JIAAC

Junta de Investigación de Accidentes de Aviación Civil

Final Report

LQ-CGK / LQ-FJQ

Presidencia de la Nación

Ministerio del Interior y Transporte
Presidencia de la Nación

Transporte Público

WARNING

This Report states the conclusions and recommendations of the Civil Aviation Accident Investigation Board (JIAAC) in relation to the facts and circumstances of the accident object of the investigation.

In compliance with Annex 13 (*Accident a nd Inc ident I nvestigation*) to the Convention on International Civil Aviation, ratified by Act 13.891, and with the Article 185 of the Aviation Code (Act 17.285), the accident investigation has a strictly technical nature, and the conclusions must not create presumption of blame or criminal, civil or management liability.

The investigation has been conducted with the only and essential objective of preventing accidents and incidents, according to Annex 13.

The results of this investigation do not determine or prejudge similar investigations of judicial or administrative nature that could be started in relation to the accident.

Introduction Note

The Civil Aviation Accident Investigation Board (JIAAC) has adopted the systemic method for the accident and incident analysis.

The method has been validated and spread by the International Civil Aviation Organization (OACI) and thoroughly adopted by organizations leaders in international accident investigations.
The main premises of the accident investigation systemic method are the following:

- The actions or omissions of the first-line operational staff and/or the technical failures of que equipment are referred to as **triggering or immediate factors** of the occurrence. They constitute the starting point of the investigation and are analyzed with reference to the defenses of the aviation system as well as other factors, in many cases distant in time and space of the precise time of the onset of the occurrence.

- The **defenses** of the aviation system detect, include, and help to recover the consequences of the actions or omissions of the first-line operational staff and technical failures. The defenses are classified into three generic entities: technology, regulations (including procedures) and training. When defenses work, they interfere with the causal sequence. When the defenses do not work, they contribute to the causal sequence of the accident.

- Finally, the factors in many cases distant in time and space of the precise time of onset of the occurrence are called **systemic factors**. They allow the understanding of the first-line operational staff performance and/or the occurrence of technical failures, and the explanation of the failures in the defenses. They are closely related to elements such as the operational context, rules and procedures, staff training, organization management which the operational staff reports to and infrastructure.

The investigation described in the following report is based on the systemic method, and has the objective of identifying the triggering factors, the failures of the defenses and the systemic factors underlying the accident, with the purpose of issuing recommendations about effective, practical and viable actions that contribute to safety management.

Junta de Investigación de Accidentes de Aviación Civil

FINAL REPORT

Exp.:088/15

ACCIDENT LOCATED IN: Villa Castelli, Province of La Rioja.

DATE: 9 March 2015.

TIME[1]**:** 20:10 UTC (aprox).

AIRCRAFT: Helicopter.

OWNER: Aviation Administration Department of the Province of La Rioja.

MAKE: Eurocopter

REGISTRATION: LQ-CGK.

MODEL: AS-350 B3

AIRCRAFT: Helicopter.

OWNER: Civil Aviation Provincial Administration of Santiago del Estero.

MAKE: Eurocopter

REGISTRATION: LQ-FJQ.

MODEL: AS350 B3

[1] *Note: All the times are expressed in Universal Coordinated Time (UTC) that for the location of the accident correspond to the time zone – 3.*

1. FACTUAL INFORMATION

a. Flight Review

On 9 March, 2015, the helicopter LQ-CGK had planned to make passenger and equipment transport flights from the city of Villa Castelli to Quebrada del Yeso, according to the Collaboration Agreement between the Secretary of Tourism of the Government of the Province of La Rioja and the producer *Adventure Line Production*. The cooperation of the Aviation Administration of Santiago del Estero had been requested the day before with their helicopter LQ-FJQ to support the activity.

The day of the accident, each aircraft made three flights. Once the flights ended, the LQ-CGK pilot, responsible of the coordination of the task, informed the LQ-FJQ pilot that they would make an additional flight in which there would be passengers on board LQ-CGK and a team of photographer and sound engineer on board LQ-FJQ to make a filming of the flight.

The helicopter pilots and the production Company staff made a *briefing* about the task to be done: the flight filming to the helicopter transporting as passengers the people involved in a competition. The *briefing* consisted in making, after the take-off, a 360° heading change turn, a passage over the location of the take-off site for the filming from the ground, and the following flight to the planned destination.

LQ-FJQ took off at about 8:00 pm; the aircraft was set to fulfil the filming task and had with four passengers on board (photographer, sound engineer and two coordinators). LQ-FJQ took off 45 seconds later, with four passengers on board (photographer and three members of the competition).

After the takeoff, both aircrafts made a low-altitude flight over the take-off site. After about 2 minutes later, and to the west of the starting point, the aircrafts crashed in flight and plunged into the ground; they impacted into terrain, got fired, and all occupants passed away.

Figure 1.Helicopters in the take-off site before the accident

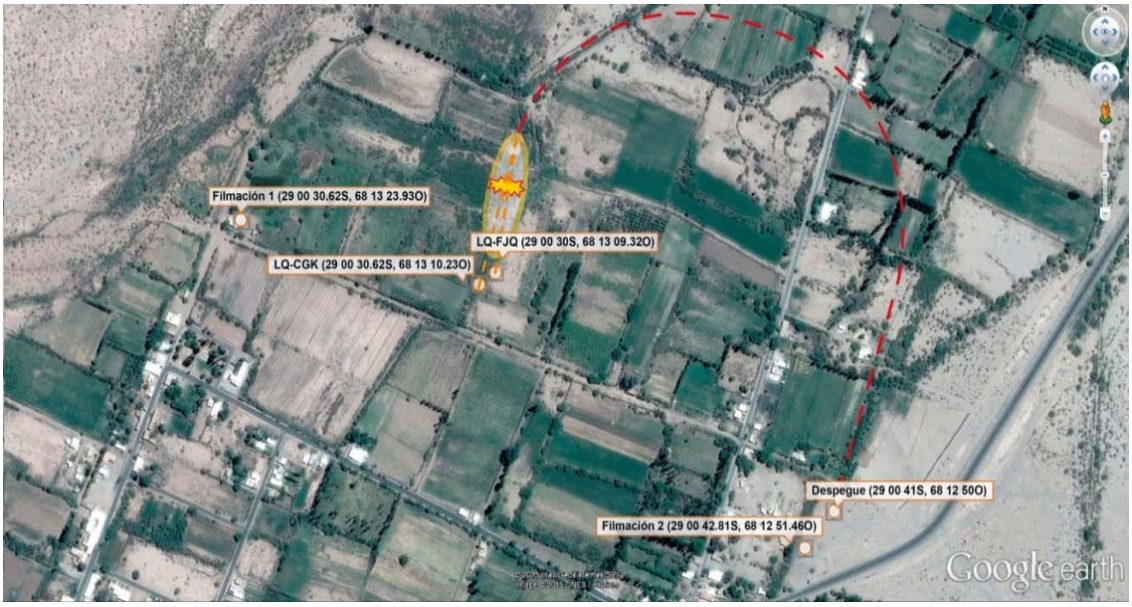

Figure 2. Estimated flight path of the aircrafts from the takeoff to the accident

b. Injuries to Staff

Helicopter LQ-CGK

Injuries	Crew	Passengers	Others
Fatal	1	4	----
Serious	----	----	----
Minor	----	----	----
None	----	----	----

1.1.1. Helicopter LQ-FJQ

Injuries	Crew	Passengers	Others
Fatal	1	4	----
Serious	----	----	----
Minor	----	----	----
None	----	----	----

c. Damage to Aircrafts

LQ-CGK

- Airframe destroyed.
- Engine destroyed.
- Main rotor and blades destroyed.
- Tail rotor and blades destroyed.
- Damage in general classified as “D” (destroyed).

Figure 3. Wreckage of the aircraft LQ-CGK

LQ-FJQ

- Airframe destroyed.
- Engine destroyed.
- Main rotor and blades destroyed.
- Tail rotor and blades destroyed.
- Damage in general classified as “D” (destroyed).

Figure 4. Wreckage of the aircraft LQ-FJQ

d. Other Damage

None.

e. Information about Staff

Pilot of the Aircraft LQ-CGK

1.5.1.1 The pilot in command of the helicopter LQ-CGK was the holder of the Commercial Pilot License for Helicopters Nº 480.08. His Aviation Medical Certification was valid until 31 March 2015.

1.5.1.2 His flying experience was:

Total general	6613.9
Last 60 days	24.0
Last 24 hours	2.0
In that type of aircraft	773.6

Note.- The flight hours correspond to the last numbering of the flight log, made before the aviation authority. The pilot's experience in that type of aircraft was verified in reference to the aircraft log of the aircraft LQ-CGK.

