



Lack of CRM training factored in a muddled approach and go-around.

# Teamwork Fades in a BLACK HOLE

BY MARK LACAGNINA

A fatal accident during an emergency medical services (EMS) flight has prompted the Transportation Safety Board of Canada (TSB) to recommend a requirement for air taxi and commuter aircraft operators to provide their pilots with recurrent training in crew resource management (CRM).

The accident involved a Beech King Air A100 that struck terrain after a go-around was initiated late during an attempted landing on a short gravel strip in Sandy Bay, Saskatchewan, the night of Jan. 7, 2007.

Based on the findings of its investigation, TSB concluded that the flight crew “was unable to work effectively as a team to avoid, trap or mitigate errors and safely manage the risks associated with [the EMS flight].”

The risks included a nonprecision approach into a “black hole” — a dark, featureless area with few visual cues to aid depth perception.

The TSB’s final report on the accident said that the absence of visual cues during the go-around might have contributed to an illusion that the twin-turboprop had pitched up excessively, tricking the captain into making a nose-down control input.

Ultimately, a positive rate of climb was not maintained, and the King Air struck trees beyond the runway. All four occupants were injured but were able to get out of the aircraft before it was destroyed by fire. The first officer escaped with minor injuries. The two passengers — emergency medical technicians — suffered serious injuries. The captain was critically injured and died before rescuers arrived.

The sequence of events leading to the accident began at 1830 local time, when the Sandy Bay Health Centre called an ambulance dispatch center to arrange for transportation of a patient from Sandy Bay to Flin Flon, Manitoba. The ambulance dispatch center called Transwest Air, a regional airline and air taxi operator, which confirmed that a King Air and a flight crew were on standby and available for the flight.

The ambulance dispatch center then arranged for the emergency medical technicians to rendezvous with the pilots in La Ronge, which

is in central Saskatchewan, 105 nm (194 km) south-southwest of Sandy Bay.

### ‘Negative Information’

Formed by the 2001 merger of Athabaska Airways and La Ronge Aviation, Transwest Air is based in Prince Albert, Saskatchewan, and has satellite bases throughout central Canada. The company operates 39 fixed-wing aircraft and four rotary-wing aircraft, and has 232 employees.

The captain assigned to the EMS flight had 8,814 flight hours, including 449 hours in King Airs. He had applied for employment at Transwest Air after earning an airline transport pilot license in April 2006 and was hired a month later.

“The captain’s flying-skill level was initially considered to be lower than expected for his experience level, but his performance during the training was consistently rated as satisfactory,” the report said.

Before joining Transwest Air, the captain had been employed as a flight instructor and as an air taxi and commuter pilot for three other companies. The first employer had reprimanded him four times for not complying with company policies or with Transport Canada flight and duty time limits.

Nevertheless, “this employer provided the captain a letter of recommendation acknowledging his two years of employment as a first officer and stating that the captain had performed well,” the report said.

The second employer had downgraded him from captain to first officer because of repeated noncompliance with standard operating procedures (SOPs).

The third employer also downgraded him because of “weak systems knowledge, preflight planning shortcuts, fixation on minor problems, dwelling on errors, narrow attention span, and poor decision making,” the report said. After being reinstated as a captain, he was reprimanded for “substandard performance” and was refused renewal of his pilot proficiency check because of unsatisfactory crew coordination and compliance with SOPs.

This employer gave the pilot a letter of reference stating that he was “extremely

knowledgeable about the aircraft he flew,” the report said.

“Based on concerns regarding privacy legislation and the potential for legal action, the previous employers all indicated that they would not have disclosed the negative information about the captain’s performance to prospective employers calling for a reference check.”

### Pilot Shortage

Transwest Air based its decision to hire the captain on his resume and a brief telephone inquiry about his credentials. No one in the company

recalled that they had conducted background checks or formal interviews.

“Pilots with current qualifications and experience on King Air aircraft were in demand across Canada,” the report said. “During the 12-month period before the occurrence, [Transwest Air] lost three King Air captains and one first officer to other companies.”

The captain received 128 hours of line indoctrination with company training pilots and line pilots. “Line indoctrination records showed that the captain initially experienced difficulty in several areas, including preflight planning and IFR [instrument flight rules] operations but made steady progress and completed the line indoctrination program on 28 June 2006,” the report said.

The report did not specify the captain’s age but noted that he was 28 years older than the first officer.

