SERIOUS INCIDENT

Aircraft Type and Registration:	ERJ 190-100 SR Embraer 190, G-LCYZ
No & Type of Engines:	2 General Electric Co CF34-10E5A1 G07 turbofan engines
Year of Manufacture:	2010 (Serial no: 19000404)
Date & Time (UTC):	11 December 2018 at 0655 hrs
Location:	On takeoff from London City Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 86
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	34 years
Commander's Flying Experience:	4,971 hours (of which 4,813 were on type) Last 90 days - 121 hours Last 28 days - 51 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

On departure from London City Airport (LCY) the aircraft commander was Pilot Monitoring (PM). As the aircraft's speed increased through 60 kt on takeoff they noticed that the 'Takeoff 3' (T/O-3) thrust indication was displayed on EICAS[1]. The departure had been planned on the assumption that 'Takeoff 1' (T/O-1) thrust would be selected and available. The T/O-3 engine de-rate setting reduced maximum available engine thrust from 18,500 lbf to 15,450 lbf per engine with all engines operating. Noting the unexpected thrust setting, the commander judged that continuing, rather than rejecting, the takeoff was the safest option at that point. The subsequent climb out was flown without incident.

History of the flight

It was the first flight of the day for the crew and they reported being well-rested. The co-pilot was nominated as Pilot Flying (PF) for the sector. During cockpit preparation both pilots independently calculated takeoff performance figures for the aircraft using their electronic flight bags (EFBs). Having agreed the takeoff settings with PF, PM entered them into the flight management computer. The required engine thrust setting, as determined by the Airline's Standard Operating Procedures (SOPs), was T/O-1.

Footnote

[1] Engine Indicating and Crew Alerting System, an aircraft system for displaying engine parameters and alerting crew to system configuration or faults.

The crew reported that engine start and taxi to the runway were carried out without undue haste. Checklists were followed and the SOP Vital Data Review (VDR) was carried out. Neither pilot could remember if, during the VDR, the displayed T/O-3 setting had been read out incorrectly or whether the call had been misheard as 'T/O-1'.

As the aircraft accelerated through 60 kt on the takeoff roll the commander realised that T/O-3 was displayed on EICAS. Concerned that the incorrect thrust setting invalidated their rejected takeoff stopping distance calculations, the commander deemed that continuing the takeoff was the safest option. As PM, they called V_1[2] at the calculated speed but delayed the V_r[3] call by approximately 5 kt to compensate for the reduced thrust level. PF did not experience any aircraft handling difficulties during the climb-out and the departure was conducted without further incident.

To better understand the safety impact of the incorrect takeoff setting, once above FL100 the crew recalculated their takeoff performance based on T/O-3 thrust. The calculations indicated that, while they would have been able to stop safely up to V_1, climb performance might have been compromised had an engine failed shortly thereafter.

Recorded information

With no appreciable headwind, the aircraft reached V_1 after a ground roll of 560 m, using approximately 41% of the 1,360 m runway length available. Data from a previous departure using T/O-1 at a comparable AUW, but with an unknown headwind component, required a 440 m ground run to achieve V_1.

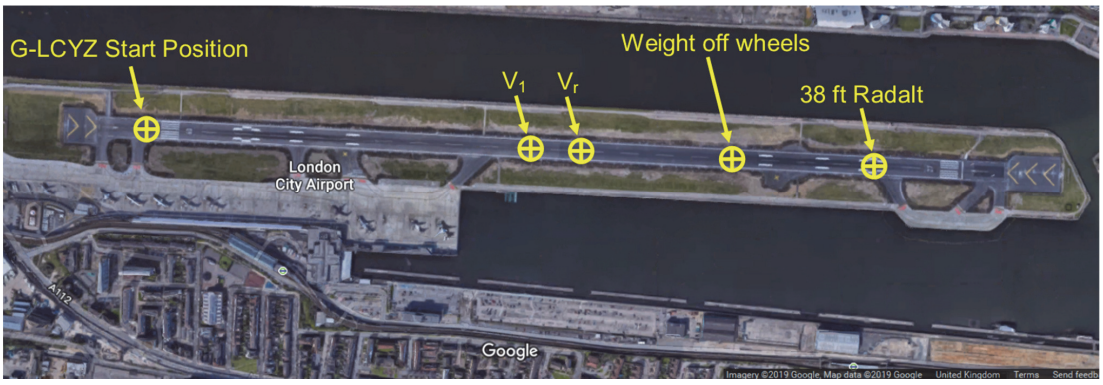

Figure 1

Overview of G-LCYZ's takeoff roll from LCY

Footnote

[2] Takeoff decision speed.
[3] Rotation speed.