Pilot of the Aircraft LQ-FJQ

1.5.2.1 The pilot in command of the helicopter LQ-FJQ was the holder of the Commercial Pilot License for Helicopters N° 12.934.243. His Aviation Medical Certification was valid until 31 March 2015.

1.5.2.2 His flying experience was:

Total general	2238.9
Last 60 days	18.5
Last 24 hours	1.5
In that type of aircraft	11.9

Note.- The flig ht hours correspond to t he last nu mbering made b efore the aviation authority, a nd of d ata obtained fr om the fli ght l og un til the da y o f the occurrence.

1.5.3 Both aircrafts were supporting the aerial filming of a tv show that involved proximity flight between the aircrafts.

1.5.4 Both aircrafts, their pilots and supporting technical staff were part of public organizations (Provincial Aviation Administrations). The regulations this type of organizations are certified under is RAAC 91 (Flight rules and general operation).

1.5.5 The provisions of RAAC 91 do not include specific training requirements for the crew in aerial filming manoeuvres that involve proximity flight between aircrafts. The investigation could not determine what the pilot's experience in aerial filming manoeuvres involving proximity flight between aircrafts was.

f. Information about Aircrafts

General Characteristics

Both helicopters were Eurocopter (currently Airbus Helicopters) model Ecureuil AS350 B3 (currently H-125). It is a single-engine aircraft, ski landing gear. It is of mixed construction, combining metal alloys with composites through a structure with truss sectors and assemblies of the semimonocoque type (structure of the tail boom).

It is equipped with composite rotors and metal alloy fittings. The main rotor has three blades and the tail rotor has two.
The landing gear has a metallic tubular structure.

The cockpit is equipped with analog instrumentation, digital avionics and a VEMD (*Vehicle and Engine Multifunction Display*). This unit is a digital avionics

system located in the cockpit instrument board of the aircraft. It has two LCD displays (*Liquid Crystal D isplay*) that present information about aircraft electric system, flow and amount of fuel, and engine parameters and turbine temperature (T4), torque (TQ) and RPM of engine gas generator (NG).

The VEMD unit also has a mode called *MAINTENANCE*. In this mode failures and limitation excesses of parameters during the flight can be consulted and a complete report of the time the news was presented, the recorded failure and parameters at the time the failure was detected can be obtained. The report is expressed in codes that, after being decoded using the Maintenance Manual, the specific type of failure appears.

Despite the described abilities, the system should not be considered a flight data recorder since it does not comply with the required regulations for the protected recording devices.

Aircraft LQ-CGK

Figure 5. LQ-CGK
Serial number 7041, manufactured in France in July 2010.

1.6.2.1 Glider

Certificate of Registration in the Aviation General Administration of the Province of La Rioja, issued by ANAC (Civil Aviation National Administration) in 22 February, 2011.

Certificate of Airworthiness Standard, Category Normal, issued in 26 October 2010, in Tabalaba, Chile, with no expiration date.

According to ANAC 337 Form of 31 October 2014, at the time of the annual overhaul inspection according to the inspection plan, it had a General Total (TG) of 914.1 hours and D/N (Again) in respect to the Last General Course (DURG), being authorized until 31 October 2015, with Type Certificate EASA TCDS R 008, of six seats. The maximum take-off weight is 2.250 kg and the empty weight is 1.272 kg.

1.6.2.2 Engine

Make Turbomeca, model Arriel 2B1, serial number 51025. According to ANAC 337 Form of 31 October 2014, at the time of the annual overhaul inspection, it had a General Total (TG) of 914.1 hours and D/N (Again) in respect to the Last General Course (DURG), being authorized until 1064 hours of TG.

The fuel required and used was JET A-1.

1.6.2.3 Rotors

Main rotor mark Eurocopter of three blades, model 355A11-0030-04, serial nº 32074-32690-32798. According to ANAC 337 Form of 31 October 2014, at the time of the annual overhaul inspection according to the inspection plan, it had a General Total (TG) of 914.1 hours, with no record of hours respect to the Last General Course (DURG).

Tail rotor mark Eurocopter, model 355A12-0050-10, serial nº 17311. There are no records of flight hours.

1.6.3 Aircraft LQ-FJQ

Figure 6. LQ-FJQ
Serial number 7574, manufactured in France in 2013.

1.6.3.1 Glider

Certificate of Registration of the Civil Aviation Provincial Administration of Santiago del Estero, issued by ANAC in 26 April 2013.

Certificate of Airworthiness Standard, Category Normal, issued in 22 February 2013, in Santiago de Chile, with no expiration date.

According to ANAC 337 Form of 4 April 2014, at the time of the annual overhaul inspection, it had a TG of 218.0 hours and 1034 cycles (Cs), with no record of hours DURG, being authorized until 31 April 2015.

1.6.3.2 Engine

Make Turbomeca, model Arriel 2D, serial number 50233 of 860 SHP. According to ANAC 337 Form of 4 April 2014, at the time of the annual overhaul inspection of the inspection plan it had a TG of 218.0 hours; there is no DURG record; being authorized until 4000 hours and/or 7 November 2027.

The fuel required and used was JET A-1.

1.6.3.3 Rotors

Main rotor with three blades, make Eurocopter, model 355A11-0030-04, serial nº 41257-41320-41344. According to ANAC 337 Form of 4 April 2014, at the time of the annual overhaul inspection it had a TG of 218.0 hours and 1034 Cs. There is no record of DURG hours.

Tail rotor, make Eurocopter; model 355A12-0060-00, serial number 20157. There are no records of flight hours.

1.6.3.4 Other Equipment

The aircraft LQ-FJQ had a Vision 1000 camera.

1.6.4 Weight and Balance of Aircrafts

1.6.4.1 LQ-CGK

Limits of the axial CG:

(+ 3.21 m) to (+ 3.425 m) for 2250 kg
(+ 3.17 m) to (+ 3.457 m) for 2000 kg
(+ 3.17 m) to (+ 3.490 m) for 1750 kg
(+ 3.17 m) to (+ 3.498 m) for 1310 kg
The line of variation goes directly between the given points.

Limits of the lateral CG:

Maximum left	0.18 m
Maximum right	0.14 m

In the calculations made during the investigation, it was established that the weights of the helicopter at the time of the accident were:

Basic weight	1388.4 kg
Pilot's weight / 1 passenger	150 kg
Fuel weight	266 kg
Load weight	50 kg
Weight of 3 passengers	210 kg
Total/W&B form date: 25/10/2010	2064.4 kg

Maximum weight (PM): 2.250,00kg
Difference: 185,60kg (less)

At the time of the accident, the helicopter had its CG at 3.30 m of the *datum* and the weight was 2064.4 kg, a difference in less than 185.6 kg, based on the Weight and Balance Form incorporated to the Flight Manual dated 25 October 2010.

The lateral CG was located 0.01 m to the right of the symmetry axis.

1.6.4.2 LQ-FJQ

Limits of the axial CG:

(+ 3.21 m) to (+ 3.425 m) for 2250 kg
(+ 3.17 m) to (+ 3.457 m) for 2000 kg
(+ 3.17 m) to (+ 3.490 m) for 1750 kg
(+ 3.17 m) to (+ 3.498 m) for 1310 kg

The line of variation goes directly between the given points.

Limits of the lateral CG:

Maximum left: 0.18 m
Maximum right: 0.14 m

In the calculations made during the investigation, it was established that the weights of the helicopter at the time of the accident were:

Basic weight	1390 kg
Pilot's weight / 1 passenger	155 kg
Fuel weight	258 kg
Load weight	50 kg
Weight of 3 passengers	210 kg

Total/Form date: 02/04/2014	2063 kg

Maximum weight: 2.370kg
Difference: 307 kg (less)

At the time of the accident the helicopter had its CG at 3.29 m of the *datum* and the weight was 2063.0 kg, a difference in less than 307.0 kg, based on the Weight and Balance form incorporated to the Flight Manual dated 2 April 2014.

The lateral CG was located -0.039 m to the left of the symmetry axis.

g. Weather Information

According to the data obtained from the National Weather Service (Servicio Meteorológico Nacional, SMN), the conditions on 9 March 2015, at 8:00 pm at the site of the accident, were wind 180/07 kt; visibility 10 km; temperature 31.8 ºC; dew point 19.7ºC; atmospheric pressure 1014.9 hPa; humidity 45%; cloudiness 3/8 SC 600 m.

According to the data obtained from the Buenos Aires Naval Observatory (ONBA), the sun positioning was 43º over the horizon and 294º of azimuth measured from North to East, locating the observer 1.318 meters of elevation.

h. Navigation Aids

The flights were under visual flight rules (VFR).

i. Communications

The investigation could not determine whether communications existed between the aircrafts. The level of destruction and fire of the equipment on board did not permit to compare the frequencies selected in the communication systems of both aircrafts.

Other communication devices besides the ones installed in the aircrafts that could have indicated that there was a link between both aircrafts and/or the aircrafts and the supporting equipment in ground were not identified among wreckage of the aircrafts.