The first officer had a commercial license and 672 flight hours, including 439 hours in type. He was a customer service agent for another company before joining Transwest Air in April 2005 as an office assistant and ramp agent. He began training as a King Air first officer in March 2006 and was approved for line operations in May.

The captain had flown to Sandy Bay nine times during the day and four times at night. The first officer had flown there five times during the day and three times at night.

“The captain and first officer flew together into Sandy Bay twice in the week before the accident,” the report said. “They had flown together the night before the accident, sharing the flight time between them by alternating legs as PF [pilot flying].”

Many of Transwest Air’s King Air pilots were aware that the captain and first officer preferred flying with other pilots, rather than with each other. “Some of the pilots were aware of a concern that the captain had about the first officer’s landings and were also aware that the captain had taken control from the first officer during several approaches and landings,” the report said.

Captains who had flown with the first officer said that they shared the accident captain’s

## Beech King Air A100



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**B**eech Aircraft introduced the first of the 100-series King Airs in 1969. Compared with the 90-series twin-turboprops introduced four years earlier, they have more powerful engines, a longer fuselage with a larger rudder and elevator, a shorter wingspan and two wheels on each main landing gear.

The King Air 100 can accommodate up to 13 passengers, but the cabin typically is configured for six or eight passengers. The engines are 680-hp (507-kW) Pratt & Whitney Canada PT6A-28s with three-blade propellers.

The A100 debuted in 1971 with a greater fuel capacity, higher operating weights and four-blade propellers. Maximum weights are 11,500 lb (5,216 kg) for takeoff and 11,210 lb (5,085 kg) for landing. At sea level, maximum rates of climb are 1,963 fpm with both engines operating and 452 fpm with one engine inoperative. Maximum cruise speed at 21,000 ft is 235 kt, and maximum range is 1,287 nm (2,384 km).

Beech ceased production of the 100-series King Airs in 1983 after building about 184 of the original model, 157 A100s and 137 B100s, which have fixed-shaft Garrett TPE331 engines rated at 715 hp (533 kW).

Sources: *Jane's All the World's Aircraft* and *The Encyclopedia of Civil Aircraft*

concern about his “inconsistent” landings. However, the first officer’s performance was improving, and “they viewed the situation as one of a junior pilot gradually becoming more proficient, not as a hazardous situation,” the report said.

Both pilots had complained to their chief pilot about each other’s performance. The captain had cited the first officer’s landings. The first officer had referred to the captain’s nonadherence to SOPs during an instrument approach. Although the chief pilot had verbally counseled each pilot, the underlying issues were not resolved, and the pilots remained “an ineffective and dysfunctional team,” the report said.

### Nonprecision Approach

The King Air departed under IFR from La Ronge at 1930. Although company policy dictated that the most experienced pilot serve as the PF for the first flight of the day or when runway length was less than 3,500 ft (1,067 m, as at Sandy Bay), the captain designated the first officer as PF before takeoff.

After leveling at 11,000 ft, the crew received the current weather conditions at Flin Flon, which is 57 nm (106 km) southeast of Sandy Bay and the closest weather-reporting facility. Winds were from 050 degrees at 2 kt, visibility was 15 mi (24 km) in light snow, and the ceiling was broken at 2,500 ft.

The report noted, however, that “about three hours after the accident, the ceiling at Sandy Bay was estimated to be 700 to 800 ft AGL [above ground level] by crews arriving to evacuate the survivors.”

The first officer temporarily transferred control of the aircraft to the captain while he reviewed and briefed the straight-in nondirectional beacon (NDB) approach to Runway 05.

Although company SOPs prohibited a straight-in approach to a runway without visual glide path indicators, the captain concurred with the first officer’s plan. Neither pilot conducted landing performance calculations, and the length and condition of the runway were not discussed.

“The crew had the global positioning system (GPS) programmed direct to the Sandy

Bay aerodrome (CY4) waypoint from the GPS database, and the first officer planned to use the GPS distance-to-go to the aerodrome to establish a descent profile of 300 ft per nm [which corresponds to a three-degree glide path],” the report said. “The captain transferred aircraft control back to the first officer following the approach briefing.”

The GPS receiver aboard the King Air was certified for IFR navigation, and GPS area navigation approaches to Sandy Bay were published. However, the crew was not trained or authorized to conduct GPS approaches.

The report noted that the pilots likely were not aware that the GPS waypoint they were using for distance information was located 1,440 ft (439 m) beyond the approach threshold of Runway 05. Thus, they were aiming to touch down at a point on the runway that was 440 ft (134 m) beyond the normal touchdown point for a three-degree glide path.

