Bombardier Global Express

Much-desired product support and aircraft improvements are on track for 2004.
The Global Express — GEX — the highly anticipated flagship of the Bombardier business aircraft fleet, is maturing into the aircraft promised by its designers in the early 1990s. Almost immediately after the superjet’s introduction in 1999, it acquired a reputation as a high-tech hangar queen among early operators because of bugs in immature, complex systems, mismanaged completions at Bombardier’s Tucson facility and wholly inadequate parts support.

“The aircraft was way, way ahead of its time. At the time, you better have had your own full-time mechanic,” said Jay Schley, president of North American Air Charter, which operates s/n 9008.

“Our aircraft had 97-percent dispatch reliability when it wasn’t in the shop. But it spent 60 percent of its time in the shop awaiting repairs or parts, most of which were related to completion center issues,” another early aircraft operator told B/CA.

Five years later, most operators are singing a much different, and happier, tune.

“We lost a couple of trips early on, but the aircraft has been very reliable for the last 1,200 hours. It’s the best airplane out there in this class,” said Ken Kuhrt, United Technologies’ UFT Flight chief pilot.

“The reliability has been outstanding. Nobody could ask for a better airplane,” said Kirby Wochst, managing director of FedEx’s corporate flight department, which flies s/n 9091. “We couldn’t be happier with our Global Express. The boss absolutely loves it and says so every time he flies on it.”

“Reliability is one of its five best features,” another southern U.S. operator said. “You’d be nuts to fly anything but a Global.”

One main reason for operators’ change in perception is Bombardier’s moving the factory completion center from Tucson to Montreal. Tucson was stripped of its business aircraft completion activities andBombardier transformed it into a CRJ service center. Business aircraft completions at the Montreal facility are under the direction of Vice President-Completions Brian Adams, a CRJ production veteran with a reputation as a stickler for quality control and on-time deliveries. Adams has instituted strict process controls, standardized interior designs and “productionized” interior completions for the Global Express program. Bombardier still offers fully customized interiors, but customers now are told up front that highly individualized interior designs cost considerably more in time, money and weight.

The result is a 29-week completion process for most Global Express aircraft, Adams said. Completed aircraft now are delivered to customers with few or no squawks, according to Kevin Hoffman, president of Aerospace Concepts, a well-respected Montreal completion consulting firm. Hoffman added that most completions he’s overseen required about 40 weeks at Bombardier, compared with 26 to 33 weeks at other manufacturers’ completion centers.

When B/CA asked operators to name the Global Express’ best features, practically all operators put high cruise speed and high-altitude performance, excellent short-field capabilities, superior cabin and cockpit comfort, low interior noise levels and built-in diagnostic systems on their top-five favorites list. Other folks mentioned Bombardier’s excellent field tech reps, ride comfort in turbulence, high-tech systems and low direct operating costs (in warranty) as being among the aircraft’s best attributes.

Questioned about the aircraft’s worst features, operators of early serial numbers had no trouble rattling off six to 10 issues, many of which were related to poorly executed aircraft completions at Tucson. They griped about vacuum toilet malfunctions, poor quality control on furniture and fittings, uneven cabin temperature and broken cabin entertainment systems. “Cry wolf” nuisance alarms, slap-flap controller problems, electrical system woes and avionics system shortcomings also made the gripe list.

Topping the list of operators’ least liked features, regardless of aircraft serial number, was Bombardier’s parts support. Folks who fly and fix the Global Express said spare parts were in poor supply, they were tied up in U.S. Customs en route from Bombardier’s Montreal warehouse, repairs and overhauls took too long and Bombardier frequently didn’t know which parts depot had which parts.

Resolving the Parts Supply Issue
No one in Bombardier’s organization is more forthcoming about the history of Global Express parts problems than Jim Ziegler, vice president/general manager of Bombardier Business Aircraft Services (BBAS).

“We know that parts support is a signifi-
It takes 45 to 50 minutes to refuel the Global Express. Some operators told B/CA that consistently full fuel loads can be obtained only by topping the tanks with no power on the airplane.

cant issue for [Global Express] operators. It's clearly the number one issue at BBAS. But putting a full-court press on the problem doesn't make it an easy thing to fix,” Ziegler said.