According to what is expressed by the support staff in ground, there did not exist a means of communication between the aircrafts and the support team in ground.

j. Information about Accident Site

The accident occurred within the municipal public land of Villa Castelli, in the Province of La Rioja. The aircrafts LQ-FJQ and LQ-CGK impacted into soft terrain with bushes of about 2 m high, and a distance of 46 m between the two.

The geographic coordinates of the accident site were:

LQ-FJQ: S 29º00´32´´ - W 068º13´09´´

LQ-CGK: S 29º00´36´´ - W 068º13´12´´

Elevation: 1321 meters over the mean sea level.

k. Flight Recorders

The aircrafts were not equipped with voice recorders or flight recorders. Such equipment was not required by the regulations their operations were certified under.

l. Information about Wreckage of Aircraft and Impact

1.12.1 The helicopters collisioned in flight, at a height of between 70 m and 85 m, and with converging paths of about 35°. As a consequence of the collision, both aircrafts plunged to the ground in uncontrolled flight. The distance between both points of impact is of 46 m.

1.12.2 The aircraft LQ- FJQ impacted into terrain with a heading of 055º and a dive angle higher than 70° and less than 90°. There was no lateral displacement. After the impact into terrain, the main mast and engine fell to the right.

The fall of the aircraft LQ-CGK had a steep lateral angle, impacting into terrain with the right side of the cockpit, with no displacement. The aircraft left with a heading of 170°.

There was scattering of the wreckage in the ground in an area of about 200x50 m.

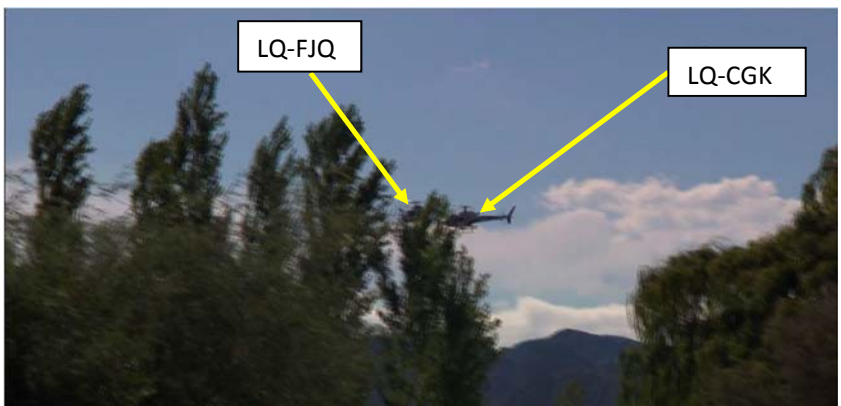

Figure 7. The aircrafts in moments immediately before the in-flight collision

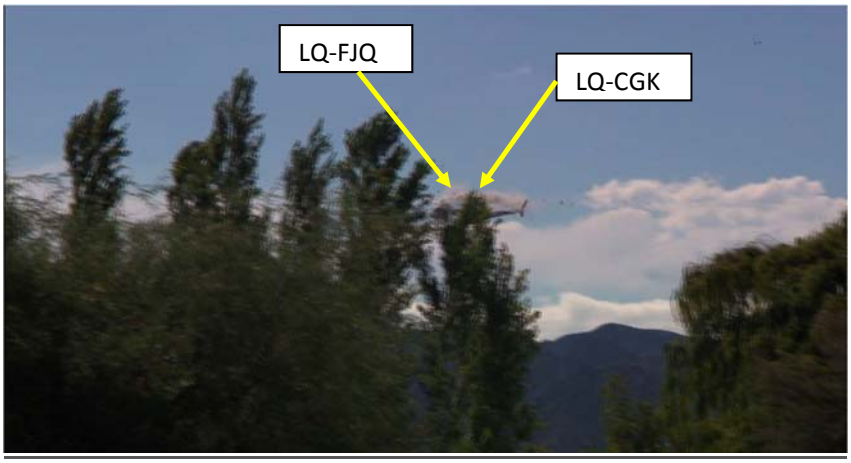

Figure 8. The aircrafts at the time of the in-flight collision

m. Medical and Pathological Information

The investigation did not find medical-pathological evidence in the pilots that could have influenced the accident.

n. Fire

After the collision and once in the ground, both aircrafts got fired.

o. Survival

The crew and passengers of both aircraft suffered fatal injuries.

The investigation could confirm the condition of the seat belts, their anchoring and attachment of seats, due to the wreckage of the aircraft.

In accordance with the documentation of the aircrafts, both would be equipped with emergency locator transmitter (ELT). The condition of the wreckage of the aircrafts did not permit to identify this equipment. None of both ELT got activated as a consequence of the accident.

According to testimonies of the first witnesses that arrived to the site of the accident, the fire-fighting services arrived to the site about 2 hours after the impact of the aircrafts into terrain.

p. Testing and Investigations

1.16.1 Arrival to the Site of the Accident

The field work was done together with accredited representatives, according to the provisions in Annex 13. The accredited representatives included BEA staff (*Bureau d´Enteques et D´analysespour l a Sécur ite d e L´ aviationCivile* from France), the aircrafts' manufaturer (*Airbus Helico pters*), and the power plant manufacturer (*Turbomeca*). The head of the Aviation Provincial Administration of the Province of La Rioja was present but no staff from them participated in the field work.

The site of the accident was preserved and with restricted access by the police authority.

When the investigators arrived to the site of the accident, both aircrafts were destroyed due to the impact and subsequent fire.

Investigators worked together with BEA staff and with the accredited representative's advisors. Different parts of both aircrafts (engine, airframe, rotors and their respective blades, elements of the systems, etc.) were identified. There followed the photographic survey and mapping for the record of the spreading of the wreckage and elements of the aircrafts.

Figure 9. Mapping of the site of the accident

1.16.2 Systems

Despite the impact and fire, the control arms of the rotor blade pitch were in place and stopped.

One control arm of the main rotor blade pitch of the LQ-CGK was observed to be broken.

The markings observed in the engine drive shaft of both aircrafts proved that at the time of impact into terrain the engines were delivering power.

The ELT equipment did not activate in neither of the aircrafts.

At the request of BEA staff, wreckage of the *Digital Engine Control Unit* (DECU), *Ground Proximity Warning System* (GPWS), *Vehicle Engine Monitoring Display* (VEMD), *Flight Data Monitoring System* equipment of each aircraft and the Appareo Vision 1000+ Drivers of the LQ-FJQ were sent to France for analysis.

BEA informed that data could not be extracted from the equipment sent to France since they were seriously damaged.

1.16.3 Fuel

A fuel sample of the movable equipment used to recharge both aircrafts was taken and sent to FAdeA (Aircraft Manufacture in Argentina) for analysis in its lab. The results were the following:

"Conclusions: The sample sent presents a limpid aspect and there are no indications of free water. The detected particles correspond to silicates coming from atmospheric powder. The analyzed sample corresponds with the technical characteristics established in ASTM 1655-13 for fuel Jet A-1. The sample does not show evidence of a reduction and/or loss of physical and chemical properties, thus it is in normal condition of use according to such technical specification. In accordance with the results, the sample corresponds to the kerosene category (fuel not for automobile use), according to Resolution 1283/2006 of the National Energy Secretary, in its annex III, since it defines kerosene as the fuels that present a minimum flashing point of 38 °C, a maximum point of distillation of 300° C and establishes that a minimum of 20% of the volume recovered to 200°C in the distillation curve must be obtained".

1.16.4 Mechanics of Flight

1.16.4.1 Two video records were obtained: “video A” provided by the staff involved, and “video B” available from an eventual observer. Both videos record the accident flight with the cameras located in the ground in an azimuthal angle of about 140º. Besides, the use of the zoom approach in the cameras used for the records is appreciated.

With the data obtained in the filming, the path of both aircrafts from the time of takeoff until the moment of impact was reconstructed.

The calculations of separation between both helicopters were made, taking as the starting point the section traveled by the aircraft LQ-FJQ from its left turn, 6 seconds before the impact.

The arc of circumference traveled by such aircraft in 3 seconds at a speed of 65 kt and with a stable bank of 15° was obtained (other 3 seconds were considered as the required to impose the bank). The calculations of the distance traveled corresponding to the arc are detailed in Annex A.

As a result of this investigation, it was determined that the separation between both aircrafts, 6 seconds before the impact, was between 90 and 100 m. It is assumed that this separation was the one kept by the aircrafts in their paths.

There were variable relative positions in the path due to the *deliberately* positioning of the aircraft that was filming in order to achieve the desired perspectives.

1.16.4.2 Flight Paths

The takeoff was individually made with a difference of 45 seconds between both aircrafts.