Aircraft information

Performance requirements for commercial aircraft require that an aircraft must be above V_{MCA}[4] before it gets airborne. Reducing available thrust for takeoff reduces the maximum asymmetric yawing moment that would be experienced in an engine failure situation. De-rating the engines can, therefore, reduce V_{MCA} and, consequently, the takeoff ground run required. The Embraer E190 and E170 aircraft have two thrust de-rate settings, 'Takeoff 2' (T/O-2) and T/O-3, which are activated using the MCDU[5].

The aircraft have an Automatic Takeoff Thrust Control System (ATTCS) which can automatically increase thrust to a reserve (RSV) level on the remaining engine should one fail. Had G-LCYZ suffered an engine failure on departure, the ATTCS would have increased the maximum available thrust on the live engine from 15,450 lbf to 17,100 lbf (T/O-3 RSV). With both engines operating normally, advancing the thrust levers from TO/GA to MAX would have commanded T/O-3 RSV on both engines.

Takeoff de-rate settings are automatically cancelled when climb power is selected. Alternatively, they can be manually de-selected through the MCDU. To do so during takeoff would divert PM's attention away from their monitoring role at a critical stage of flight.

Other than the EICAS display, the aircraft was not fitted with any automated system capable of alerting the pilots to an inappropriate takeoff thrust setting.

Weight and balance

The Company SOP takeoff thrust mode for all E170 and E190 flights is 'Optimum', except E190 departures from LCY. For an Embraer E190 departing LCY with a takeoff mass (TOM) above 40,000 kg, T/O-1 thrust is used. At lower masses T/O-2 is standard (Figure 2). Where Optimum is specified, the thrust setting calculated by the EFB performance software is not artificially limited and the EFB calculates the most appropriate engine de-rate for the environmental conditions. On the incident flight G-LCYZ's TOM was 41,118 kg.

Human factors

The crew could not positively say why the slip occurred, nor why it remained undetected. Pilots can fly the Embraer E190 and its smaller E170 variant on a common type rating. In the two weeks prior to the incident, the commander had almost exclusively flown the E170, often using T/O-3 as the required de-rate. The commander believed that this may have led to the initial slip and contributed to confirmation bias when reviewing the information displayed on EICAS. At no stage during the takeoff did the flight crew assess that advancing the thrust levers to command T/O-3 RSV was necessary to assure safe flight.

Footnote

[4] Velocity Minimum Control (air) (V_{MCA}): in broad terms, the minimum speed at which directional control can be maintained with the critical engine inoperative and the other delivering takeoff power.

[5] Multi-purpose control and display unit.