Ziegler conceded that Bombardier didn’t have a grasp on the potential magnitude of parts shortages when the aircraft was introduced. The assumed parts reliability numbers proved optimistic, and thus there just weren't enough spares on the shelf. Moreover, spares were kept at several parts depots that weren't directly linked through a central computerized inventory system. Moreover, many parts were stored at Bombardier's Montreal facility, causing extensive U.S. and Canadian Customs processing delays when they were imported for use by U.S. operators or shipped to and from U.S. systems manufacturers for repair and overhaul.

“We had too many legacy [parts inventory] systems and they weren’t capable of handling growth. There’s no question that we would have done this better at the start if we had known then what we know now,” Ziegler told B/CA. BBAS now is in the process of revolutionizing its parts inventory and distribution system as a result.

The Global Express spares inventory has been beefed up from $15 million to $60 million, Ziegler said. In May 2002, BBAS embarked upon a plan to unify all six U.S. BBAS service facilities, plus the Montreal and Wichita spares operations using SAP business solutions software. “This change now gives us better data, essential for inventory planning,” Ziegler said. SAP, founded in Walldorf, Germany, three decades ago, has become the world’s third-largest independent soft-

ware supplier, with 12 million users.

Ziegler also said Bombardier has moved the majority of Global Express parts to the United States from Montreal, eliminating the U.S. Customs import processing delays for U.S. operators, who make up 70 percent of Global Express owners. In addition, moving rotatable parts to the United States cuts the three-week repair and overhaul time by several days because it eliminates four border crossings for such parts when they are used by and repaired by U.S. firms.

In January, Bombardier expected to announce a teaming arrangement with a “best in class” third party inventory planning services and distribution provider.

Initially this upgrade will provide BBAS with new tools for forecasting demand for spares. Long term, it will enable BBAS to outsource much of its inventory distribution to a new network provided by the third party firm.

“No doubt, we should have recognized all this in the 1995 to 1996 time frame,” Ziegler said candidly. “At Global Express’ entry into service, we were experiencing 70-percent parts fill rates for customer orders. That’s now improved to 86 to 87 percent. By the end of 2004, we fully expect the parts fill rate to improve to 95 percent.” With 95-plus-percent fill rates, operator grumbling should turn into raves.

BBAS also is focusing on quality control of repaired and overhauled rotatable parts. Ziegler claimed “significant” improvement in quality control and “fewer parts are being rejected for defects.”

How Operators Use Their Aircraft

Operators of 37 Global Express aircraft responded to B/CA's survey, representing just under one-third of the active fleet of 115 airplanes. We spoke with operators of early, mid and late delivery aircraft, including large fleet operators TAG and Jet Aviation. Most operators said they chose the Global Express over other makes of large cabin, ultra-long-range business aircraft because of its high technology, larger cabin, higher cruising speeds and shorter runway requirements.

Some operators also said that Bombardier had been more flexible on price than some other OEMs. A few operators said they upgraded to the Global Express because of previous favorable operating and support

Kevin Baughman, Del Mar Jet’s director of maintenance, takes full advantage of Build 4 maintenance diagnostics to troubleshoot Global Express systems.
experiences with Bombardier Challenger 600-series aircraft. They liked the Challenger's cabin cross section, but they wanted more speed, range and cabin length.

Operators said they fly an average of 582 hours per year and they estimated their average stage length at 3.5 hours. Bombardier, in contrast, said that the fleet-wide average annual utilization is 432 hours and the average flight is 2.4 hours. The latter numbers are more accurate than B/CA’s survey data.

The Global Express customer fleet has amassed more than 95,000 flight hours, and all aircraft, including Bombardier’s test and demo aircraft, have logged more than 106,000 hours in the air.

GEX operators also fly fast, according to B/CA’s survey results. Practically no one flies slower than 0.85 Mach, equivalent to 488 KTAS on a standard day, except on the longest missions. They only slow down when flying farther than 5,500 nm, and then they fly no slower than 0.82 Mach unless the aircraft is very light. A few cruise at 0.88 Mach or 505 KTAS on almost all transcontinental U.S. missions.

Operators said they carry three to four passengers on day-to-day, bread-and-butter missions, cruising at FL 410 to FL 450. They plan on burning 5,800 to 6,000 pounds for the first hour, but then fuel flows drop to 4,000 or less for the second hour. On long-range missions, initial fuel flows are closer to 4,800 to 5,000 pph for the first hour, dropping to as low as 2,500 pph when the airplane is light near the end of the mission.