The helicopter LQ–FJQ (Red color for graphic purposes), was the first to take off; on board were a coordinator in the left front seat and three members of the filming team at the back of the cockpit. The photographer was at the left back, with the door open to fulfil his filming task. The aircraft took off with heading 010° climb until about 70 m and 85 m high and kept a speed of about 60/70 kt, positioning itself to the right side of the other helicopter during all the proximity flight path.

The helicopter LQ–CGK (Blue color for graphic purposes) took off in the second place. This helicopter was being filmed. On board were a photographer in the front left seat and three members of the competition team *Reality Show Dropped* at the back of the cockpit. It took off with heading 010° climb until about 70 m and 85 m and kept a speed of about 60 and 70 kt, positioning itself at the left side of the other helicopter during all the proximity flight path.

After about 50 seconds of the flight, the helicopter LQ–FJQ (Red), that was fulfilling the filming task, initiated a gentle left turn keeping level, decreasing its speed, and positioning itself diagonal, with a separation of about 90 and 100 m (Figure 10) and in front of the helicopter LQ–CGK (Blue), that initiated a left turn.

Both aircrafts continued the flight, making a left turn. The separation and speed parameters suggest irregular paths.
After of about 75 seconds of flight, LQ–FJQ (Red), with the filming task, repeated the diagonal positioning maneuver with a decrease in speed and same separation of the LQ–CGK (Blue).
After about 90 seconds of flight, LQ–FJQ (Red) delayed in its path due to its decrease in speed, change attitude increasing speed.

After about 94 seconds of flight, LQ–FJQ (Red) increased its bank towards the left in a collision course with LQ–CGK (Blue), which at this moment was decreasing the turn-speed relation.

After about 100 seconds of flight, LQ–FJQ (Red) crashed LQ–CGK (Blue), both main rotors made contact and both aircrafts plunged to the ground.

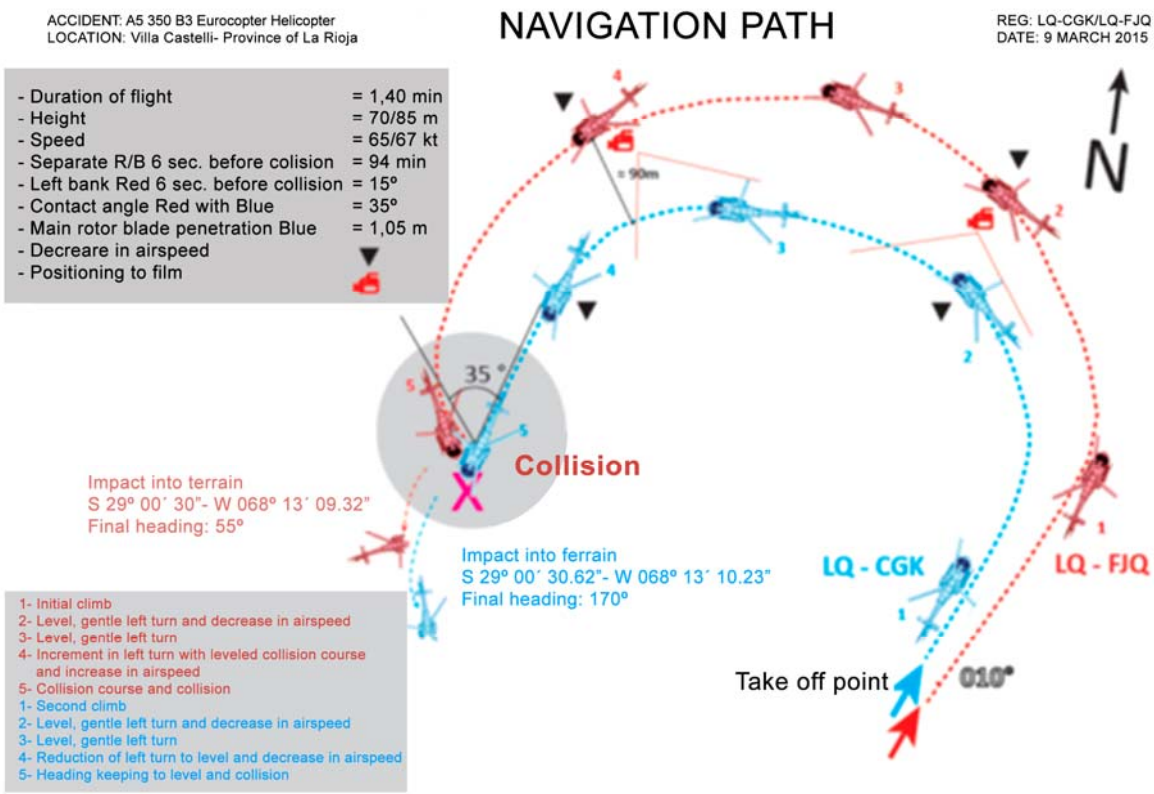

Figure 10. Estimated flight path of the helicopters

1.16.4.3 Visibility in Cockpit

After a second the aircrafts were about 25 and 35 m of the collision point and there was a difference of about 20/30 m between the two. In a right angle of about 70º, the LQ-CGK pilot could have seen about 25% of the total surface of LQ-FJQ, since at the direction of his line of vision there was the structure that divides the front right windshield from the right door window.

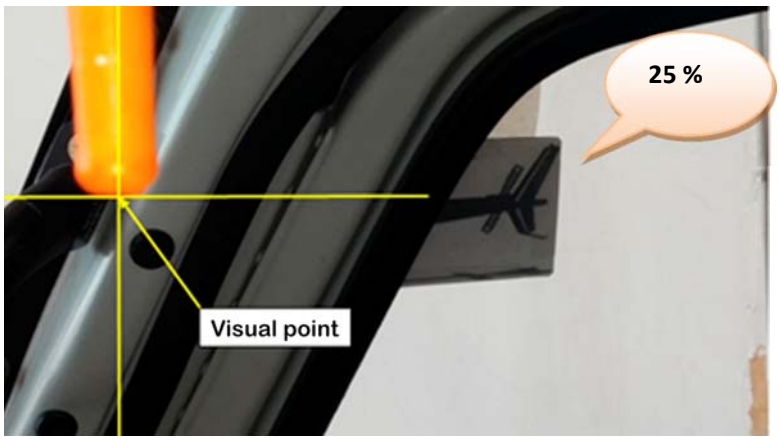

Figure 11. Line of vision from the LQ-CGK pilot's position

One second before the impact, with a bank of about 10/15º and an angle of about 70º to the left, the LQ-FJQ pilot could have roughly seen a 20% of the totality of the LQ-CGK, since in the line of vision of the pilot's position there was the top front structure, the left windshield and the left door window.

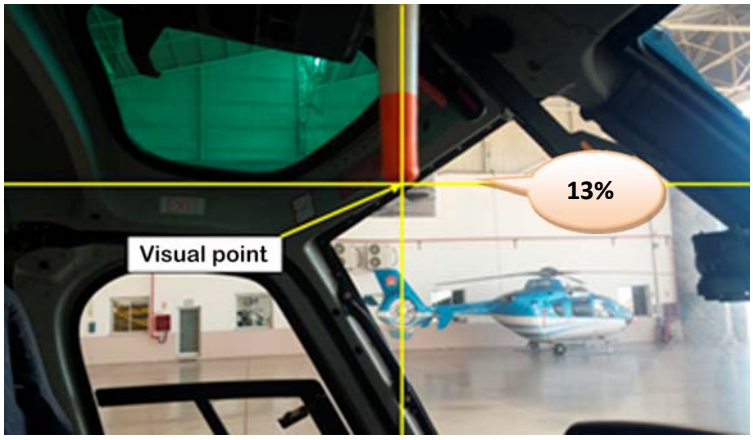

Figure 12. Line of vision from the LQ-FJQ pilot's position

1.16.4.4 Geometry of Collision before Impact

For reasons of precision of filming evidences, the following parameters were obtained, taken as reference for all calculations 1 second before the impact:

- The relative angle of the vision between both pilots was of about 70°;
- The estimated navigation speed of the aircrafts was between 60 and 70 kt;
- The separation between both aircrafts was between 20 and 30 m;
- The approximate approaching speed between both aircrafts was 20 m/s (40 kt).

