# Technical report IN-019/2021

Incident on 28 May 2021 involving a Boeing 737-800W aircraft, registration PH-BXF, operated by KLM, and a Tecnam P2006T, registration EC-MNG, operated by the European Aviation School of Barcelona, to the SE of the Barcelona TMA Area 1 (Barcelona, Spain)

Please note that this report is not presented in its final layout and therefore it could include minor errors or need type corrections, but not related to its content. The final layout with its NIPO included (Identification Number for Official Publications) will substitute the present report when available.



#### Notice

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident and its causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.6 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1 and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

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## ABBREVIATIONS

o ' "	Sexagesimal degrees, minutes and seconds
°C	Degrees Celsius
ACC	Area Control Centre
ACP	Area control procedural
ACS	Area control surveillance
AD	Aerodrome
ADI	Aerodrome control instrument
ADV	Aerodrome control visual
AIP	Aeronautical Information Publication
AIR	Air control endorsement
ALT	Altitude
APP	Approach control procedural
APS	Approach control surveillance
ARP	Aerodrome reference point
ATC	Air traffic control (in general)
ATPL	Airline transport pilot license
BCN	Barcelona
CPL	Commercial pilot license
CRI	Class rating instructor
СТА	Control area
CTR	Control zone
DME	Distance measuring equipment
DVOR	VOR Doppler
E	East
EHAM	ICAO code for Amsterdam-Schiphol Airport
ETD	Estimated time of departure
FI	Flight instructor rating
FIR	Flight information region
FL	Flight level
Ft	Feet
ft/min	Feet/minute
GMC	Ground movement control endorsement
GMS	Ground movement surveillance endorsement
h	Hours
HIRO	High intensity runway operations
hPa	Hectopascals
IFR	Instrument flight rules
IR	Instrument flight rating
kg	Kilogrammes
km	Kilometres

kt	Knots
LEBL	ICAO code for Josep Tarradellas Barcelona-El Prat Airport
LECB	ICAO code for Barcelona control centre
LECH	ICAO code for Castellón Airport
LELL	ICAO code for Sabadell Airport
m	Metres
max	Maximum
MEP	Multi-engine piston rating
METAR	Aviation routine weather report (in aeronautical meteorological code)
MHz	Megahertz
MTCD	Medium-term conflict detection
N	North
NM	Nautical miles
ICAO	International Civil Aviation Organisation
OCN	Ocean control endorsement
PAR	Precision approach radar endorsement
PEP	Prediction alert
PPL	Private pilot license
PSR	Primary surveillance radar
QNH	Altimeter setting to obtain elevation above sea level when on the ground
RAD	Aerodrome radar control endorsement
RNAV	Area navigation
SACTA	Automated air traffic control system
SE	Southeast
SEP	Single-engine piston rating
SID	Standard instrument departure
SLL	Sabadell's DVOR/DME
SRA	Surveillance radar approach endorsement
STAR	Standard (instrument) terminal arrival route
STCA-PAC	Short-term conflict alert - Prediction of conflict alert
STCA-VAC	Short-term conflict alert - Violation of conflict alert
STCP	Short-term conflict detection function
TAF	Terminal aerodrome forecast
TCAS RA	Traffic collision avoidance system - resolution advisory
TCAS TA	Traffic collision avoidance system - traffic alert
TCL	Terminal control endorsement
TMA	Terminal control area
TWR	Control tower endorsement
UTC	Coordinated universal time
VEV	Violation alert
VFR	Visual flight rules

VMC	Visual flight meteorological conditions
W	West

## Technical report IN-019/2021

Aircraft 1:

KLM
KLM
Boeing 737-800W, registration PH-BXF (the
Netherlands)
6 (crew members), 82 (passengers)
Commercial air transport - Scheduled -
International - With passengers
On route – Climbing to the route level
IFR
Get de Victory
European Aviation School of Barcelona
Tecnam P2006T, registration EC-MNG (Spain)
2 (crew members, instructor and student pilot)
General aviation - Instruction - Dual command
On route
IFR
28 May 2021: 13:32 h <sup>1</sup>
SE of the Barcelona TMA Area 1
29 September 2021

## Synopsis

#### Summary:

The Tecnam P2006T aircraft, with registration EC-MNG, operated by the European Aviation School of Barcelona, had taken off for an instruction flight from Sabadell Airport (LELL) to Castellón Airport (LECH). The aircraft's flight plan consisted of flying over the BCN DVOR/DME (close to Josep Tarradellas Barcelona-El Prat Airport (LEBL)) and then

<sup>&</sup>lt;sup>1</sup> All times used in this report are local time. UTC is 2 hours less.

from that navaid on course to the RODRA waypoint. The incident occurred when the aircraft was between the navaid and the waypoint mentioned above, at FL90.

The Boeing 737-800W aircraft, with registration PH-BXF, operated by KLM, had taken off from runway 25L at Josep Tarradellas Barcelona-El Prat Airport (LEBL) and was bound for Amsterdam-Schiphol Airport (EHAM). It was flying a standard instrument departure (SID) RNAV1 called OKABI THREE QUEBEC (OKABI3Q), which consists of a conventional initial climb to the DOTIS waypoint (passing it at an altitude of 3,000 ft or higher), and then following the RNAV1 procedure from there.

At the time of the incident, the Boeing 737-800W aircraft was climbing through 8,640 ft to flight level FL190, and the Tecnam P2006T was maintaining FL090.

