

Voyage To The Ice

“The machine does not isolate man from the great problems of nature but plunges him more deeply into them.” Antoine de Saint Exupéry¹,
Wind, Sand, and Stars, 1939.

In order to scientifically understand the physical reality of operational process of an aircraft, from the reliability theory point of view, the MIRCE Akademy² sponsored British Aviatrix, Polly Vacher’s unsupported, solo flight around the world in a single-engined aircraft via North and South Pole, places where no women have flown solo in a light aircraft, ever! The project was named the “Voyage To The Ice” (VTTI) and planned to be materialised between May 2003 and March 2004, and endow an annual flying scholarship for a disabled person³.

The longest and the most challenging leg of the whole journey would be the flight between Christchurch in New Zealand and McMurdo in Antarctica, the 2068 nautical miles of inhospitable Southern Ocean. Hence, safety wise, the major consideration was the direction of the flight between these two destinations. Both options, eastbound (New Zealand to Antarctica) and westbound (Antarctica to New Zealand) had their advantages and disadvantages. However, this decision would determine the starting date of the project and consequently all other dates and events.

At the beginning of January 2002, the MIRCE Akademy allocated four students of the Master Diploma Programme to study the proposed flight with the aim of determining the necessary reliability and supportability issues concerned with its successful completion. They created RBD, obtained the all necessary information and made the reliability predictions, in the manner described in the part 2 of this text, for both options. After reading the Akademy’s report and speaking with pilots who had flown in either, or both, directions, in the spring of 2002 Polly decided to fly westbound, which meant that, in her judgment, flying from Antarctica to New Zealand was the safer option. This decision determined the whole journey ahead. Thus, Polly planned to start the flight in British springtime with a route from Birmingham inevitably headed north towards Scotland and Norway with the intention of over-flying the North Pole during the month of June. This timing was considered as the best chance for clear skies in that region. As a result of the annual rotation of the Earth around the Sun, Polly had around five months to make the flight south towards Argentina to fly over Antarctica during the summer months in the Southern Hemisphere. So, after over-flying the North Pole, the route south would take her through Canada, USA, Mexico, Guatemala, Belize, Antigua, Tobago, Trinidad, Brazil and Argentina. Polly had to demonstrate a great deal of patience in waiting for the right weather window for the flight to Antarctica. From there, the journey home was pretty much well defined. Namely, through New Zealand, Australia, Indonesia, Malaysia, Thailand, India, Bhutan, Oman, Bahrain, Jordan, Egypt, Greece, Yugoslavia, Italy, France and back to Birmingham

¹ Antoine Marie Jean-Baptiste Roger, comte de Saint-Exupéry (1900-1944) a French writer, poet, aristocrat, journalist, and pioneering aviator.

² www.mirceakademy.com

³ Knezevic, J., B2B/A+A - Polly Vacher's Voyage To The Ice, Birmingham To Birmingham Over Arctic & Antarctic <http://www.MIRCEAkademy.com/index.php?page=applied>

In order to assist the research effort of the MIRCE Academy in Reliability Polly generously accepted to record relevant in-service data during the trip. The main purpose of the research was to study the impact of the environmental conditions on the reliability and supportability of VTTI system. Data to be collected as the basis for reliability research are shown Table 1.

Departure	In Flight	Arrival
Location	Altitude	Location
Co-ordinates	Winds/directions	Co-ordinates
Time	Distance	Time
Fuel Load	Fuel consumption	Refuel Qty
Oil Refill	Oil Temp	Oil refill
Maintenance Actions	Oil Pressure	Maintenance Actions
Battery Charge	Cabin Temperature	Total Distance
Ambient Temperature	Ambient Temperature	Ambient Temperature
Cabin Temperature	Engine Temperature	Max G-force
Max G-force	Engine RPM	
	Fuel Mix	

Table 1: Physical Parameters Continuously recorded by Polly during the VTTI project.

Generally speaking, the problem for reliability engineers and managers is the variability of their internal and external parameters, in time and locations. The research was planned to provide the largest possible range of data in respect to any flights anywhere in the world made by any pilot. Owner’s manuals for any product available on the market tend to provide typical values for their performance (speed, acceleration, fuel and oil consumption, etc.). Hence, the main objective of the research was to collect the data that will help engineers and operators to learn more about causes, size and variations of the factors that drive a reliability of systems in respect to time.

On the 6th May 2003, at 16:22 Polly took off from Birmingham airport, in her Piper Dakota PA-28-236⁴ (G-FRGN) with the thoughts “when will I see home again” flying north in the direction of Scotland. She arrived at a cloudy and cold Wick at 19:20. After five days of waiting for the weather “window”, Polly flew onward across the North Sea to Norway, through Bergen to Tromso. On the 26th May 2003 Polly finally left Europe, very much looking forward to the Poles.

