

Don't be led astray by the

Robert Kirby argues against the theory that South Africans lured Mozambican president Samora Machel to his death

It is believed that between 80% and 90% of aviation accidents are due to human error. Refining the statistic a little further, it was found that out of a total of 28 000 aviation "incident reports" made to Nasa researchers in the United States between 1976 and 1981, no less than 70% were related to a failure in voice communication.

This could be misunderstanding of air traffic control directions, it could be the wrong thing being heard and acted on under stress in a busy and noisy cockpit.

The crash near Komatiport of the Russian-built and Russian-crewed Tupolev 134A-3 aircraft which, on October 19 1986, killed the then Mozambican president Samora Machel is a case in point.

At the time rumours were rife that the crash had been "organised" by the South African military, by the setting up of a "decoy" ground navigational aid, tuned to and — for some yet unexplained reason — also overriding the signal of the Maputo ground aid it was mimicking. Thus were the Russian pilots led astray, to crash their

aircraft on high ground just inside South African territory. Another cruel blow by the apartheid regime?

Nice stuff for a James Bond movie plot. In real life, though, a proposition of considerable incertitude. What is worrying to the aviation profession is the recent announcement that "new evidence" relating to this accident has come to light, again proposing the theory of the "decoy beacon", and has been presented to the Truth and Reconciliation Commission. What makes this even more worrying is the announcement that this new evidence was heard *in camera*.

Any new or contradictory finding as to the cause of the Tupolev accident enjoys the certainty of being regarded with scepticism by those in the business of professional aviation. Like most of what is cynically termed "Bermuda Triangle" thinking, this one is most damned by an objective examination of the facts. (Statistically, the infamous "Bermuda Triangle" is one of the safest places either to sail or fly across.)

Inquiry boards are always chosen with care. In the Tupolev crash, the board, chaired by Judge Cecil Margo, a retired supreme court judge and a highly experienced civil aviation administrator, included Sir Edward Walter Eveleigh, former lord justice of appeal; Colonel Frank Bormann, congressional medal of honour, former test pilot, astronaut and aeronautical engineer, and president of Eastern Airlines in the United States; Geoffrey Wilkinson, chief investigator for the accidents investiga-

tion branch of the British Ministry of Transport; JJS "Jock" Germishuys, former commissioner for civil aviation of South Africa; and P van Hoven, chair of the Airlines Association of South Africa.

A doughty collection, and Margo's own. For obvious reasons he accepted the brief only if these choices remained solely his. The board went further than required under the Chicago Convention of 1944, accommodating the other states — USSR and Mozambique — by inviting their attendance to participate in the inquiry and offering the right to representation, cross-examination and the calling of their own witnesses. (They took no advantage of that.)

The accident had occurred 150m inside South African territory. The aircraft's passengers included the president of a neighbouring and, at the time, politically antagonistic state; destabilisation of the sub-continent was conspicuous in the political agenda of the South African government. All in all a juicy steak for speculation.

Aviation professionals, who had already suspected the real cause of the accident, shuddered in disbelief at the sweep of the rumours. These included tales of spurious electronic Maputo approach and landing corridors, long since planned and installed; portable ground navigation beacons and transmitters, calibrated and ready.

Best of all was buzz about simulated runway threshold lighting and flarepath, carefully set up on a mountainside and at the end of a counterfeit instrument landing system, all aligned to the Maputo airport parameters. Something to fool even the brilliant Russian pilots and their state-of-the-art jetliner.

They needn't have bothered.

The Russian pilots of the Tupolev were quite capable of flying into mountains at night without any help from outside agencies. The recordings from the Tupolev's cockpit voice recorder, which were translated by the Russians themselves, reveal a formidably poor level of airmanship — negligence one would hesitate to associate with a low-hours private pilot.

As briefly as possible, this is what the Margo board found. The Tupolev was on a flight from Zambia to Maputo. Approaching Maputo from the north-west, at 100km out but directly on track for the Maputo airport, the Tupolev made an unexpected turn to the right — of some 37°. The decision to initiate this turn was the navigator's and in reply to the captain's query about such a sudden change in course, the navigator answered: "VOR indicates that way."

A rather cursory explanation but one with which the captain apparently agreed. He never again questioned the decision. The Tupolev was now flying on a new heading, towards the mountains of the escarpment.

Here, a short digression is necessary. Modern airline and air force flight management insist their flight crews undergo what is often termed crew management training. These disciplines — of which there are several different versions in the world — are designed to the same end: the efficient management of human and technical resources available to the pilot. There is great emphasis on psychology, especially with regard to cross-checking among crew members and, above all, the refining of communication.

One of the most fascinating topics in the crew management training course has to do with the "poor judgment chain", by definition a primary mistake and its consequences.

Let us say an aircraft turns left instead of right, as it should have done. All latter decisions and manoeuvres are infected by that primary basic mistake. The aircraft now flies, say, east, but the crew believe they are flying west. North is actually to the left of them, they think it's to the right.

Worse, the more the number of subsequent flight decisions made along the "poor judgment chain", the harder it is to unstitch back to the primary mistake.