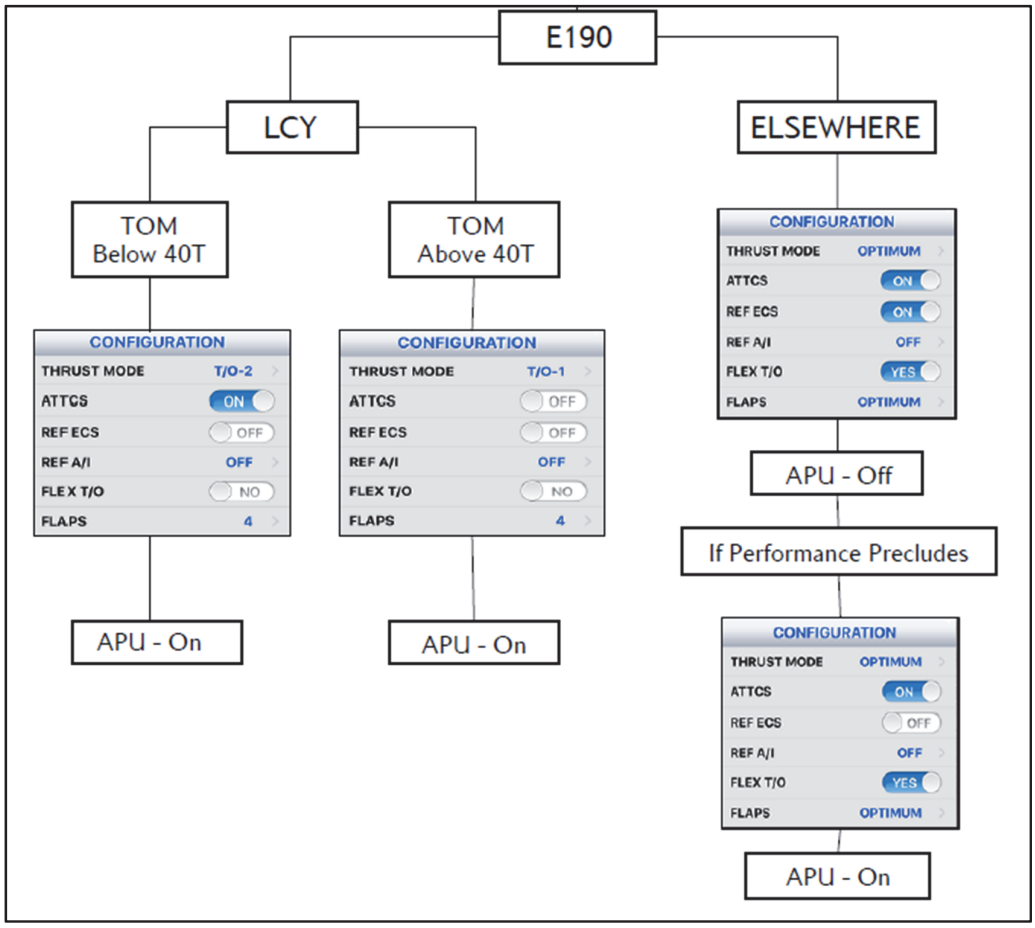

Figure 2

The Airline's SOP takeoff thrust settings for E190 aircraft

Additional information

Performance-related accidents and serious incidents

The AAIB published a Formal report[6] into a serious incident, where a Boeing 737 (C-FWGH) took off with excessively reduced thrust. Appendix A to the report lists 33 performance-related accidents and serious incidents occurring to commercial aircraft during the period 14 October 2004 to 20 March 2018. The report advocates the future development of automated systems to supplement procedural barriers and act as additional risk controls to mitigate against performance-related accidents and incidents. The report also examines various human factors that explain why it may not be instinctive for pilots to advance thrust levers when faced with abnormal takeoff performance.

Footnote

[6] https://www.gov.uk/aaib-reports/aircraft-accident-report-aar-2-2018-c-fwgh-21july-2017 accessed 11 February 2019.

Analysis

On balance, the evidence suggests that, following the correct calculation of takeoff performance, T/O-3 was manually selected in error. Normal limitations in human performance are likely to have been contributory factors to the T/O-3 setting remaining undetected during the VDR. Subtle differences associated with operating different variants of a common type appear to have played a part in the error chain. While the aircraft took off without incident, an emergency on departure might have been made more challenging by the reduced thrust available with T/O-3 activated. The commander did not consider manually de-selecting the engine de-rate, either through premature activation of climb thrust or through the MCDU, to be a safe or appropriate course of action at that time. Neither did they consider that T/O-3 RSV thrust was required for a safe climb out.

Performance-related errors remain a threat to the safe conduct of commercial air transport operations. Until technical solutions can be developed, procedural barriers remain a key defence against such events.

Conclusion

Human Performance limitations contributed to the aircraft departing LCY with a power setting that might have had an adverse effect on aircraft handling and performance in the event of an engine failure. Given the known limitations of humans, robust procedural barriers will remain a key defence against mishap until technological solutions are sufficiently mature.