The flight to the first of the Ice Challenges at the beginning was slow due to the strong headwind. At some stages of the flight Polly was flying at only 98 kts (cruising speed 135 kts.). Then, as she described in her diary, “My ferry tank ran dry and I switched to the left wing tank. About five minutes after changing tanks THE ENGINE STOPPED - panic - why is it stopping now? I went into automatic mode and changed onto the right tank; put the fuel pump on and the carburettor heat⁵. Heaven be blessed

⁴ Knezevic, J., From B to B, Polly Vacher’s Global Challenge, pp 50, MIRCE Science, 2001, Exeter, UK

⁵ The problem was two-fold. First: the fuel mixture being on the lean side. Second: carburettor icing. All the time Polly was using the warmer fuel from the ferry tank within the aircraft, no ice was forming in the carburettor. But once this was all used and she had to change to the fuel tanks in the wings where

it started again, but from then onwards, every little noise every little whistle became a huge problem.” Despite having to manage this in-service operational challenge, in real time, she successfully landed at Resolute on the 27th May 2003.

During following 5 months she flown through: USA, Mexico, Guatemala, Belize, Cayman Islands, Dominican Republic, Antigua, Trinidad and Tobago, Suriname, Brazil and Argentina to arrive to Ushuaia, the most southern tip of Argentina, on the 25th October. Then, the waiting for the favourable weather started. On the 29th November 2003, after 8 hours of flying, Polly landed at the British Research Station in Rothera (67°33’S, 68°07’W) in Antarctica, to start her flight over the South Pole.

On the 5th December at 07:00 the weather forecast was good, overall winds +3 kts. The first hour into the flight was good: tail wind at 5000 ft and the cruising speed was 111 kts. Polly flew up the glacier and flying over the top the views were stunning. Four hours into flight the wind changed direction, from a tailwind to a headwind and soon the ground speed decreased to 80 kts. The GPS indicated that planned 11-hour trip would take 15 hours! Soon Polly reached the point of no return. An updated weather report was not encouraging, as the headwinds were expected to continue to increase in strength. As a captain, in charge of the VTTI system, whose function was to “safely fly solo a single-engined aircraft around the world” she made the decision to turn back! Naturally, Polly’s speed rapidly increased to 133 kts and she safely landed back at Rothera.

As the fuel for Polly’s one-way flights over Antarctica were propositioned several months in advance, she had no fuel to make the second attempt to fly over South Pole. The only help came from the Argentine Air Force that on the 17th December delivered 4 drums of fuel to their base in Marambio. More bad weather further tested her stamina and determination. On New Year’s Day, 2004, Polly started re-routing flight north through South America and 14,000 miles later, on the 30th January landed in Auckland (New Zealand), to be in the position to continue the planned trip and honour commitments made to this part of the world in aid of her favourite charity.

After 357 days of circumnavigating the globe via all seven continents, 60000 nautical-miles, thirty countries and spending over 500 hours in the pilot’s seat, Polly arrived, on schedule, at 12:30 at her starting point, Birmingham International Airport, but this time from the south and “landed” in the aviation record history books as: The first woman to fly solo:

- In a single engine light aircraft over the North Pole
- In a single engine light aircraft over Antarctica
- The first person to fly solo around the world landing on all seven continents.

Aviatrix Polly Vacher generated £400,000 for the Royal International Air Tattoo Flying Scholarship for the Disabled in Memory of Group Captain Sir Douglas Bader and recorded over 20,000 in-flight technical data to support the research at the

the outside temperature was –20°C, the injection of such cold fuel froze any moisture in the carburettor, and caused the engine to cough and splutter unless carburettor heat was continuously applied.

MIRCE Akademy. Today, this data is a part of the Polly Vacher Collection⁶ at the Akademy's Resource Centre, frequently used by our students.

3.1 Impact of VTTI on Reliability Modelling at the MIRCE Akademy

*“Success is a lousy teacher. It seduces
smart people into thinking they can't lose.”*
Bill Gates⁷

Polly Vacher's flight of 11 hours and 53 minutes, covering 1092 miles, from Rothera to Rothera on the 5th December 2003, had a profound impact on the studies of reliability at the MIRCE Akademy. Although the syllabus offered by the Akademy, was comparable with postgraduate programmes in Reliability Engineering and the other “ilities”, with all other universities in the world, it was unacceptable to the author that no single part of the whole body of existing knowledge was able to address the observed physical reality. If this “disruptive” event was predicted and the decision was made to provide enough fuel for one attempt, the author would have been happy as a scientist, but unhappy as a project manager. However, to have a science-based body of knowledge that predicts the system operational behaviour that is unable to even address the wind direction was totally unacceptable to the author. The brutal truth is that all the components of Polly's aircraft were performing their expected function and yet the final result of her flight was a failure! Thus, author asked himself, “How is it justifiable to construct a reliability block diagram for an **aircraft** without a single block being related to **air**?” [1]

Requesting scientific approach when entering into the MIRCE Akademy, from his students, author, as its president, had no option than to suspend the studies of Reliability Engineering until the “scientific approach” was found. Hence, the MIRCE Akademy stopped admitting students to the Master and Doctoral Diploma Programmes in Reliability Engineering, from October 2004.

⁶ Mirceakademy.com/index.php?page=Resource-Centre

⁷ <https://www.brainyquote.com/quotes/quotes/b/billgates122131.html>