### No Radar Service

Air traffic control (ATC) radar service was not available at the uncontrolled airport. At 1948, ATC cleared the crew to conduct the NDB approach to Runway 05 and to descend at their discretion. A radio frequency change also was approved.

The first officer established the aircraft in a descent on the 058-degree final approach course, and the captain broadcast an arrival advisory and activated the airport lights.

The NDB is near the approach threshold of Runway 05, a gravel strip 2,880 ft (878 m) long and 75 ft (23 m) wide at an elevation of 1,001 ft. The minimum descent altitude (MDA) for both the straight-in and circling approach is 1,780 ft. The runway did not have approach lights or visual glide path indicators.



Causal factors included a misunderstood GPS waypoint and somatogravic illusion during an attempted go-around.

“The gravel runway was covered with a layer of compacted snow and a thin layer of fresh and unmarked snow,” the report said.

The King Air was about 5.5 nm (10.2 km) from the airport when the first officer called for the landing checks. “The captain indicated that the landing lights would remain off because the aircraft was still in cloud,” the report said.

The captain then told the first officer that he saw the lights of the town and a nearby hydroelectric dam. The town is 1.2 nm (2.2 km) southwest of the airport, and the dam is 2.3 nm (4.3 km) southwest of the field.

“Both crewmembers acquired visual reference with the aerodrome at about 4.2 nm [7.8 km] from the runway while the aircraft was still in descent toward the MDA,” the report said.

**Too High**

About 2.5 nm (4.6 km) from the runway, the pilots agreed that the aircraft was on profile for the approach and extended the flaps to the landing position. However, shortly after turning on the landing lights a few seconds later, the captain determined that the aircraft was too high.

The report said that the crew’s use of the airport GPS waypoint for distance information might have caused a “spatial awareness error

[that] contributed to the aircraft being high on final approach.”

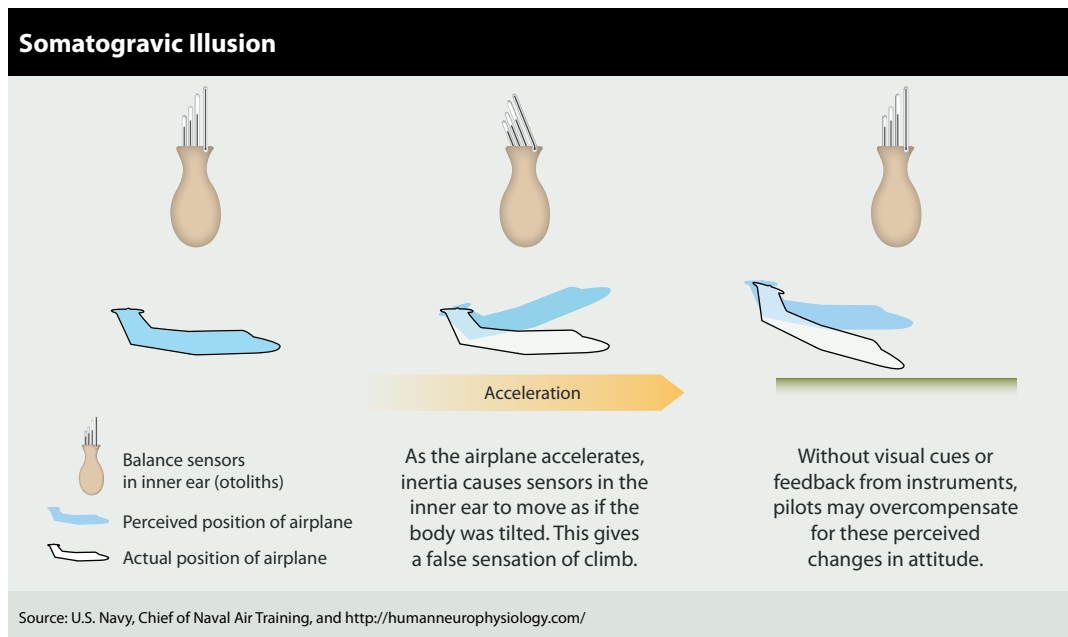
The captain reduced power and told the first officer to increase the descent angle. “The captain’s coaching continued, and at 2002:05 [38 seconds before impact] the first officer suggested that they conduct a go-around,” the report said.

