PW200-powered version of the helicopter, possibly using a five blade rigid rotor.

The new venture was supported by the governments of Canada and Ontario. Fleet Aerospace in Fort Erie was an equity partner and provided MBB with its first office across the street from the construction site of the new plant.

The first delivery was an MBB BK117 to ALC Airlift Corp. of British Columbia to develop helicopter emergency medical services market in Western Canada. The first production Bo 105LS flew at Fort Erie on March 13, 1986, while the 85,000 ft² (7,900 m²) factory on 180 acres (73 ha) of land officially opened three months later on June 20, 1986.

Between 1984 and 1988, MBB delivered 16 helicopters, designated Bo 105S-CDN-B5-4, to the Canadian Coast Guard. The first two were delivered by MBB Helicopter Corp. in West Chester, Pennsylvania before MBB Helicopter Canada gained full responsibility for the Canadian market.

In 1986, the BK117 entered service with the Shock Trauma Air Rescue Society (STARS) in Alberta (flown by ALC Airlift) and the Ontario Air Ambulance Service (flown by Toronto Helicopters), followed by the delivery of a BK117 to the Ontario Ministry of Natural Resource for firefighting use.

New Bo 105LS helicopters were exported to customers in the US (New York State Police, California Highway Patrol, Drug Enforcement Agency and CalStar), Mexico (Taesa) and Peru (Air Force and Federal Police) and a few Bo 105Cs were sold in Canada (Sunrise Helicopters, Department of Fisheries and Oceans, and Trans Mountain Pipelines).

When development of the P&W PW200-powered Bo 105LS was shelved, MBB Canada engineers led the development of the PW206-powered version of the Bo 108 and the EC135.

Eurocopter Canada Limited (ECL) was formed in 1992 with the merger of the helicopter divisions of MBB of Germany and Aerospatiale of France. At the time there were 125 Aerospatiale and 24 MBB helicopter models flying in Canada. The merger was very beneficial to the Canadian company when it gained sales and service responsibility for the entire French helicopter product line, including the popular AS350B AStar, which has been the top selling factory new turbine helicopter family in Canada ever since.

All helicopters are built by the parent German and French factories and shipped “green” to Fort Erie for assembly and completion to customer specifications.

The composite manufacturing has grown in parallel, with Fort Erie making the engine cowlings for the EC145 and UH-72 Lakota, as well as components for the AS350, EC120, EC135 and EC155. In early 2014, the company announced plans to hire 40 more people to build new composite components for the EC225.

In February 2014 the company was renamed Airbus Helicopters Canada Limited (AHCL). With annual revenues of about C$100 million, the company employs 250 people at its 135,000 ft² (12,500 m²) factory and regional offices supporting 180 domestic customers flying 670 Airbus helicopters. The company has won a greater than 50% share of the new sales of commercial and parapublic (i.e. police) helicopters in Canada during the past 10 years.

### Bell Helicopter Canada

After the 1983 agreement with the federal and provincial governments, Bell Helicopter Textron Canada (BHTC) opened its new manufacturing facility north of Montreal near Mirabel International Airport in 1986. The original 436,000 ft² (40,500 m²) facility on 151 acres (61 ha) of land...
was initially constructed to produce three members of the Model 400 TwinRanger light twin helicopter, with the total investment of $512 million (in 1983) to be split between Bell and the governments of Canada and Quebec. In 1986, Bell renegotiated its agreement with the governments after making a strategic decision to separate its helicopter business, transferring production of all its commercial products to Canada, with the company’s military work conducted in Texas.

The Bell 206B JetRanger was the world’s most popular light single-engine helicopter and in the summer of 1986, production began shifting to Canada with the first “Canadian” assembled JetRanger (serial 3959) flown for the first time at Mirabel in October. The first Mirabel-assembled 206L-II LongRanger III flew in April 1987, the first Bell 212 in October 1988 and Bell 412 in 1989, with both the 212 and 412 powered by PT6T engines. BHTC installed the P&W PW209T Twin-Pac engine into the prototype Model 400A at Mirabel in 1987, but the TwinRanger program was cancelled before first flight.

In October 1989, Bell announced the development of the Model 230. A refinement of the Model 222, the new helicopter was powered by a pair of Allison 250-C30 engines with the prototype (a converted 222) flying at Mirabel for the first time on August 12, 1991.

In 1991, Bell delivered its 500th helicopter from Mirabel; the same year, annual production passed the 200 aircraft mark for the first time. In 1992, Bell received a major contract to build 100 CH-146 Griffon helicopters – based on the 412EP – for the Canadian Armed Forces to replace its existing fleet of CH-118 Iroquois, CH-135 Twin Huey and CH-136 Kiowa tactical and SAR helicopters. Designated the Bell 412CF, the PT6T-3D Twin-Pac-powered Griffon breathed new life into the Model 412, which has become a popular replacement for single-engine Bell UH-1 military helicopters in many parts of the world.

In 1993, the US Army selected the Bell TH-67C Creek (based on the Bell 206B-3) to replace the UH-1 in the training role at Fort Rucker. The US Army ordered 157 TH-67Cs and the Taiwan Army bought 30. The basic helicopter was built at Mirabel and customized for the Army in Texas.

By 1994, the Canadian factory was producing about one-third of the world’s commercial turbine helicopters when Bell launched development of the four-bladed Bell 407 and 430 at Mirabel. The Model 430 was a growth version of the Model 230 featuring a four-bladed rotor system, an 18 inch (46 cm) cabin stretch, and more powerful Allison 250-C40B engines. The prototype began flying on October 25, 1994.

Fleet Aerospace (now Fleet Canada) was selected to build the cabins and tail booms for the 230 and the 430 (until 2005 when Hafei Aviation Industry in China took over Model 430 component production). Bell built 136 Model 430s between 1994 and 2008.