On crew management training courses, pilots and other flight crew are trained how to recognise and unstitch. Had the Tupolev captain even tried to do this, he would have realised that something basic was out of kilter.

Again, before continuing, a brief explanation of the navigational aids, the VOR and DME. VOR stands for very high frequency omni-directional radio-range. In effect, a VOR transmits 360 electronic spokes, one for each degree of the compass — called "radials". By use of on-board electronic instrumentation, aircraft can intersect and fly accurately along any one of these 360 radials — to and from the selected ground station. (A VOR can be truck-mounted, for use in strategic military extensions, or as a standby for failed or under-maintenance permanent equipment.)

The DME abbreviation stands for distance measuring equipment. Here the aircraft transmits a radio signal to the airport DME station which immediately returns the signal to the aircraft. Allowing for switching, the time elapsed is measured and, from this, the distance from the DME station is electronically calculated and displayed in the cockpit in figures.

The primary navigational mistake on the Tupolev flight would have been obvious to an alert crew. There were certainly enough of them. Five people doing what in Boeing terms takes only two.

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The turn on to the (assumed Maputo) VOR radial of 045x was synchronous with a DME reading of 100km from Maputo airport. Simple geometry shows that, in order to produce these two synchronous readings, the aircraft would have had to be 100km north-east, way off track and out to sea.

Neither the captain, the navigator, nor the co-pilot picked up this formidable contradiction of the aircraft's DR (deduced reckoning) position, which, in fact, was accurately on track to Maputo — 100km north-west.

The captain, however, had other matters on his mind, as did the rest of his crew. During the crucial minutes leading up to the accident and while the aircraft was descending in pitch darkness and through cloud, the captain was concerned with fielding and fumbling crew questions, making decisions about a drinks order for the flight deck crew involving "Cokes and beers". He was also concerned about the fuel "reserve" lights, which he believed were dysfunctional.

The co-pilot's input was somewhere between minimal and nil. Most of the time he was listening on his headphones to an HF (high-frequency shortwave) transmission of a Moscow news and music station.

The most nominal flight-deck procedures were completely ignored. The aircraft descended through what is called "transition level" — roughly 4 000 feet — without the crew making necessary adjustments to their altimeters — that is, setting them to the "QNH", which gives a more accurate reading of the aircraft's actual height.

Here they ignored about as basic a notch as you can get in flight procedures. Pilots learn about the vital importance of the QNH in their first few hours of training.

The Tupolev reported it was "maintaining 3 000 feet", when in fact the aircraft had descended below that altitude and was still descending. When things appeared to be badly awry, the captain's first analysis was that there had been a general electrical failure at Maputo and, hence, that all the ground navigation aids were out of commission.

He surely would have known that the airport — by international law — had to have back-up generators. He did not notice another anomaly in that, despite the supposed Maputo electrical failure, the airport's air traffic controller was still talking to the Tupolev. The same air traffic control officer assured the aircraft the runway lights were working.

Normal "challenge and response"



Samora Machel: The crash that killed the Mozambican president occurred 150m within South African territory

'decoy beacon' theory



Disaster zone: Circumstances made the fateful crash 'a juicy steak for speculation'. PHOTOGRAPHS COURTESY RAPPORT

descent and landing checklists were part of standard operating procedures on the Tupolev, as they are throughout the world. These were not once referred to or used by the Russian crew. Up to the point of impact neither pilot had adjusted his course indicator from the original setting of 164° (the track in from the north-west).

The board's investigations revealed more sloppiness. The Tupolev had reported an incorrect passenger complement. No flight plan had been filed, no alternate destination identified. The reported fuel endurance of the aircraft as given by the crew was generous by a quarter of an hour. In either event, the Tupolev was not carrying enough fuel to make any diversion. It had less than half the amount necessary to get to Beira, in "usable" fuel something in the order of half an hour's endurance.

The pressure was on the captain to land at Maputo — and soon. He simply had nowhere else to go or reach.

What the Margo board found was that the operative VOR receiver on the aircraft had, at the time of the unexpected right turn, been inadvertently tuned to the wrong frequency; in this case the VOR facility at Matsapa in Swaziland. The point where the Tupolev turned to the right would be where it would intersect the 045x radial from the Matsapa VOR — the same radial they were trying to "capture" from the Maputo facility.

The flight's track after this was as would be expected, given that one basic primary mistake. Later that

aircraft VOR receiver, one of two, was re-tuned to the Maputo ILS (instrument landing system) frequency in expectation of capturing its centre-line localiser signal. Crash investigators found it set to this frequency. The other VOR receiver — inoperative at the time of the turn — was set to the Maputo frequency.

Amplifying the mistake were other factors. The frequencies of Maputo and Matsapa are ludicrously close together — 112.7 and 112.3 respectively, a difference of only 0.4 of a megahertz. Notwithstanding unlikely harmonic overlap in the frequencies, the somewhat haphazard layout of the Tupolev cockpit invited the error. The VOR selection panels were poorly illuminated, their readouts hard to see from the navigator's position behind the co-pilot. The Russian figures for seven and three are very similar — a horizontal bar across the top and a curved stem.