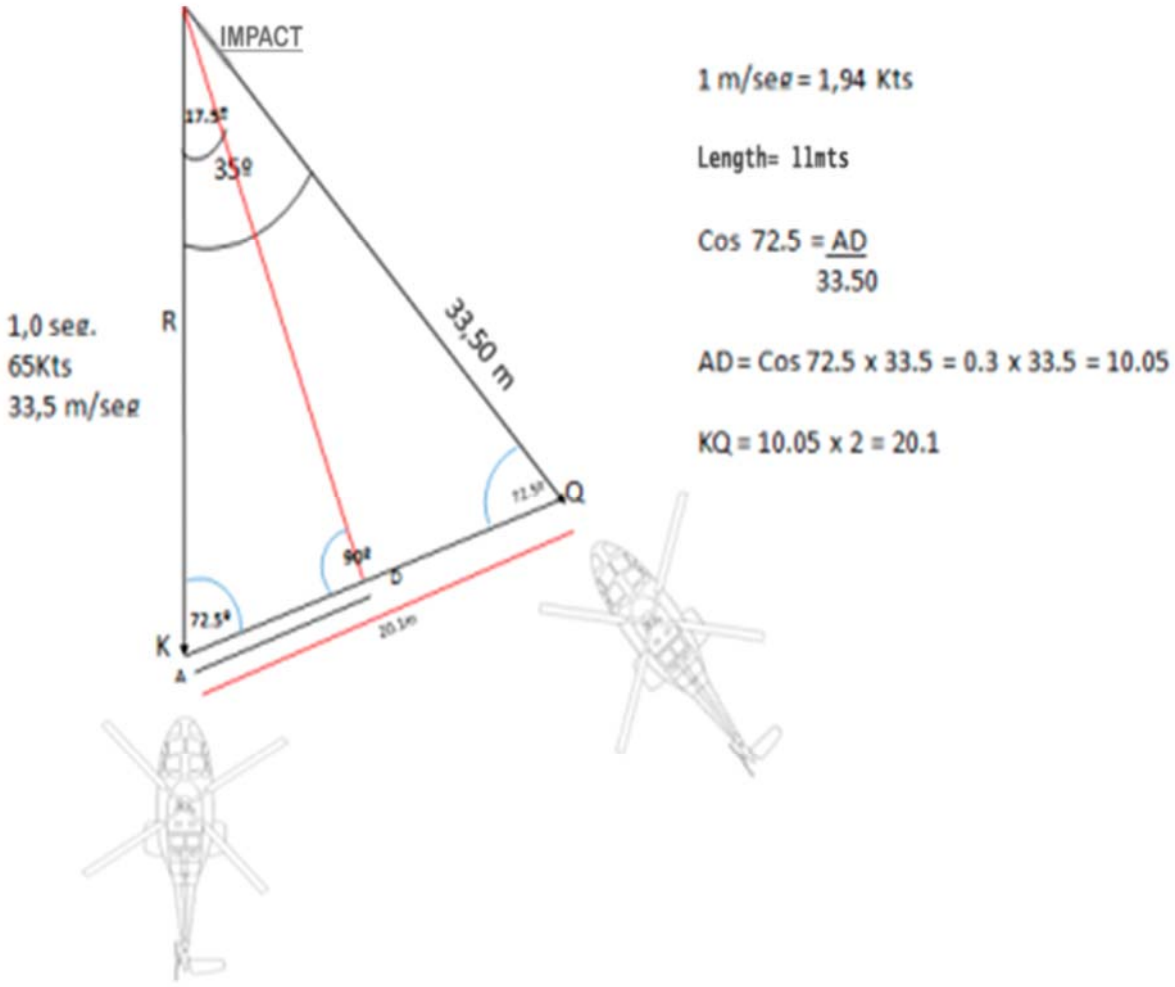

Figure 13. Geometry of the collision

1.16.4.5 Collision

The course of LQ-FJQ got into conflict in relation to the position of LQ-CGK 6 seconds before the collision.

From filming data it was observed that seconds before the collision there was taper ratio of the LQ-CGK (Blue) main rotor, that cut off one of the control arms of the LQ–FJQ (Red) main rotor pitch. The situation was probably fortunate due to the taper ratio of the LQ–FJQ (Red) main rotor. Both aircrafts were left with no collective command and cyclic pitch control since both rotors were mutually damaged by contact.

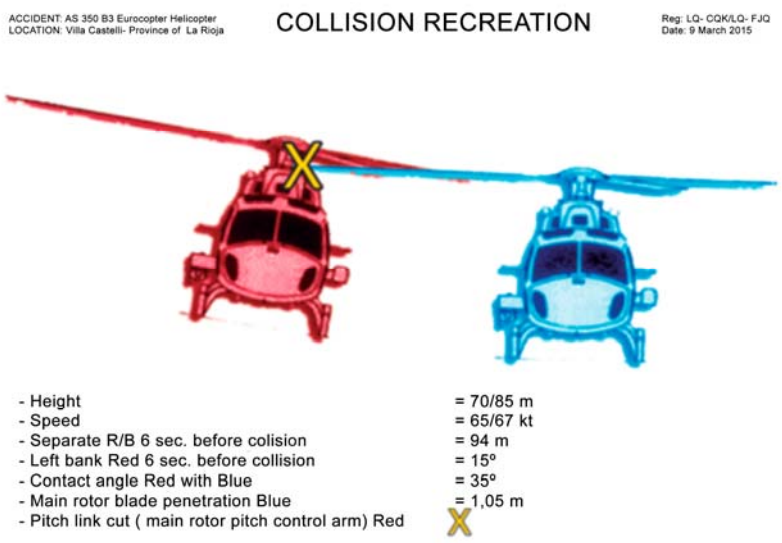

Figure 14. The collision between the helicopters

1.16.4.6 Fall and Impact into Terrain

LQ–FJQ (Red) collapsed vertically, with a left yaw due to a loss of anti-torque effect[2], which produced the impact into terrain with a steep angle of dive, and next fire.

[2]*The action created by the main rotor system turning will make that the fuselage turn in the contrary direction to the turning direction of such rotor. The tail rotor generates the anti-torque effect to counteract the torque maintaining the control of the aircraft.*

Among the wreckage were the turbine, main gear box and main rotor shaft with displacement towards the front and right of the direction of the impact. The main rotor blades were cut off by the contact of both main rotors.

One of the control arms of the main rotor pitch was cut off by a main rotor blade of the LQ-CGK (Blue) helicopter. The tail cone and tail rotor were recognized for their condition (minor damage and not burned located in the adjacent position to the wreckage in the cockpit).

The LQ–CGK (Blue) helicopter plunged with a horizontal displacement and fell to the right lateral, impacting into terrain and getting fire. Among the wreckage it was observed that the main rotor blades were cut off by the contact of both main rotors.

Taking into account the approximate heading of the aircrafts at the time of the collision and the final direction of the wreckage in the ground (LQ-FJQ heading 055° and LQ-CGK heading 170°, this variation in the heading of the aircrafts was produced as a result of the yaw towards the west of them caused by the loss of the anti-torque effect.

In the filmic documentation obtained, the mechanics of the fall of both helicopters until about two seconds before the impact into terrain was observed.

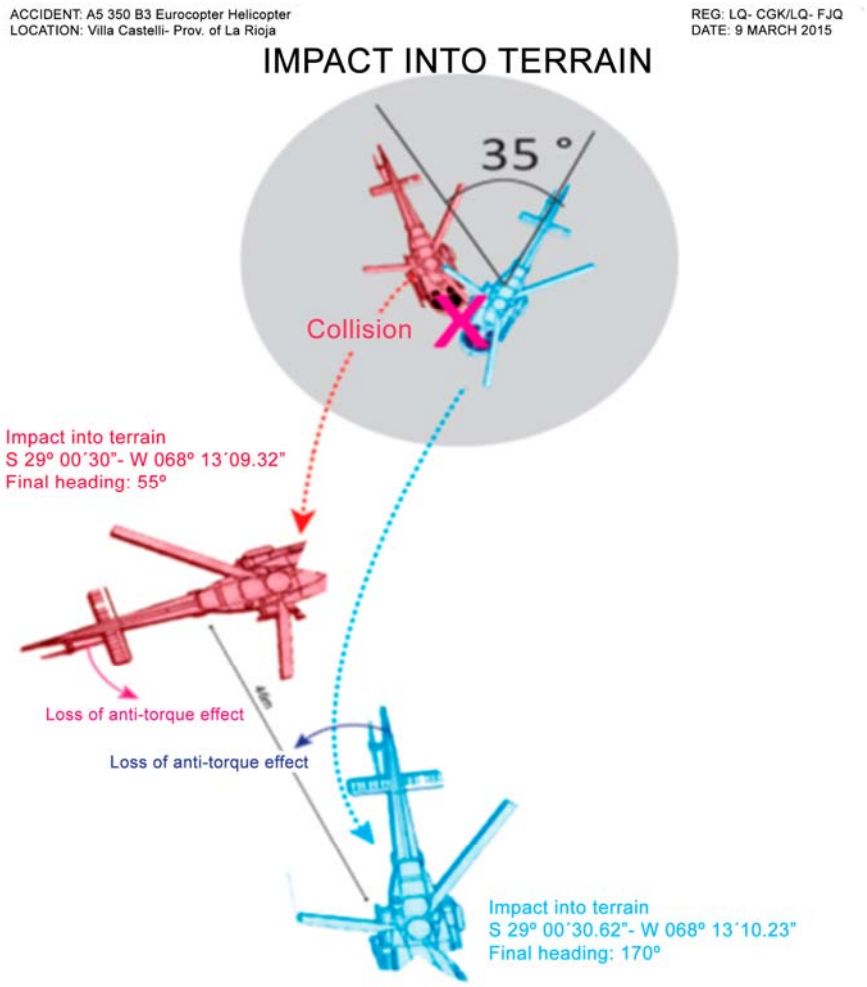

Figure 15. The impact into terrain

1.16.4.7 Analysis of Video A (Take-off Area)

This video shows that in the helicopter LQ-CGK the left seat was occupied by a photographer, side-sitted, with a clear attitude of recording the passengers on the back seat. Even though this position, his legs, and then his filming equipment could have obstructed the pilot's collective pitch control, making it difficult to control the aircraft, this possibility was discarded considering that none of the videos shows that LQ-CGK had performed an evasive maneuver.