The captain told the first officer to continue the approach. “The captain continued to coach the first officer through the approach and into the landing flare,” the report said. “At 2002:15, the captain instructed the first officer to bring the power off and put the aircraft on the runway.”

Just after the first officer reduced power to flight idle, the captain apparently saw that the aircraft could not be landed safely on the runway remaining, and he commanded a go-around. However, his communication was non-standard and ambiguous, and the first officer did not immediately take action.

“At 2002:23, the captain advanced the power levers to a high power setting,” the report said. “The first officer perceived pressure on the control column and observed the captain’s hand on the control column. Believing the captain to be taking control, the first officer released the control column. Neither pilot verbally announced or acknowledged the transfer of control.”

The first officer called for the flaps and landing gear to be retracted, which complied with the aircraft flight manual procedure for a bailed landing. The captain responded by saying “positive rate, gear up.” The first officer retracted the landing gear and the flaps. The captain then selected the approach flap setting — an action that might have distracted him



**Figure 1**

from monitoring the aircraft's climb performance, the report said.

### 'False Climb' Illusion

The terrain beyond the runway slopes downward, and the first officer recalled seeing the altimeter indicating 100 ft below airport elevation. However, he also "perceived sensations of being pushed back in the seat and the aircraft pitching up, and believed the aircraft was climbing," the report said.

The first officer's perceptions were typical of the *somatogravic illusion*. "Instrument-rated and experienced pilots are not immune to this illusion, which is a subtle and dangerous form of disorientation," the report said. "The illusion occurs because the body relies on sensory organs in the inner ear to maintain balance; and, in the absence of visual cues, signals from these organs can produce a very powerful disorientation (Figure 1).

"In the case of an aircraft that is accelerating during a go-around, the sense organs of the inner ear of the pilot send a signal to the pilot's brain that is interpreted as tilting backward instead of accelerating forward. ... The pilot has a very strong sensation of climbing. The illusion of false climb tends to lead the pilot to lower the nose and descend. The aircraft then accelerates, and the illusion can intensify."

The report said that it is likely that the captain also experienced the somatogravic illusion and lowered the aircraft's nose.

At 2002:43, the King Air struck trees near a river bank 2,880 ft (878 m) from the end of the runway and descended into a hillside.

"The collision with the ground was survivable to most of the aircraft occupants because the aircraft decelerated gradually, with the flexing and shredding trees absorbing impact forces as the aircraft traveled through them," the report said.

The fuel tanks were ripped open, however, and a fuel-fed fire eventually consumed all but the rear fuselage and tail of the King Air. Meanwhile, the first officer and one passenger were able to force the cabin door open.

"The occupants evacuated the aircraft with difficulty, with only the clothing they had been

wearing," the report said. "The survival and first-aid kits on board were either inaccessible or could not pass through the limited opening of the door." Outside air temperature was about  $-17^{\circ}\text{C}$  ( $1^{\circ}\text{F}$ ).

The first officer and the passenger who helped him open the door dragged the other passenger and the captain away from the burning wreckage. The accident site was not accessible by foot or by road. The first rescuers arrived on snowmobiles at about 2200.

### CRM Skills Not Honed

The report said that the crew's lack of coordination and ineffective communication during the approach and go-around were caused in part by the absence of recent CRM training.

The captain had not received CRM training since March 2000, and the first officer had received only 16 hours of instruction in human factors and decision making while attending an aviation college from 2001 to 2003.

Transwest Air did not provide — and was not required by Canadian Aviation Regulations (CARs) to provide — recurrent CRM training for its air taxi and commuter pilots.

Without recurrent training, CRM skills fade. "Measurements of the impact of CRM training show that, after initial indoctrination, significant improvement in attitudes occurs regarding crew coordination and flight deck management," the report said. "Research also shows that, when there is no reinforcement of CRM concepts by way of recurrent training, improvement in attitudes observed after initial indoctrination tends to disappear."

Based on these findings, TSB called on Transport Canada to revise the CARs to require aircraft operators governed by Subpart 703, *Air Taxi Operations*, and Subpart 704, *Commuter Operations*, to provide their pilots with annual, recurrent CRM training that includes threat and error management. ➔

*This article is based on TSB Aviation Investigation Report A07C0001, "Collision With Terrain: Transwest Air Beech A100 King Air, C-GFFN; Sandy Bay, Saskatchewan; 07 January 2007." The full report is available from the TSB Web site, <tsb.gc.ca>.*