Both aircraft were in radio contact with ATC but on different frequencies. The Tecnam P2006T aircraft with registration EC-MNG was in contact with the LEBLT23FW sector controller, and the Boeing 737-800W aircraft with registration PH-BXF was in contact with the LEBLT14W sector controller. The controllers did not give instructions to the aircraft in order to reduce the risk of AIRPROX between them.

The Boeing 737-800W aircraft, registration PH -BXF, received an RA warning from the TCAS system and had to stop climbing and descend to avoid the conflict. The separation between the aircraft at the time of the TCAS RA warning was 1.52 NM and 350 ft.

The investigation has determined that the cause of the incident was a loss of situational awareness on the part of the LEBLT23FW sector controller. The LEBLT14W sector controller, who had transferred the Tecnam P2006T aircraft 9 minutes before the incident, did not think it would conflict with the aircraft in his sector. The LEBLT23FW controller, who was focused on the final sector, did not anticipate that the Tecnam P2006T aircraft would conflict with the aircraft taking off from Barcelona Airport.

## 1. THE FACTS OF THE INCIDENT

#### 1.1. Summary of the incident

The Tecnam P2006T aircraft, with registration EC-MNG, operated by the European Aviation School of Barcelona, had taken off for an instruction flight from Sabadell Airport (LELL) to Castellón Airport (LECH). The aircraft's flight plan consisted of flying over the BCN DVOR/DME (close to Josep Tarradellas Barcelona-El Prat Airport (LEBL)) and then from that navaid on course to the RODRA waypoint.

At 13:23 h, when the aircraft was on course to the BCN DVOR/DME, the controller of the LEBLT14W sector (which comprises the LEBLT1W and LEBLT4W Barcelona TMA sectors) transferred control of the aircraft to the controller of the LEBLT23FW sector (which comprises the LEBLF25, LEBLT2W and LEBLT3W Barcelona TMA sectors). The LEBLT14W sector controller made the decision to transfer control of the aircraft, thinking that it might affect the traffic on final but wouldn't conflict with the traffic in the other control sector.

The following image shows both sectors involved together with the DVOR/DME BCN navaid and the RODRA waypoint (both marked in yellow):



Illustration 1: LEBLT14W and LEBLT23FW control sectors

The Boeing 737-800W aircraft, with registration PH-BXF, operated by KLM, had taken off from runway 25L at Josep Tarradellas Barcelona-El Prat Airport (LEBL) and was bound for Amsterdam-Schiphol Airport (EHAM). It was flying a standard instrument departure (SID) RNAV1 called OKABI THREE QUEBEC (OKABI3Q), which consists of a conventional initial ascent to the DOTIS waypoint (passing it at an altitude of 3,000 ft or higher), and then following the RNAV1 procedure from there<sup>2</sup>.

At 13:32 h, the time of the incident, the aircraft was approaching the DOTIS waypoint, climbing through 8,640 ft to flight level FL190 and in contact with the LEBLT14W sector controller.

Neither the LEBLT14W sector controller nor the LEBLT23FW sector controller gave the aircraft instructions to reduce the risk of them coming too close to each other, as they were unaware of the loss of separation until the STCA-VAC alarm was active.

According to the testimony of the LEBLT14W sector controller, from the moment he transferred control of the Tecnam P2006T aircraft, with registration EC-MNG, until the moment the incident occurred, he carried out numerous communications with visual traffics and resolved several alarms that weren't fundamental but did take up his time. He added that, in his opinion, there were too many non-fundamental alarms and that their sounds aren't distinguishable from the STCA-PAC and STCA-VAC alarms.

The Boeing 737-800W aircraft, registration PH-BXF, received an RA warning from the TCAS system and had to stop climbing and descend to avoid the conflict. The separation between the aircraft at the time the TCAS RA warning sounded was 1.52 NM and 350 ft.

There were no injuries.

Neither aircraft sustained any damage.

## 1.2. Injuries to persons

1.2.1.	Injuries to persons	on board the Boeing	737-800W,	with registration	PH-BXF:
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Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				
Unharmed	6 <sup>3</sup>	82	88	
TOTAL	6	82	88	

<sup>&</sup>lt;sup>2</sup> Annexe I shows the standard instrument departure chart.

<sup>&</sup>lt;sup>3</sup> The crew consisted of 2 pilots and 4 flight attendants.

#### 1.2.2. Injuries to persons on board the Tecnam P2006T, with registration EC-MNG:

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				
Unharmed	24		2	
TOTAL	2		2	

#### 1.3. Damage to the aircraft

Neither aircraft sustained any damage.

#### 1.4. Other damage

There was no additional damage.

#### 1.5. Personnel information

#### 1.5.1. Information about the crew of the Boeing 737-800W, with registration PH-BXF

The pilot had an airline transport pilot license (ATPL) with the B737 type rating valid until 30 June 2021. He had a Class 1 medical certificate that was valid at the time of the incident.

The first officer had an airline transport pilot license (ATPL) with the B737 type rating valid until 30 June 2022. He had a Class 1 medical certificate that was valid at the time of the incident.