It can be observed that, during the take-off, LQ-FJQ's left door, according to the task to be performed, was open so that the photographer could record the other aircraft flight and its environment, without deteriorating the image quality due to the window.

Once the helicopters take off, it can be observed that LQ-FJQ is performing a manoeuver to position itself at a relative position to film LQ-CGK.

When LQ-CGK overtakes it, LQ-FJQ flies behind and over LQ-CGK. This manoeuver makes FJQ reduce its speed. Then it is observed that FJQ lowers its nose, indicating a speed increase, in an apparent attempt to stay close to LQ-CGK, to do the filming during the flight.

The slight vertical oscillations observed in both aircrafts are caused by the manual movement of the camera, and not by occasional turbulence.

During the path previous to the accident, LQ-FJQ reaches LQ-CGK and overtakes it, positioning ahead of it, to the right, slightly over it.

Figure 16. Relative position of the helicopters previous to the collision

Finally, LQ-FJQ makes a very slight turn, slightly yawing (with the right pedal), and with a low descent, which reduces significantly the separation in relation to the LQ-CGK path. This provokes the impact of one of LQ-CGK's blades against one of LQ-FJQ's pitch controls. This resulted in the pilots losing control of the aircrafts and plunging to the ground without control.

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Figure 17. Image of the impact between the helicopters

1.16.4.8 Analysis of Video B

In this record, the aircraft path is more perpendicular to the camera that is filming, therefore, the relative distance between both helicopters is less apparent due to the filming perspective.

Figure 18. Image of video B

It can be observed that the attitude (position) of the helicopters is not parallel in the video. The causes of this can be: that the aircraft paths are convergent, or that one of the two helicopters has deliberately kept a yaw.

At the moment of the crash, the fuselage shadow of LQ-FJQ turns completely dark, because LQ-CGK fuselage is blocking the sunlight.

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Figure 19. Image of the impact from another position

It can be observed in both videos that none of the aircrafts performs evasive or defensive maneuvers before the collision, which indicates a deficit in the visual acquisition of the other aircraft by both pilots.

It is plausible to hypothesize that the photographer's need of recording the images could have influenced the pilot's distributive vision control, or even caused distractions.

It is also probable that, due to the relative position of the aircraft before the collision, the sun may have affected LQ-CGK pilot's vision of LQ-FJQ.

Simultaneously, the LQ-FJQ pilot did not have a right reference of separation in relation to LQ-CGK because, apart from the photographer's position in the cabin, CGK approached it from its "blind angle".

With the limitations of the image quality and trying to reduce the perspective effect, it can be observed that the fuselage of the helicopter closer to the camera (in video B) takes 0.5433 seconds to "go over" the distance of "one"

fuselage [average obtained from three measurements: 0.53 s; 0.60 s; y 0.50 s]. Considering the fuselage length of 10.93 meters, we get the ground speed of 39.1 kt. This value is just a reference and it cannot be deemed to be the air speed, as it can be observed from the surrounding vegetation in both videos, both aircraft had headwind. Therefore, the ground speed would have been inferior to the one indicated by the helicopters' speedometers.

By setting up a scaled action based on the images, at the moment of the crash, it can be inferred that the helicopters were at a height of approximately 70 to 85 m over the ground.

In the video B, which has a simultaneous audio record, the sound of the crash is heard 1.40 seconds after the image. This means that the camera, at the time of the collision, was 480.20 meters away from the helicopters (this calculation takes into account that the sound speed is of 343 m/s in standard conditions over sea level; with 50% relative humidity; and 20º C air temperature).

q. Administrative and Organizational Information

1.17.1 The Aviation General Administration of the Province of La Rioja has a simple structure.

It has an aviation director in charge of six airplane pilots and three helicopter pilots (including the dead pilot).

It does not have an operator certificate since its aircrafts are registered as public aircrafts (LQ). The operations are regulated under RAAC 91 – *Flight Rules and General Operation.*

Although it is not a requirement of the regulations this organization is certified under (RAAC 91 – *Flight Rules and General Operation*), the Aviation General Administration of the Province of La Rioja has implemented a safety management system (SMS), whose responsible manager is the aviation director. The aviation director is in charge of a safety manager (GSO), that implements and keeps the SMS of the organization.

The damaged aircraft had been incorporated about four years ago, the same as the dead pilot and the maintenance mechanic.

1.17.2 The Civil Aviation Provincial Administration of Santiago del Estero is an autonomous organization with its own budget. It has 10 aircrafts and own economic-financial and legal advice. It contributed with the helicopter and crew through a reciprocity agreement with the Province of La Rioja.
It does not have an operator certificate since its aircrafts are registered as public aircrafts (LQ). The operations are regulated under RAAC 91 – *Flight Rules and General Operation.*

1.17.3 At the time of the accident, there existed a reciprocity agreement between the two governmental organizations for the air collaboration in different tasks including the promotion of tourism. The operation that triggered the accident had been classified by the governmental organizations as “promotion of tourism”.

r. Additional Information

1.18.1 According to the aircraft documentation, both aircrafts had the ELT equipment installed.

1.18.2 The National Registry of Radio Baliza informed that, at the time of the accident, the ELT equipment of both aircrafts were not registered.

1.18.3 Take-off Performances

None of the aircrafts had performance limits for the weight and altitude (7000 feet) at the time of the accident, according to information from the Flight Manual.

1.18.4 Antecedents with Aviation Provincial Authorities

Even though this accident has specific characteristics, it is a relevant antecedent the accident of a public aircraft belonging to the Aviation Provincial Administration of San Juan on October 11, 2013. To this respect, the following recommendation is part of the JIAAC final report about the accident;

“*4.1 To the Aviation Authority - ANAC*

4.1.1 The recommendation is supported by the fact that the operations must be considered, planned and carried out within a regulatory framework, which shall serve as a guide so that any individual risk assessment that proves inappropriate (as it may happen in a flight planning and preparation), will immediately show a deviation from the security parameters established by said documents. In view of the forgoing, it is recommended that the following requirements are implemented in the air operations of the Aviation Provincial Administrations based on the RAAC 91 and 135 framework, so that they: 1. Develop an Operations Manual that covers the scope of their operations. 2. Implement a Safety Management System (SMS) suitable for its organization and types of operations. 3. Put into operation a Training Programme compatible with the operational demands, including the most complex ones. 4. Include the Standard Operating Procedures in the Operations Manual (SOPs).

4.1.2 In view of the specificity of the operations conducted by the Aviation Provincial Administrations, it is recommended that they study the possibility of developing specific regulations that control its operations and also the 19

training systems, documentation and structures organization; with the aim of standardizing this activity at a national level.

4.2 To the Organization

4.2.1 The operations should be considered, planned and conducted within a regulatory framework, which shall serve as a guide, so that any individual risk assessment that proves inappropriate (as it may happen in a flight planning and preparation), will immediately show a deviation from the security parameters established by said documents. In such a case, the risk would be immediately considered unacceptable and the operation would be re-planned and/or cancelled. The pilot is not the only component in the operational context; therefore, the approach adopted was to relate the operational actions or inactions of the occurrence within the operational context. In view of the foregoing, it is recommended: 1. To create an independent ground transportation structure, with driving personnel sufficiently qualified who can be in charge of planning, conducting and controlling air operations (operative and maintenance), and to educate and train the personnel. 2. To develop an Operations Manual that covers the scope of its operations. 3. To implement a Safety Management System (SMS) suitable for its organization and types of operations. 4. To put into operation a Training Programme compatible with the operational demands, including the most complex ones. 5. To include the Standard Operating Procedures in the Operations Manual (SOPs)."

1.18.5 Operational Requirements

The take-off slot did not have any services attending the place (fire-fighting services and ambulance). However, according to RAAC Part 91 – Flight Rules and General Operations, Annex H – General procedures for helicopters, general flight rules, the following applies:

14. Flight operations (a) Proper services and facilities: The pilot in command shall not begin a flight unless it has been previously determined by all available and reasonable means that the facilities and ground and/or maritime services available and necessarily required during this flight, and for the operation of the helicopter, are adequate, even the communication services and facilities and the navigation aids.