Bombardier claims the Global Express can fly eight passengers 6,410 nm while cruising at 0.8 Mach and land with 3,208 pounds of NBAA IFR fuel reserves. Operators, in contrast, said they're comfortable flying 5,893 nm on average. They said they like to have 5,000 to 6,000 pounds of fuel left in the tanks when there’s iffy weather at the destination or when flying extended, over-water missions.

The Global Express 6,443-gallon fuel tanks can hold 43,170 pounds of fuel at 6.7 pounds/gallon, the B/CA and airline industry standard for fuel density. However, differences in crude oil refining practices, especially in Asia, can result in lower fuel weights at the same liquid capacity. Moreover, fuel density decreases at fuel temperatures above the 15°C standard day temperature. These differences can result in fuel loads of less than 43,000 pounds, thereby reducing range below Bombardier’s quoted numbers.

Basic operating weight is another variable that should be considered when evaluating actual aircraft range performance. Bombardier quotes the Global Express BOW at 50,300 pounds for a lean, standard spec interior. Not so, say operators. They report an average BOW of 51,505 pounds, with weights decreasing a bit for newly delivered aircraft. Notably, Bombardier’s spec BOW for a premium interior is 51,200 pounds. According to operators of the 10 most recently delivered aircraft — not 50,300 pounds.

Balooning BOWs are less of a problem for Global Express operators than for folks who fly competitive, large-cabin aircraft. Bombardier has certified an optional 98,000-pound MTOW for the aircraft, a 3,000-pound increase over the standard MTOW. The increase almost eliminates passenger load vs. fuel load compromises. The extra weight, though, does reduce maximum range by 100 to 200 miles, according to B/CA estimates.

On the longest range missions, operators say they climb their aircraft directly to FL 410, unless it’s fairly warm in the upper atmosphere. On warm days, typical of wintertime polar routes, initial cruise altitude may be in the high 30s, especially if actual takeoff weight exceeds 96,000 pounds. Operators told B/CA that 0.82 Mach is a better initial long-range cruise speed than the quoted 0.80 Mach. In addition, they said that thrust should be manually controlled because the autothrottles tend to “hunt” for desired cruise speed, thereby wasting 100 to 200 pph of fuel.

After four to five hours, the aircraft can be climbed to FL 450. Most operators said they climb no higher than FL 470 near the end of long-range missions to stretch range performance, even though the aircraft is certified to FL 510.

Addressing Operators’ Concerns
Reliability issues, second only to the above-mentioned parts supply woes, dominate the list of operators’ top concerns. They faulted engine fan hub cracking, “phantom” battery electrical drains, nuisance CAS messages, problematic slap/flip control boxes, inconsistent cabin temperature levels, hydraulic fluid migration between systems and inconsistent refuel quantity.

Remedying such issues takes priority over development and certification of high-profile product improvements, such
as head-up displays and infrared-based enhanced vision systems, according to Marc Bouliane, Bombardier’s Global Express family manager. As for developing a large-format, flat-panel avionics system for the Global Express, similar to Dassault’s EASy suite or Gulfstream’s PlaneView, operators told Bombardier that, too, can wait while Bouliane’s team tackles fundamental problems.

“From the time the first Global Express entered service in 1998, there’s no question that our priority has been to support the basic airplane, especially when it comes to addressing reliability issues,” Bouliane explained. “But, there’s also no question that we have to do product development.” Bombardier announced the availability of HUD and EVS for the Global Express at the 2002 NBAA Convention. But certification of those systems won’t be complete until 2005, operators told B/CA.

Bouliane’s responses were closely aligned with operators’ concerns, based upon what they told us during the survey. Bombardier and Rolls-Royce Deutschland continue to evaluate a permanent fix for the BR710 fan hub cracking problem caused by a resonant frequency in the operating envelope. They’ve narrowed the list of candidate fixes and expect to have a solution this year. Meanwhile, BR710 operators have to perform an eight-hour inspection every 450 flights.

Retrofitting the “Build 4” electrical system configuration, an update that fully integrates the electrical system with the Global Express’ advanced onboard Central Aircraft Information and Maintenance System (CAIMS) and which eliminates many nuisance fault messages, has been assigned high priority. About 80 percent of the GEX fleet now is fitted with Build 4, a configuration that was pre-wired in aircraft s.n. 9064 and subsequent, and now comes standard in newly delivered aircraft, starting at about s.n. 9100. Older aircraft may require three or more weeks in the service center to install Build 4 wiring, connectors and components.