#### 1.5.2. Information about the crew of the Tecnam P2006T, with registration EC-MNG

The 47-year-old instructor pilot had a commercial pilot license for aircraft (CPL) first issued on 30 January 2006, and a private pilot license (PPL) for aircraft first issued on 7 April 2003, with the following ratings:

- MEP (land) valid until 31 August 2021
- SEP (land) valid until 30 June 2022
- A320 valid until 31 March 2022
- Instrument flight rating (IR) valid until 31 March 2022
- Class rating instructor (CRI) for MEP aircraft (land), valid until 31 August 2022
- Flight instructor rating FI (aircraft) for PPL, CPL, SEP, MEP, IR and FI valid until 31 May 2022
- NIGHT

He had a Class 1 medical certificate valid until 07 October 2021.

<sup>&</sup>lt;sup>4</sup> The crew consisted of an instructor and a student pilot.

#### 1.5.3. Information about the executive controller of the LEBLT23FW sector

The 59-year-old controller had an air traffic controller license first issued on 29 June 1989, with the following ratings:

- ADV (aerodrome control visual),
- ADI (aerodrome control instrument),
- APP (approach control procedural),
- APS (approach control surveillance),
- ACP (Area control procedural) and
- ACS (Area control surveillance)

and the following endorsements:

- AIR (air control), GMC (ground movement control), TWR (control tower), GMS (ground movement surveillance) and RAD (radar aerodrome control) for the ADI rating,
- PAR (precision approach radar), SRA (surveillance radar approach) and TCL (terminal control) for the APS rating,
- OCN (oceanic control) for the ACP rating and
- TCL and OCN for the ACS rating.

His unit endorsement was LECB, TMA position, APS/TCL rating with an expiry date of 15 May 2022.

His class 3 medical certificate expired on 26 July 2021.

#### 1.5.4. Information about the planner controller of the LEBLT23FW sector

The 44-year-old controller had an air traffic controller license first issued on 12 November 2001, with the following ratings:

- ADV (aerodrome control visual),
- ADI (aerodrome control instrument),
- APP (approach control procedural),
- APS (approach control surveillance),
- ACP (Area control procedural) and
- ACS (Area control surveillance)

and the following endorsements:

- AIR (air control), GMC (ground movement control), TWR (control tower), GMS (ground movement surveillance) and RAD (radar aerodrome control) for the ADI rating,
- PAR (precision approach radar), SRA (surveillance radar approach) and TCL (terminal control) for the APS rating,
- OCN (oceanic control) for the ACP rating and

• TCL and OCN for the ACS rating.

His unit endorsement was LECB, TMA position, APS/TCL rating with an expiry date of 04 April 2022. He also had the following endorsements: OJTI (on-the-job instructor) until 25 October 2023 and evaluator until 02 April 2022.

He had a Class 3 medical certificate that was valid at the time of the incident.

### 1.5.5. Information about the executive controller of the LEBLT14W sector

The 39-year-old controller had an air traffic controller license first issued on 16 April 2008, with the following ratings:

- ADV (aerodrome control visual),
- ADI (aerodrome control instrument),
- APP (approach control procedural),
- APS (approach control surveillance),
- ACP (Area control procedural) and
- ACS (Area control surveillance)

and the following endorsements:

- AIR (air control), GMC (ground movement control), TWR (control tower), GMS (ground movement surveillance) and RAD (radar aerodrome control) for the ADI rating,
- PAR (precision approach radar), SRA (surveillance radar approach) and TCL (terminal control) for the APS rating,
- OCN (oceanic control) for the ACP rating and
- TCL and OCN for the ACS rating.

His unit endorsement was LECB, TMA position, APS/TCL rating with an expiry date of 07 May 2022.

His class 3 medical certificate expired on 11 July 2021.

#### 1.5.6. Information about the planner controller of the LEBLT14W sector

The 55-year-old controller had an air traffic controller license first issued on 15 September 1993, with the following ratings:

- ADV (aerodrome control visual),
- ADI (aerodrome control instrument),
- APP (approach control procedural),
- APS (approach control surveillance),
- ACP (Area control procedural) and
- ACS (Area control surveillance)

and the following endorsements:

- AIR (air control), GMC (ground movement control), TWR (control tower), GMS (ground movement surveillance) and RAD (radar aerodrome control) for the ADI rating,
- PAR (precision approach radar), SRA (surveillance radar approach) and TCL (terminal control) for the APS rating,
- OCN (oceanic control) for the ACP rating and
- TCL and OCN for the ACS rating.

His unit endorsement was LECB, TMA position, APS/TCL rating with an expiry date of 15 September 2021.

His class 3 medical certificate expired on 28 July 2021.

#### **1.6.** Aircraft information

#### 1.6.1. Information about the Boeing 737-800W aircraft, with registration PH-BXF

- Make: Boeing
- Model: 737-8K2
- Year of manufacture: 2000
- Serial number: 29596
- Registration: PH-BXF
- Maximum take-off weight: 73,708 kg
- Number of engines: 2
- Type of engines: CFM56-7B24
- Information about the owner and operator: The aircraft is registered to KLM NV in the Dutch Aircraft Registry.

The aircraft has an Airworthiness Certificate and an Airworthiness Review Certificate valid until 16 August 2021.

This aircraft was equipped with a TCAS system.

#### 1.6.2. Information about the Tecnam P2006T, with registration EC-MNG

- Make: Tecnam
- Model: P2006T
- Year of manufacture: 2016
- Serial number: 174
- Registration: EC-MNG
- Maximum take-off weight: 1,230 Kg
- Number of engines: 2
- Type of engines: Rotax 912 S3-01

• Information about the owner and operator: The aircraft has been registered with the Spanish Aircraft Registry in the name of Get de Victory, as owner, and the European Aviation School of Barcelona as lessee, since 21 December 2020.