1.18.7 Other Statements

The investigation received the opinion of pilots from a private company who had made similar flights in Patagonia, with the same film team who chartered the flights that ended up in this accident, a week before the accident.

The interviewed pilots expressed that –occasionally- the photographers would make remarks during the flight, asking for specific maneuvers, as they made comments on the positions that the aircrafts should take.

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1.18.8 Training of Support Staff

The investigation did not receive any evidence that could support that the photographer staff and ground support to the aerial filming had received information on basic safety issues that could have warned them about operational needs and specificities.

1.18.9 Airworthiness Directives Issued by Foreign Aviation Authorities

1.18.9.1 AAC 39 – *Airworthiness Directives*, Sub part C, 39.15 establishes that the airworthiness directives considered binding by the civil aviation authority of the country holding the original valid type certificate, shall be deemed as Argentine airworthiness directives.

1.18.9.2 In the case of the aircrafts involved in the accident, the state of design of both helicopters and their engines is France. Both aircrafts were registered in the National Aircraft Registry of the Argentine Republic and held Argentine registrations. Therefore, the ADs issued by the *European Aviation Safety Agency* (EASA) were binding, as well as the applicable ones issued by the ANAC.

1.18.9.3 Regarding LQ-CGK, the comparison of the list of ADs issued by EASA with the information provided by the owner indicates the following discrepancies:

- EASA AD 2009-0256 enforcement record. The document presented declares that the AD was implemented on 31 October 2014; however, this AD was replaced by the EASA 2013-061 AD (this AD is not listed in the document presented), which was in turn replaced by the EASA 2013-0191E EAD (*Emergency* AD) (this AD is also not listed, nor analyzed).

- FAA AD 2014-07-52 enforcement record. This AD issued by FAA adopts the EAD EASA 2014-0076E but with differences in the requirements.

- FAA AD 2014-05-10 enforcement record. This AD issued by the FAA adopts the EASA AD 2013-0029 but with differences in the requirements.

s. Useful or Effective Techniques of Investigations

Routine techniques were applied.

2. ANALYSIS

t. Introduction

The triggering factor of the accident was, according to the information obtained during the investigation and its analysis, the pilots' lack of perception of the closeness or the deficit in the separation between their respective aircrafts. This lack of perception led to the air collision of the aircrafts without attempting any evasive or defensive maneuvers.

The limitations under which the technical and operational investigation was completed, due to the lack of protected data recording devices or cockpit voice recorders, proved the need to make a great technical-operational analytical effort to make up for the absence of technology. This effort, complemented by essential Human Factors knowledge, allowed to create a clear picture of the situation regarding the circumstances of the accident; what happened, and how it happened. These aspects of the investigation are reflected in the first part of this analysis section.

As important as defining what happened and how it happened, is to define why it happened: that is, the root causes of the accident. To that end, the analysis of the defenses and the systemic factors underlying the circumstances that triggered the accident is essential. These aspects of the investigation are reflected in the initial part of this analysis section.

2.1.2 Technical-Operational Aspects

General Scene of the Operation

The aircraft operation had been scheduled to be a filming flight for a sports competition. According to plans, the flight consisted of an initial orbital flight over the take-off area, and then going to a final spot where the participants in the television show would finally descend.

The beginning of the operation had been scheduled for approximately two hours before, but it had to be rescheduled due to meteorological factors.

The purpose of the flights was that LQ-CGK filmed LQ-FJQ. For that, a photographer was on board LQ-CGK, in the front left seat, next to the pilot, and another photographer was on board LQ-FJQ, in the passenger cabin with the door open, who would film LQ-CGK.

The operation was conducted in an arid and dusty environment located in an area near The Andes pre-mountain range, with ambient temperatures close to 89º F. Due to the specific characteristics of the operation, outside a formal

airfield perimeter, the ground did not have any operational references and markings.

On board each aircraft were participants of a television programme and a photographer recording the events. The lack of protected data recording devices or cockpit voice recorders does not allow to draw any decisive conclusions regarding potential distractions that the pilots may have experienced due to the presence of the passengers and photographers. Even though it could not be confirmed, it is plausible to hypothesize that the cabin environment described could have negatively contributed to the pilots' visual acquisition of the flight path as well as the communications.

In both aircrafts the photographers had the objective of making the best filming. Even though it could not be confirmed, the question about up to what extent the filming imperative generated pressure on the pilots to locate the aircrafts in the most favorable conditions for filming is open.

The LQ-FJQ cabin suffered an even greater contamination, since the aircraft had the door open. Even though it could not be irrefutably determined that there had been a direct relation with the accident, factors like the engine noise, the environmental noise and the photographer´s location standing in the cabin filming could have potentially affected the internal communication and the pilots' concentration.

There are other additional factors, which, even though it could not be accurately determined whether they had been directly related to the event, bear a high disruptive potential regarding the operative performance. The first factor is related to the low altitude flight. This particular type of operation demands great concentration by the pilots, who have to split their attention in the internal monitoring of the cabin and the external monitoring of the operational environment. This can be translated into an increase of the workload, which can lead to an operational performance deficit. The operation they were performing is representative of this kind of situations, exacerbated by the fact that it was a single-pilot operation, and under the conditions of potential distraction as mentioned in the above paragraphs.

The second factor is the possible time pressure in relation to the show production, which had been delayed. This could have contributed to the accumulation of factors of potential operative pressure, as expressed above, due to the need for fast filming.

The lack of perception of the visual references is factual data clearly arising from the accident filmic records, which shows that none of the two aircrafts tried to perform an evasive or preventive maneuver upon the proximity of the other.

Environmental Context

Conditions of the Operational Area

The site where the aircrafts operated was an unreported place, whose operational aptitude was given by the operator following the exception for public helicopters (RAAC 91 – Appendix H). However, it could be concluded that the obstacle area was not a limitation for a normal operation.

The documentation obtained and the interviews conducted confirmed that the rescue and fire-fighting services were not present in the operational area.

Due to the type of take-off, landing and operational area, there was no air traffic control nor related communications. There is no evidence of communications between the aircrafts.

Visual Acquisition – "See and Avoid" Concept

The "see and avoid" concept is a method to separate and avoid the collision between two aircrafts.

The filmic observations and analysis performed establish that probably there was no visual acquisition between both aircrafts until the instant previous to the impact.

The next two factors might have threatened the effective application of the "see and avoid" concept:

- Internal cabin work (contaminated cabin); and
- Limitation in the pilot's external visibility from the cabin.

Evasive Manoeuvers

Approximately 12.5 seconds are required to notice an approaching aircraft, to evaluate the situation and to perform the evasive manoeuver. This time varies from person to person; for those with less experience and older in age, the time range can be wider.

The characteristics of this collision suggest that the pilots did not have enough time to start evasive maneuvers.

Impact Speed/Relation of Approach between Aircrafts

The accident analysis shows that the approach speed between the aircrafts was 40 kt provoking an impact with a kinetic energy corresponding to the stated relative speed, causing serious and significant damages to the aircrafts.

Analysis of the Components Sent to BEA (France*)*

The components of the aircraft wreckage sent to the BEA do not provide additional evidence on their functioning at the time of the occurrence.

Preliminary Analysis of BEA's Investigation

Bea's preliminary report concludes that there is no evidence about technical failures previous to the impact.

BEA's Analysis about Aircraft Path and Functioning of Engines

The analysis of the filming allows to identify that 6 seconds prior to the collision LQ-FJQ started a turn towards the left, whose path interferes with LQ-CGK's.

The spectrum analysis of the audio of the two filmings did not show any anomalies related to both aircraft's propulsion systems.

2.1.3 Regulatory Framework Analysis

The Regulatory Framework

It is of particular relevance to take the regulatory framework into account in the analysis of this accident. Regulations are a fundamental defense in the aviation system. A contextualized analysis of the specific regulations applied to a type of aircraft register (public aircrafts), and its extension to the circumstances of this accident, suggest that a discrepancy between the conception of such regulations and its application became a systemic factor in the origin of the accident.

The Regulatory Framework of Provincial Aviation Administrations

The Convention on International Civil Aviation (the Chicago Convention), to which the Argentine Republic is signatory, in Article 3 states:

Civil and State aircraft

a) This Convention shall be applicable only to civil aircraft, and shall not be applicable to State aircraft.

b) Aircraft used in military, customs and police services shall be deemed to be state aircraft.