Bombardier engineers are narrowing in on the cause of the Global Express “phantom” battery drain. It appears that some unknown equipment is connected directly to the hot battery bus, but engineers expect to have the problem isolated by midyear. Until then, operators have been advised to disconnect both the avionics and APU batteries if the aircraft will not be operated for several days. The factory also now is installing fresh batteries with each aircraft just prior to customer delivery. Aircraft completed at Bombardier’s Tucson facility seem to be most susceptible to “phantom” battery drain.

Operators told B/CA that the GEX avionics suite needs fine-tuning. The autothrottles are rough, flight level change doesn’t work properly, the automatic FMS to ILS mode doesn’t work, and the autopilot needs improvement. Bombardier is readying a Block 2 avionics upgrade for midyear release. The upcoming fix should remedy most of those avionics suite shortcomings.

Some folks told B/CA that the Honeywell RE220 APU has locked up after the aircraft has been parked for several days, especially in warm, humid climates. Bombardier and Honeywell have traced the problem to the APU’s abradable compressor case lining that holds very tight tip clearances for increased compressor efficiency. However, the liner is prone to moisture absorption and swelling that can cause the compressor to cease after shutdown. This has affected about 10 percent of the GEX aircraft currently in service. Honeywell is developing a moisture sealant coating for the liner that should solve the problem.

Cabin temperature fluctuations have been a problem for some operators. One big cause was installation of hard bulkheads at locations that disturb flow patterns from the air-conditioning distribution system. Careful placement of optional cabin bulkheads in newer aircraft has eliminated most of the problem. Operators of aircraft that don’t have such bulkheads reported...
fewer problems with uneven cabin temperatures. Bombardier also has advised operators to keep aspirated temperature probes clear of flow restrictions.

Balky vacuum toilets were a problem for certain early operators. Some even reverted to installing chemical toilets to ensure operational reliability. Bombardier has since switched vendors, thereby solving the problem.

When setting the parking brake, operators report that hydraulic fluid tends to migrate between two of the hydraulic systems because of seepage through the wheel brake shuttle valves. Bombardier has developed a work-around procedure that remedies the problem, but a permanent fix has yet to be engineered.

Operator reports of inconsistent refuel quantity appear to be an operational problem rather than a design flaw, Bombardier officials report. They admit that the GEX takes 10 to 15 minutes longer to refuel than a Gulfstream V/550, but said that the aircraft can be loaded with a consistent liquid volume of fuel. Variations in refuel weight are caused by the aforementioned differences in refining procedures and fuel temperature, according to Menes Pierre Pierre, Bombardier's senior GEX demo pilot.

**Operators' Loyalty Is Steadfast**

Despite any shortcomings with their aircraft, almost all operators said they were willing to suffer through the Global’s growing pains because it offers so much more than competitive aircraft. Cabin comfort and quiet can’t be beat, they said. And the blend of high cruise speed and short-field performance was unmatched by anything with transport category aircraft certification.

“Why would anybody want a small tube airplane with a 50-foot cabin when they could have a big tube airplane with a 50-foot cabin?” one operator asked.

Some wanted more range, so Bombardier is developing the Global Express XRS, a heavier variant of the basic airplane with 1,486 pounds of additional fuel that will stretch range 220 to 240 miles, depending upon cruise speed.

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**Dispatch reliability and parts availability are more likely to determine the Global Express' long-term success, now that completion center issues no longer are problematic. Bombardier officials appear to be strongly committed to making substantive improvements in both areas.**

“I have 11,000 hours of flight time [in a competitive heavy iron jet]. The Global Express is the best product out there, but Bombardier needs to address product support problems,” said North American Air Charter’s Schley.

“I'd surely like to get those [parts support] guys off of top dead center,” said another operator of two recently delivered aircraft. “We still made the right decision [to buy the Global Express],” he quickly added.

“As the airplane has matured, with all the various upgrade modifications, I’d sure recommend it to other folks. It’s a terrific airplane for pilots, passengers and mechanics, but dealing with Bombardier has been a challenge,” a director of maintenance remarked.

“Just buy what the boss wants. The Global Express has more cabin comfort and great ramp presence. We’re really happy with our third GEX,” another operator said, echoing the positive comments we heard from many other operators.

Bombardier indeed appears to be building and completing an ultra-long-range, large-cabin business aircraft that’s highly competitive with the best from Airbus, Boeing and Gulfstream. Assuming Bombardier’s support infrastructure now matures in parallel with the aircraft, the Global Express is well positioned to have a very long and successful production run.