The aircraft has an Airworthiness Certificate issued on 20 October 2016 and an Airworthiness Review Certificate, valid until 23 October 2021.

This aircraft was not equipped with a TCAS system.

#### 1.7. Meteorological information

The aerodrome routine weather reports (METAR) for Barcelona Airport at 11:00 and 11:30 UTC were as follows:

METAR LEBL 281100Z 16005KT 110V210 9999 FEW025 20/16 Q1017 NOSIG= METAR LEBL 281130Z 16005KT 130V200 9999 FEW025 21/15 Q1017 NOSIG=

The METAR for Barcelona on 28 May at 11:00 UTC reported the following:

- Variable wind direction between 110° and 210°, speed 5 knots.
- Visibility 10 km or more.
- Low cloud cover, with the cloud base at 2,500 ft.
- Temperature of 20°C and dew point of 16°C.
- QNH of 1,017 hPa and
- No significant changes expected.

The METAR for Barcelona on 28 May at 11:30 UTC reported the following:

- Variable wind from between 130° and 200°, speed 5 knots.
- Visibility 10 km or more.
- Low cloud cover, with the cloud base at 2,500 ft.
- Temperature of 21°C and dew point of 15°C.
- QNH of 1,017 hPa and
- No significant changes expected.

The 11:00 UTC TAF report was:

TAF LEBL 281100Z 2812/2912 18010KT 9999 FEW025 TX23/2812Z TN17/2906Z BECMG 2817/2820 27005KT TEMPO 2820/2906 VRB03KT=

The Barcelona TAF on 28 May at 11:00 UTC was valid from 12:00 UTC on 28 May until 12:00 UTC on 29 May. It forecast:

- Wind direction180°, speed 10 knots.
- Visibility 10 km or more.
- Low cloud cover, with the cloud base at 2,500 ft.

- Maximum temperature of 23°C on 28 May at 12:00 UTC and minimum temperature of 17°C on 29 May at 6:00 UTC
- Between 17:00 UTC and 20:00 UTC on 28 May, the wind will change to a speed of 5 knots from a 270° direction.
- Between 20:00 UTC on 28 May and 06:00 UTC on 29 May, temporary wind fluctuations from variable directions with a speed of 3 knots.

## 1.8. Aids to navigation

To facilitate the analysis of the incident, the points below outline the position of the aircraft according to their radar traces at different times. The red numbers represent the position of the Tecnam P2006T aircraft with registration EC-MNG and callsign EAX303. The green numbers represent the position of the Boeing 737-800W aircraft with registration PH-BXF and callsign KLM22B:

Point **1**. At 11:20:44 UTC (13:20:44 h), the crew of the EAX303 aircraft notified the LEBLT14W sector controller<sup>5</sup> that they were reaching FL90.

Point **2**. At 11:24:35 UTC (13:24:35 h), the aircraft contacted the controller of the LEBLT23FW sector<sup>6</sup>. The LEBLT14W sector controller transferred control of the aircraft at 11:23:29 UTC (or 13:23:29 h) when it was about 10 NM north of BCN's DVOR/DME navigation aid.

Point **3.** At 11:30:17 UTC (13:30:17 h), the crew of the KLM22B aircraft was instructed by the LEBLT14W sector controller to climb to FL190 and, once at 6,000 ft, proceed directly to the OKABI waypoint.

Point **3**. Position of the EAX303 aircraft at 11:30:17 UTC.

Point **4.** Position of the KLM22B aircraft at 11:32:06 UTC (13:32:06 h), which was the moment the STCA-PAC alarm was triggered.

Point 4. Position of the EAX303 aircraft at 11:32:06 UTC.

Point **5.** Position of the KLM22B aircraft at 11:32:13 UTC (13:32:13 h), which was the moment the STCA-VAC alarm was triggered.

Point **5**. Position of the EAX303 aircraft at 11:32:13 UTC.

Point 6. Position of the KLM22B aircraft at 11:32:30 UTC (13:32:30 h). As the aircraft was approaching the DOTIS waypoint through FL86 and climbing from to FL190, it had to stop

<sup>&</sup>lt;sup>5</sup> The LEBLT14W sector combines the airspace of the Barcelona TMA LEBLT1W and LEBLT4W sectors in the W configuration.

<sup>&</sup>lt;sup>6</sup> The LEBLT23FW sector combines the airspace of the Barcelona TMA LEBLT2W and LEBLT3W sectors in the W configuration.

its ascent upon receiving a TCAS RA alert. At that moment, the distance between the two aircraft was 1.52 NM and 350 ft.

Point 6. Position of the EAX303 aircraft at 11:32:30 UTC. The aircraft was flying towards the RODRA waypoint at FL90



Illustration 2: Position of the aircraft at different points in time

The following image show the two air traffic control sectors involved in the incident and the position of the aircraft at various points in time. The boundary between them has been highlighted with a blue line:



Illustration 3: Position of the aircraft at different points in time and control sectors involved in the incident

#### 1.9. Communications

To facilitate the analysis of the incident, the most relevant communications between the aircraft crews and air traffic controllers are described below:

At 11:10:44 UTC (13:10:44 h), the crew of the Tecnam P2006T aircraft with registration EC-MNG and callsign EAX303 contacted the LEBLT14W sector controller to report that it was maintaining at 4,000 ft above the SLL (Sabadell) DVOR/DME. The controller cleared them to climb to FL90 and, once there, fly directly to the BCN (Barcelona) DVOR/DME. He informed them that traffic was taking off from the airport at that time. In addition, he told them that the runway in use was 06 at Castellón airport and the STAR was TORDU2S.