Add to this that at no stage did any of the crew confirm the actual identity of the VOR they had selected by listening to its audio output. As an identification aid, most ground navigational aids also transmit their Morse code identity. In Maputo's case, the VOR transmitted the letters VMA. Matsapa was coded VMS. Checking frequency tuned by means of the audio signal is among the most basic of standard operating procedures.

Nor did they make one single other cross-check!

The cockpit voice recorder reveals almost total confusion between

flight-deck crew and the Maputo air traffic control officer. The aircraft's radio operator was making decisions about circuit patterns, over-riding and electing a reciprocal runway to the captain's choice. The ground controller seemed not to have the faintest idea of what was going on. To call the communications fatally flawed would be to praise them.

But worst of all was to come. As the aircraft approached the ground, its automatic ground proximity warning signal sounded. This strident warning was ignored for a period of 32 seconds. No emergency evasive action was taken beyond a slight reduction in rate of descent.

The Maputo airport had no secondary surveillance radar by which the actual position of the Tupolev could have been ascertained by the tower controller. The control tower's VDF — a radio compass which indicates the compass bearing of the aircraft's radio transmissions — was apparently unserviceable.

Given these uncertainties and the generally untrustworthy Maputo airport facilities, it is very surprising that a non-visual instrument descent at night, to low altitude, was attempted with, as it turned out, little more help than voice communication with the Maputo air traffic controller.

What is most grotesque, with so little fuel to spare.

Had the aircraft mistakenly flown

towards the Matsapa VOR on the radial of 045x and descended in cloud, it would have flown into rising ground almost exactly where they did.

After the release of the Margo board's findings, there came a jointly submitted rebuttal from the Mozambican authorities and the Soviets. The rebuttal served a dominant purpose, which was to dismiss the board's findings as incomplete and misleading.

An example: where the Margo board had noted the poor performance of the air traffic controller in an English-language course he had undergone, the Mozambicans offered the following: "To say that the air traffic controller was second to last in his class is misleading. In this case he was 12th out of 13 and this would be a more informative way of stating his position in the class."

In attempting to absolve the Russian crew of either misdeemeanour or miscalculation, the theory of the mystery "decoy beacon" was forcibly submitted. The wordy response from the Russians boiled down to this one possibility, that the South African Defence Force (SADF) had moved a portable VOR station into position, waited until the appropriate moment and started transmitting on the same frequency as the Maputo airport facility. All they had to do was wait for a cloudy night and for the pilots to believe this false signal and descend innocently into the

Komatipoort mountains.

Neat, but not absolved by the facts. The Soviets persisted, quoting technical information acquired from an un-named British VOR manufacturer and which stated that a portable VOR could be mounted on the back of a Land Rover and powered by two 12V car batteries. Possibly producing 24V if connected in series, it seems doubtful such a system could emit a signal strong enough to override the Maputo VOR.

If other claims in the Soviet response were taken as factual, this "decoy" beacon would have had to be some 7km inside Mozambique territory. Conveniently right alongside a Mozambique army camp.

The other main spoke of the Soviet argument was that the Tupolev could not, as claimed by the Margo board, have received the Matsapa VOR signal. There was a great big mountain, Bembegazi, in the way. Allowing for aberrations in signal distribution, this challenge was taken seriously by the board, which asked for permission to send an aircraft to overfly Mozambique in order to test the strength, indeed the presence or absence of the Matsapa VOR signal. The Mozambican authorities refused. The board asked the Russians to test the signal. They refused. Yet the Mozambican response complains testily that no flight test was carried out to prove that the Matsapa beacon could in fact be received.

The South Africans were later to admit to having dispatched two South African Air Force Mirage fighter jets on an unannounced fly-by in order to test the signal the Tupolev is supposed not to have been able to receive. The Mirages reported the signal workable and true within the height ranges the Tupolev used. At a later date, so did two independent freight aircraft companies.

In whatever event, the Soviet and Mozambican "decoy beacon" propositions do not allow for some fairly lengthy odds: given the coincidence of fastidious prerequisite weather conditions, Samora Machel himself coming along exactly the route where his aircraft could be ensnared by an electronic spider web the cunning apartheid military establishment set up to catch him or, presumably, any other disagreeable neighbouring politicians.

Let us assume that there was, in fact, a decoy VOR beacon. Rumours are already abounding that the truth commission has evidence from military personnel who actually did the job. If true, this hardly excuses the laxity of the aircrew, revealed in just about every phase of their operation. The most essential element to make this plan succeed was the assumption that the aircrew the SADF was trying to bamboozle would be as abysmally careless as this was.

In statistical terms it was a bit like setting an elaborate mousetrap to catch a mouse that would only pass close enough to be caught once every 50 000 or 60 000 years. What's more, a decidedly gullible mouse.

At which stage does human error become human culpability? The Tupolev aircraft was a fatal accident looking for a place to happen. No measure of untested speculation alters that one unanswerable truth.

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