The Model 407 mated the proven LongRanger IV airframe with the four-bladed soft-in-plane rotor system of the US Army OH-58D and a Rolls-Royce 250-C47 engine. Molded fairings were added to the LongRanger cabin to increase the cabin width by eight inches. The Model 407 has been an outstanding success, with production reaching 1,500 aircraft by April 2014.

Bell delivered 13 Model 206LT TwinRangers from Mirabel between 1994 and 1997 as a supplemental type certificate (STC) modification of the 206L-4, utilizing Tridair’s Gemini ST twin engine conversion kit.

In 1996, Bell announced the development of the twin engine Model 427, which mated a pair of P&W PW207D turboshafts to a modified Model 407 airframe. The helicopter was developed in partnership with South Korea’s Korea Aerospace Industries (KAI) and Japan’s Mitsui Bussan Aerospace; the prototype 427 began flying at Mirabel on December 11, 1997.

In 1998, Bell launched the development of the Bell 412 Plus, which would be powered by the PT6T-9, with first deliveries in 2001. A total of 26 military 412 Plus helicopters were delivered by Bell and Agusta-Bell to the Royal Saudi Air Force and the Turkish Coast Guard, but plans for a new version were dropped when Bell and Agusta joined forces in 1999 to develop the Agusta-Bell AB139.

In August 2005, Bell marked the delivery of the 3,000th helicopter from the Canadian factory with the delivery of a Bell 412 to Offshore Logistics (now the Bristow Group). At the time, Bell was gearing up to develop a new line of MAPL (Modular Affordable Product Line) helicopters as well as build Model 407 cabins and Model 427 tailbooms for the Honeywell HTS900-2 turboshaft-powered ARH-70A Armed Reconnaissance Helicopter (ARH) program (cancelled in March 2007). A civil version, the Bell 417, was never launched, although Eagle Copters of Calgary plans to certify its Bell 407HP conversion powered by the HST900D-2.

The MAPL program evolved into the Bell 429 GlobalRanger, a clean sheet design featuring an Instrument Flight Rules (IFR) cockpit, a large cabin with rear clamshell doors and elements of the Model 427 rotor and dynamics system. The development of the MAPL...
and Model 429 received a total of C$230 million in government financial support, equally provided by the governments of Canada and Quebec. The prototype Model 429 flew at Mirabel February 27, 2007 and was certified by Transport Canada on July 1, 2009.

In 2010, Bell launched the Bell 412EP with a new avionics system and the PT6T-9 replacing the PT6T-3D/DF engine. The new PT6T-9 provides a new 30-second and 2.5-minute One Engine Inoperative (OEI) rating structure, electronic engine control (EEC) with manual backup, and improved CAT A single engine performance resulting from a 11% higher takeoff rating.

In February 2012, BHTC delivered its 4,000th helicopter, a Model 206L-4 to Air Medical Group Holdings (AMGH) and at the end of 2012, it delivered the first Bell 407GX featuring a Garmin G1000H cockpit.

Today, the 1,800 people employed at the 660,000 ft² (61,000 m²) BHTC factory produce four helicopter models: Model 206L-IV LongRanger IV, Model 407, Model 429 and Model 412EP. New helicopters are customized at Mirabel or the Edwards and Associates facility owned by Bell in Piney Flats, Tennessee.

Since BHTC moved to Canada, European rivals AgustaWestland and Airbus Helicopters have both established helicopter final assembly lines in the United States. To rebuild a US commercial presence, the new Bell 505 JetRanger X is to be assembled in Lafayette, Louisiana and the Bell 525 Relentless in Amarillo, Texas.

**Supporting Industries**

In addition to the nation’s rotorcraft manufacturing industry, Canada also developed a very capable helicopter MRO industry to support its large fleet of commercial helicopters. In the 1980s, many of these companies began to expand to support international civil and military helicopter operators. Major MRO companies concentrated in western Canada include Standard Aero of Winnipeg (engines), Vector Aerospace of Vancouver (airframes and engines), Heli-One of Vancouver (airframes and engines) and Eagle Copters of Calgary (airframes and STC upgrades).

Turbomeca Canada opened its MRO in Mirabel in 2003.

CAE Inc. of Montreal is one of the world’s leading developers of helicopter full flight simulators (FFS) and military mission rehearsal systems and entered the civil fixed-wing and helicopter pilot training business by establishing a network of FFS training centers (see “The Outlook for Simulators” in this issue).

Other leading Canadian helicopter industry suppliers include SEI Industries (Bambi Bucket firefighting systems), L-3 Wescam (electro-optic / infrared, laser imaging and targeting systems), Magellum Aerospace (helicopter wire strike protection system) and Dart Aerospace (accessories), Messier-Bugatti-Dowty (landing gear for the V-22 and AW609) and Héroux-Devtek (landing gear for the CH-47 and CH-53K).

On the military side, BHTC provides MRO support for the CH-146 Griffon, IMP Aerospace of Halifax supports the CH-124 Sea King and AgustaWestland CH-148 Cormorant, and General Dynamics Canada and Boeing will support the RCAF’s 15 new CH-147F Chinooks.

**Summary**

In 1947, Canada became one of the first export markets for the initial postwar helicopters developed in the United States and has since become the world’s second largest civil market by fleet size.

In the 1970s and 1980s, investments by leading manufacturers – supported by the Canadian federal government, and the governments of Quebec and Ontario – helped engender a robust indigenous Canadian commercial helicopter and turboshaft engine manufacturing industry.

The benefits include the creation of more than 2,500 new helicopter engineering and manufacturing jobs since 1984 and hundreds of millions of dollars in annual Canadian exports.

**About the Author**

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