At 11:20:44 UTC (13:20:44 h), the crew of the Tecnam P2006T aircraft informed the controller that they were approaching FL90.

At 11:22:16 UTC (13:22:16 h), the crew of the Tecnam P2006T aircraft contacted the LEBLT14W sector controller again to confirm that they were proceeding to the BCN DVOR/DME at FL90. The controller told them to follow the flight plan route as filed. Subsequently, at 11:23:29 UTC (13:23:29 h), the controller of that sector transferred them to the Barcelona 126.505 MHz frequency (the frequency for the LEBLT23FW).

At 11:30:13 UTC (13:30:13 h), the crew of the Boeing 737-800W aircraft with registration PH-BXF and callsign KLM22B contacted the LEBLT14W sector controller, who cleared them to climb to FL190 and, once at 6,000 ft, fly directly to the OKABI waypoint.

At 11:32:31 UTC (13:32:31 h), the LEBLT14W sector controller started to provide to KLM22B aircraft traffic information, but given the proximity between the two aircraft, told it

to comply with the Resolution Advisory. The crew informed ATC that they had a 'descent' Resolution Advisory. Twenty-five seconds later, the crew of the aircraft informed ATC that it would continue to climb once clear of conflict.

#### 1.10. Aerodrome information

The Boeing 737-800W aircraft with registration PH-BXF, which callsign was KLM22B, had taken off from runway 25L at Josep Tarradellas Barcelona-El Prat Airport (whose ICAO is LEBL). The airport is located 10 km to the southwest of the city of Barcelona. Its elevation is 4 m, and it has three runways: 02/20, 07L/25R and 07R/25L.

At the time of the incident, the airport configuration was the preferred daytime configuration or parallel runway west configuration, which has arrivals landing on runway 25R and departures leaving from 25L and 25R<sup>7</sup>. The aircraft had taken off from runway 25L.

Given the volume of traffic at the time of the incident, Josep Tarradellas Barcelona-El Prat Airport was operating in the single WLL configuration, with RWY 25L being used for both take-offs and landings.

## 1.11. Flight recorders

KLM provided the following analysis of the TCAS event using the memory of the TCAS computer.

The first Traffic Advisory (TA) was issued when the Boeing 737-800W aircraft, registration PH-BXF and callsign KLM22B, was at FL84 (specifically, at an altitude of 8,416 ft) and climbing at 1,987 ft/min. At that time, the Tecnam P2006T aircraft, registration EC-MNG and callsign EAX303, was holding at FL90 (specifically, at an altitude of 8,992 ft). The distance between the two aircraft was 2.24 NM, and the relative heading was 60°.

The Traffic Advisory was interrupted 16 seconds later by a "DESCEND" Resolution Advisory (RA) when the Boeing 737-800W aircraft, which was climbing at a rate of 389 ft/min, reached FL86 (specifically, an altitude of 8,640 ft). The other aircraft maintained the same altitude. The distance between both aircraft was 1.52 NM and 352 ft with a relative heading of 68°.

The "DESCEND" Resolution Advisory (RA) lasted for 8 seconds as the Boeing 737-800W aircraft decreased its altitude at a rate of -780 ft/min, from 8,640 ft to 8,608 ft. The other aircraft maintained the same altitude. The distance between the two aircraft was reduced horizontally to 1.31 NM and increased vertically to 384 ft with a relative heading of 94°.

After those 8 seconds, the "DESCEND" Resolution Advisory (RA) was cancelled and the Boeing 737-800W aircraft continued descending at -2,445 ft/min until it reached FL84

<sup>&</sup>lt;sup>7</sup> The use of RWY 25R is restricted to aircraft that can justify the need for a longer runway than the length provided by RWY 25L, with the exception of certain flights detailed in the AIP.

(specifically, an altitude of 8,384 feet). The distance between the aircraft was increased to 1.77 NM and 608 ft.

## 1.12. Aircraft wreckage and impact information

N/A.

## 1.13. Medical and pathological information

We have found no evidence to suggest that the actions of the flight crew or the air traffic controllers were affected by any physiological or disabling factors.

1.14. Fire

N/A.

#### 1.15. Survival aspects

N/A.

#### 1.16. Tests and research

N/A.

#### 1.17. Organisational and management information

N/A.

#### 1.18. Additional information

#### 1.18.1. Airspace in which the incident took place.

The incident occurred in the Barcelona TMA<sup>8</sup> Area 1 airspace, which is classified as A<sup>9</sup>.

Annexe I shows the Standard Instrument Departure chart that the Boeing 737-800W aircraft with registration PH-BXF and callsign KLM22B was performing at the time of the incident.

The reporting points that the Tecnam P2006T aircraft with registration EC-MNG and callsign EAX303 flew over on the day of the incident are detailed in Annexe II.

<sup>&</sup>lt;sup>8</sup> The Barcelona TMA Area 1 encompasses a circular area with a radius of 24 NM, centred on 411743N, 0020507E, excluding BARCELONA CTR. From the MAX ALT VFR SECTOR to FL195, it is a class A airspace, and from 1,000 ft AGL/AMSL to the MAX ALT VFR SECTOR, it is a class G airspace.

The upper vertical limit of Barcelona CTR is FL75.

<sup>&</sup>lt;sup>9</sup> Only IFR flights are allowed. All flights are subject to the air traffic control service and separated from each other. Continuous air-ground communication by voice is required for all flights. All flights are subject to ATC clearance.

The illustration on the right shows the Barcelona TMA sectors involved in the incident.

The LEBLT14W sector comprised the LEBLT1W and LEBLT4W sectors at the time of the incident.

TheLEBLT23FWsectorcomprisedtheLEBLF25,LEBLT2W and LEBLT3W sectors.



Illustration 4: The Barcelona TMA sectors involved

#### 1.18.2. Horizontal radar separation minima

The AIP (Aeronautical Information Publication) establishes the minimum separation applicable in the Barcelona TMA:

Unit	Radar selection Minimum separation applic		
Barcelona	Multi-radar	<sup>10</sup> Nominal with	3 <sup>11</sup> (0 to 60 NM from ARP)
APP	(remote and	PSR	
	autonomous) Nominal without		3 <sup>11</sup> (0 to 30 NM from ARP)
		PSR	5 (30 to 60 NM from ARP
		Degraded <sup>12</sup>	5 (0 to 60 NM from ARP)
	Monoradar Main		3 <sup>11</sup> (0 to 30 NM from ARP)
	(autonomous)		5 (30 to 60 NM from ARP)
		No main radar	5 (0 to 60 NM from ARP)

#### 1.18.3. Vertical separation minima

The Air Traffic Regulations establish the following in section 4.3.3. VERTICAL SEPARATION MINIMA:

<sup>&</sup>lt;sup>10</sup> Nominal: At least one main radar operational

<sup>&</sup>lt;sup>11</sup> Minimum separation of 2.5 NM between successive aircraft on the same final approach path, less than 10 NM from the threshold, in BARCELONA APP (LEBL AD), under HIRO operating conditions (see LEBL AD)

<sup>2 -</sup> Section 20).

<sup>&</sup>lt;sup>12</sup> Degraded: No main radar operational

4.3.3.1. Vertical separation minima.

Note. - SERA.8005, letter c), number 1), contains provisions on how to provide vertical separation between aircraft.

And the aforementioned SERA.8005 requirement, letter c), number 1) indicates that:

c) Except for cases when a reduction in separation minima in the vicinity of aerodromes can be applied, separation by an air traffic control unit shall be obtained by at least one of the following:

1) vertical separation, obtained by assigning different levels selected from the table of cruising levels in Appendix 3 to the Annexe to this Regulation, except that the correlation of levels to track as prescribed therein shall not apply whenever otherwise indicated in appropriate aeronautical information publications or air traffic control clearances. The vertical separation minimum shall be a nominal 300 m (1,000 ft) up to and including FL410 and a nominal 600 m (2,000 ft) above this level.

#### 1.18.4. Barcelona ACC operating manual

The following sections of the Barcelona ACC Operating Manual are relevant to this incident:

6.5.1.3.1 LEBL departures

Describes the procedure for departures in the west configuration towards the OKABI waypoint, as well as the ATC units and sectors involved:

ОКАВІ	-F/-Q/	LEBL ↑ 6000FT →	T4W ↑ FL190 →	DDN² ↑ FL300 →	LFBB
	-P/-D	Nota² Si hay dos de a FL320 actualizan	spegues sin separación longitudinal, el do el OLDI. <b>El nivel de vuelo más bajo</b>	primero puede subirse por OKABI es FL200.	

Illustration 5: Procedure and units/sectors involved in take-offs in the westerly configuration

#### Notes:

- Q: SID RWY 25L/20 PRNAV
- F: SID RWY 25L/20 CONV.
- P: SID RWY 25R PRNAV
- D: SID RWY 25R CONV.

Departure sector: T4W.

#### 6.5.4 LELL procedures

Describes the procedure and coordination for aircraft that intend to take off from LELL under VFR rules and change to IFR above the SLL DVOR/DME:

This airport is unique within the Barcelona FIR in that it doesn't have any instrument approach or departure procedures published in the AIP. The coordination of type Y<sup>13</sup> or Z flight plans will be carried out in accordance with their approved route and the corresponding Barcelona TMA sector. When a traffic departing from LELL with a Z flight plan involving transfer to IFR over the SLL DVOR/DME requests start-up, the LELL control tower will pre-activate its flight plan in SACTA (at least 10' before the ETD) and notify LECB by telephone line or the hotline. When the traffic takes off, the LELL control tower will notify LECB by telephone or via the hotline (sector T1W/D1W in W configuration at LEBL, sector T4E in E configuration at LEBL). The LELL control tower will clear the traffic to orbit over the LELL DVOR/DME at 4,000 ft, maintaining VMC conditions and under VFR rules. It is the responsibility of the LELL control tower to ensure that VMC conditions exist at this altitude above the LELL airport. The LELL control tower will provide the aircraft with clearance for the IFR part of the Z flight plan.

#### 1.18.5. Internal report from ENAIRE

ENAIRE conducted an internal investigation into the incident and decided to implement the following measures to prevent similar incidents from occurring again:

- 1. Send the internal report (from ENAIRE) to the Executive and Planner controllers of sectors T14 and F23F25L to share knowledge of the causal factors detected and the lessons learned. This action has already been implemented.
- 2. Carry out a debriefing session with the executive and planner controllers of the T14 and T23F sectors involved. This action has already been implemented.
- 3. Include the lessons learned in the unit and/or ongoing training programmes. The expected date of implementation is 31 October 2021.
- 4. Include (ENAIRE's internal report) in the Instructors' Meeting and encourage instructors to cover the threats detected both in unit training and ongoing training. The expected date of implementation is 30 November 2021.
- 5. Ensure the Safety Board considers which measures should be adopted to disseminate and share the lessons learned with the unit's ATCs in the short term, without waiting for the annual incident training. The expected date of implementation is 31 December 2021.
- 6. Assess the interaction between LEBL's departures sectors and SID legs in external sectors, taking into account the historical modification of the initial SID clearance of FL120 to 6,000 ft that automatically limits departures altitudes, as well as situational awareness of the presence of traffic below the initial SID altitude. This action has already been implemented.
- 7. Implement differentiated audible alarms for different types of active alerts (PEP/ VEP, PAC/VAC...). The expected date of implementation is 31 January 2022.
- 8. Improve the on-screen representation and perceptive discrimination of the blue colour of interest (luminance, hue, saturation...) to differentiate it from the external white or mode S blue. The expected date of implementation is 31 March 2023.

<sup>&</sup>lt;sup>13</sup> A Y flight plan consists of starting the flight under IFR rules and changing to VFR at a point decided by the pilot-in-command. A Z flight plan is the reverse, starting under VFR rules and later changing to IFR.

- 9. Include radar tag marking/highlighting tools in SACTA (executable from the sector) as a cognitive aid for ATCs. The expected date of implementation is 31 March 2023.
- 10. Include MTCD o STCP tools (What-If) in SACTA. The expected date of implementation is 30 April 2023.

## 1.19. Special investigation techniques

N/A

## 2. ANALYSIS

The analysis of the incident focuses on the integration of the sectors, the volume of traffic and the performance of the air traffic controllers.

### 2.1. Analysis of the integration of the sectors

At the time of the incident, the LEBLT14W sector comprised sectors: LEBLT1W and LEBLT4W, and the LEBLT23FW sector comprised sectors: LEBLF25, LEBLT2W and LEBLT3W.

This integration of the airspace sectors responded, among other considerations, to the low volume of traffic.

Although the controllers involved in the air incident considered the integration of the sectors to be "inconvenient" because it increased the points of attention and required the display screen to be expanded according to the area of interest, they ruled it out as a decisive factor in this incident. In fact, the configuration at the time of the incident has been used quite regularly.

Therefore, the integration of the sectors is not considered to have been a factor in this incident.

#### 2.2. Analysis of the traffic volume

The controllers involved in the air incident defined the volume of traffic at the time as medium/high.

VFR flights are now requesting more information from air traffic controllers and, as a result, the volume of communications with this type of traffic has significantly increased.

## 2.3. Analysis of the performance of the LEBLT14W sector controller

The LEBLT14W sector controller transferred control of the Tecnam P2006T aircraft, registration EC-MNG, to the LEBLT23FW sector controller because he thought it might affect the traffic on final. In addition, he did not think there was a risk of it conflicting with the traffic in his control sector. The transfer of control of the aircraft is, therefore, considered to be adequate in terms of both timing and form.

According to his testimony, from the time he transferred control of the aircraft until the moment the incident occurred, 9 minutes later, he carried out numerous communications with visual traffics and resolved several alarms that, while not fundamental, took up a lot of his time. Given that ENAIRE has already decided to implement differentiated audible alarms depending on the type of active alert (PEP/VEP, PAC/VAC...), no recommendation is issued in this regard.

When the incident occurred, the traffic, which was in the LEBLT23FW sector's airspace, appeared on his radar screen in the "blue of interest"<sup>14</sup> colour, which is quite similar to white. This distinction could cause the controller to suffer from cognitive attention bias, i.e., giving preference to the information that directly affected him (the traffic on his frequency) while ignoring the surrounding traffics (those within his sector whose communication had already been transferred). Given that ENAIRE has already decided to make it easier for controllers to perceptively discriminate between the on-screen blue colour of interest (its luminance, hue, saturation...) and the external white or S mode blue colours, no recommendation is issued in this regard.

According to ENAIRE's procedures, once the KLM22B aircraft was departed; crew contacted the LEBLT14W sector controller despite the fact that part of the SID takes place in the LEBLT23FW sector's airspace. The controller instructed the KLM22B aircraft to climb to FL190 and, once at 6,000 ft, proceed directly to the OKABI waypoint without passing through the BL055 waypoint, forgetting about the presence of the Tecnam P2006T aircraft with registration EC-MNG. He remained unaware of the imminent loss of separation between the two aircraft until the STCA-VAC alarm active. After the activation, the controller started to inform the KLM22B aircraft about the traffic, but given the proximity between both aircraft, he allowed the crew to continue following the Resolution Advisory procedures.

Given that ENAIRE has taken or will soon take various measures to train its controllers in this type of conflict, no recommendation is issued in this area. Specifically, ENAIRE forwarded its investigation report to the controllers involved in the event to share knowledge of the causal factors and the lessons learned. They also conducted a debriefing session with them. In the near future, ENAIRE will include the lessons learned in the unit and/or ongoing training programmes, cover the internal report in the Instructors' Meeting and encourage the instructors to discuss the identified risks with students during both the unit training and ongoing training.

Given that during the conflict both aircraft were in the airspace of the LEBLT23FW sector but in contact with two different controllers, ENAIRE has also assessed the interaction between the LEBL departures sectors and the SID legs in the external sector.

#### 2.4. Analysis of the performance of the LEBLT23FW sector controller

Because his attention was more focused on the final sector, the LEBLT23FW sector controller, who was handling multiple traffics bound for Barcelona Airport, did not anticipate the conflict and did not provide traffic information to the Tecnam P2006T aircraft with registration EC-MNG that was on his frequency.

- traffic of interest appears in blue
- traffic under the control of other sectors appears in white

<sup>&</sup>lt;sup>14</sup> When a traffic is transferred to another sector, it changes colour on the air traffic controller's screen as described below:

<sup>•</sup> accepted traffic appears in dark green; that is, the traffic whose communications and control are the responsibility of the controller

Although the KLM22B aircraft was in the airspace belonging to his sector as part of its SID passed through it, the aircraft was in contact with the controller of the LEBLT14W sector, as per ENAIRE's procedures. It, therefore, appeared on the radar screen in "blue of interest", which, as previously mentioned, is not dissimilar to white. Given that ENAIRE has already decided to take action on the matter, we have ruled out a recommendation.

Moreover, given that ENAIRE will be assessing various measures to train its controllers in this type of conflict, we are not issuing any recommendations in this area.

## 3. CONCLUSIONS

## 3.1. Findings

- The incident occurred in the LEBLT23FW sector.
- As per ENAIRE's procedures, the Boeing 737-800W aircraft with registration PH-BXF had just taken off and was in the airspace belonging to the LEBLT23FW sector but in contact with the controller of the LEBLT14W sector.
- The LEBLT14W sector controller instructed the Boeing 737-800W aircraft with registration PH-BXF to climb to FL190 and, once at 6,000 ft, proceed directly to the OKABI waypoint without passing the BL055 waypoint.
- The Tecnam P2006T aircraft with registration EC-MNG was in contact with the LEBLT23FW sector controller and did not receive any instructions to prevent the conflict.
- The Boeing 737-800W aircraft, registration PH-BXF, received an TCAS RA warning and had to stop climbing and descend to avoid the conflict.
- The Tecnam P2006T aircraft with registration EC-MNG was unaware of the loss of separation and did not carry out any manoeuvres to avoid it.
- The minimum separation between the two aircraft was 1.52 NM and 350 ft.
- The LEBLT23FW sector controller was unaware of the conflict until the STCA-VAC alarm activated.

## 3.2. Causes/contributing factors

The investigation has determined that the cause of the incident was a loss of situational awareness on the part of the LEBLT23FW sector air traffic controller. The LEBLT14W sector controller, who had transferred the Tecnam P2006T aircraft 9 minutes before the incident, did not think it would enter into conflict with the aircraft in his sector. The LEBLT23FW controller, who was focused on the final sector, did not anticipate that the Tecnam P2006T aircraft would enter into conflict with the aircraft departing from Barcelona Airport.

#### 4. OPERATIONAL SAFETY RECOMMENDATIONS

The measures proposed by ENAIRE are considered sufficient to prevent this type of incident from reoccurring in the future, and, as a result, no safety recommendations are issued.

#### Annexe I: Standard instrument departure chart.

The standard instrument departure chart (SID) RNAV 1 for the Josep Tarradellas Barcelona-El Prat Airport West configuration departing from RWY 25L is included below.

The procedure to follow for all SIDs is:

- Initial clearance: Climb and initially maintain 6,000 ft and request flight level change en route.
- The RNAV1 procedure begins once the conventional initial climb ends at the DOTIS waypoint for OKABI.

#### Conventional initial climb runway 25L (West configuration)

Due to environmental issues and except for safety reasons, turning to the left will begin no later than reaching a 500 ft altitude. Do not overshoot R-235 BCN on turning.

## OKABI THREE QUEBEC (OKABI3Q) departure

Climb on runway heading, at 500 ft turn left to follow magnetic heading 163° to intercept and follow R-208 PRA. Follow R-208 PRA to cross DOTIS (5.5 DME PRA) at 3,000 ft or above.

OKABIGO RNAV1 (DME/DME) Salvo in dicación en contra de BARCELONA TWR, al alcanzar 2000 ft llame a BARCELONA APP 127.700. // Unless otherwise indicated by BARCELONA TWR, on reaching 2000 ft call BARCELONA APP 127.700.											
001	IF	DOTIS	Y	-	-0.4	-	-	+ <b>3</b> 000	-2 <b>3</b> 0	-	RNAV1
002	CF	BL055	-	<b>3</b> 28 ( <b>3</b> 28.0)	-0.4	-	R	+FL120	-	-	RNAV1
003	TF	OKABI	-	353 (353.3)	-0.4	66.0	-	-	-	-	RNAV1



#### Annexe II: Fixes flown over by the aircraft with callsign EAX303

According to its flight plan, the aircraft with callsign EAX303 took off from Sabadell Airport (LELL) at 11:05:37 UTC, bound for Castellón Airport (LECH).

It flew over the following fixes: SLL, BCN, RODRA, PEXOT, EBROX, LOTOS, TORDU, CTN, F07CH, IF06CH, FA06CH and TH06CH. The standard arrivals procedure in use at Castellón Airport was TORDU2S.

The following chart shows the fixes the aircraft flew over along with the arrival procedure:



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