The Argentine Republic transfers this principle in article 2.339 of Act Nº 340 (Civil Code of the Argentine Republic) and in article 37 of Act Nº 17.285 (Aeronautical Code of the Argentine Republic), according to which *"aircraft are public or private; those aircraft for public service are public aircraft, the rest are private even if they belong to the State."*

The Argentine aviation legal system presupposes that public aircraft shall be used by their respective owners in duties of common interest, of general wellbeing and/or community service. The aforementioned includes tasks such as medical assistance, public safety, crime prevention or repression, justice assistance, public health, penitentiary transfers, land registry, protection of economy, and tax evasion control. Therefore, public aircrafts are authorized to deviate from the air traffic and general operation rules established for the rest of the aircrafts. Furthermore, they are unseizable, imprescriptible and inalienable, as any public property. This implies economic and tax advantages for the acquisition of materials, equipment and spare parts for maintenance. .

To make the difference between public and private aircrafts evident, Decree Nº 4.907/73, which regulates the National Aircraft Register, mandates in article 12 the adoption of different national identification prefixes for each type. Private aircraft are identified with a register that starts with the letters “LV”, while the public ones are registered with the registration prefixes “LQ“.

In the transposition of article 3 of the Chicago Convention to the national legislation, the Aeronautical Code of the Argentine Republic moves slightly away from the principle supported by the former regarding the classification of an aircraft as public or private, by applying a criteria based on the use of the aircraft regardless of its identification prefix (LV or LQ). The regulation takes a functional approach to consider an aircraft as public or private: an aircraft is public only when it is used to serve pubic authority. In other cases, it is not considered “public”, even if the aircraft in question belongs to the State, its divisions or related bodies. According to the Aeronautical Code, it is not the quality nor the condition of the owner what defines the category of the aircraft, but the specific function that each has[3].

The aforementioned bears a practical significance of importance to the application of the regulatory framework: whenever an aircraft, regardless of its identification prefix or the proprietor, performs operations that are not related to the service of public authority, it should operate under the regulatory framework applied to private aircrafts for the operation in question.

The two aircrafts involved in the accident under analysis were registered as public aircrafts. They were provincial aviation administrations’ aircrafts in the Argentine Republic. The regulations applicable to public aircrafts, among others, are: RAAC 1 (Definitions), RAAC 18 (Transportation of Dangerous Goods), RAAC 61 (Pilot Licensing), RAAC 63 (Crew Member Licensing,

[3] When the Aeronautical Code of the Argentine Republic was sanctioned, the State sent the corresponding notification of misalignment to the International Civil Aviation Organization (ICAO), without affecting the harmonious application of the Chicago Convention.

excluding pilots), RAAC 67 (Medical Certification) and RAAC 91 (Flight and General Operation Rules).

Previsions under RAAC 91 are of particular interest in this accident, taking into account that they have different requirements from those in RAAC 135, the equivalent regulations applicable to aircraft like the ones involved in this accident, if they have been registered as private aircraft and used in non-regular transportation or aerial work (with LV registration).

Therefore, the aircrafts involved in the accident, having not been registered in commercial aviation, were not subject nor bound to those licensing requirements, to having specific operation manuals, training requirements, minimal equipment and of the sort required for private aircrafts registered as air commercial aviation function.
The situation that actually happens in the Argentine civil aviation system is that aircrafts registered as public are used for aerial operations with no relation to that condition, under regulatory requirements more lax than those required from similar aircrafts that perform similar operations, but registered as private.

The aforementioned is a systemic factor potentially detrimental to safety. This is because the implementation and observance of regulations and procedures (a fundamental defense of any aeronautical system) that exceed the simplest and most basic requirements applicable to public aircrafts depend, mostly, on the operating organizations' willingness to adopt them, without enforcement or control by the aeronautical authority, since those aircraft were not registered as intended for commercial operations.

There is a dissimilar situation in the context of operation of the provincial aviation administrations. In some cases, there are LV and LQ aircrafts in the same provincial administration. Certain administrations have certified their provincial aviation according to RAAC 135, with safety criteria and standards suitable for passenger transport, medical air transport services and the sort, while others have not done so. The tendency is to keep aircrafts with public registration because of its flexibility regarding tax requirements, regulations requirements and controls by the aeronautical authority.

The conclusion of the aforementioned is unequivocal: the aircrafts involved in the accident, their operation and crew should have observed the requirements established by the RAAC 135 for the specific operation that they were conducting. A factual situation, recurrent in the Argentine aviation system, generated a scene where aircrafts and crew were used for activities that were outside their regulatory certification spectrum, weakening the regulations' role as essential defense of safety.

In the accident under analysis, two aircrafts whose public identification prefixes (LQ) imply their operations are for the service of the community, were used to provide logistics and aerial support for filming, a strictly private operation. The

operation of the aircrafts is clearly stated in article 132 of the Aeronautical Code and its regulatory decree 2836/71 as Aerial Work. According to this regulation, this type of activities can be performed only by those companies authorized by the applicable authority by the issuance of the corresponding Air Work Operator Certificate (CETA). This condition was not complied with in the operation that generated the accident, becoming a systemic factor leading to the accident.
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Regulations Applicable to Flight in Close Proximity between Aircrafts

The flights that led to the accident were flights operated in close aircraft proximity. RAAC 91. 111 (a) and (b), establishes that the flight in proximity between two aircrafts should not be done in a distance lower that 150 m. RAAC 91.111 (c) and (d) authorizes formation flights, but, among others, the following considerations prior to its realization:

- The pilots operating the flight should sign an agreement;
- The signed agreement should be given to the Aeronautical authority; and
- It is forbidden to perform formation flights with passengers on board.

The evidence of the investigation confirms that the RAAC 91.111 previsions were not observed.

3. CONCLUSIONS

3.1 Defined Facts

3.1.1 At the time of the impact into terrain, both helicopters' engines were delivering power.

3.1.2 There is no evidence of technical failure in any of the two helicopters that could have contributed to the accident.

3.1.3 Aircraft LQ-CGK did not comply with the airworthiness requirements as in RAAC 39, since it did not comply with ADs as specified in RAAC 39.15. The lack of compliance with ADs did not have an influence on the triggering of the accident.

3.1.4 The weight and balance of both helicopters were within the operational limits specified in their respective flight manuals.

3.1.5 The pilots had the aeronautical licenses and aviation medical certifications to perform the flights.

3.1.6 The pilots had the flight experience necessary to perform air operations in helicopters.

3.1.7 There were no records of the pilots´ training for flight in proximity like the one that turned into the accident.

3.1.8 The meteorological conditions did not influence the performance of the aircraft nor the accident.

3.1.9 The flight was conducted at low height, with proximity between the aircrafts for filming purposes.

3.1.10 Even though it was not possible to establish with certainty, the relative position of the aircrafts in relation to the sun could have caused bedazzlement in the LQ-CGK pilot.

3.1.11 At the time of the collision, LQ-CGK was in a blind spot of LQ-FJQ pilot.

3.1.12 It could not be established with certainty whether there had been distraction factors inside the cabin that may have contributed to the accident.

3.1.13 There are antecedents of similar operations in which the photographers acted, unintentionally, as a distraction factor in the pilots' performance.

3.1.14 The flight that turned into an accident had been delayed. It could not be established with certainty whether the delay generated pressure on the television show production people to fulfill the flight and the filming, which could have contributed to a reduction in the attention level.

3.1.15 The convergence paths of the aircrafts were not detected by the pilots.

3.1.16 It was not observed that any of the pilots had performed an evasive maneuver prior to the impact.

3.1.17 There were no medical disability signs in the pilots that could have influenced the accident.

3.1.18 The flights performed by the pilots during the previous days do not imply operational fatigue as a contributing factor.

3.1.19 The pilots were adapted to the weather of the place, and familiarized with the geography of the place where they performed the operation.

3.1.20 None of the aircrafts had performance limitations for the weight and pressure altitude of the operation at the time of the accident.

3.1.21 There were no internal procedure records issued by the organizations operating the aircrafts about the specific training for the tasks that the crews were performing in the flights that turned into the accident.

3.1.22 The operation of the aircrafts involved would be in the framework of the concept of aerial work, which differs from the operations authorized for public aircrafts.

3.1.23 It is not unusual that in the Argentine aeronautical system operations with public aircrafts that require the certification for private aircrafts are performed.

3.1.24 There are safety recommendations issued by the JIAAC related to the need for establishing specific regulations for the operation, training and safety management of the provincial aviation administrations.

3.2 Conclusions of Analysis

In an operation classified as aerial work, which involved the transport of passengers and air-air filming activity, there was an in-flight collision between the two participating aircrafts. The collision was caused by the combination of the following factors:

- Location of the helicopter that was filming (LQ-FJQ), from the “outside”, in the path of both aircrafts, that significantly limited the visual contact of the pilot who had to move forward in flight in order to film the target (LQ-CGK);

- Lack of a formal assessment of the safety risks for an unusual operation (filming and flight in proximity), which prevented the identification and analysis of the dangers inherent to that operation, and the adoption of mitigation actions, requirement not required by the current regulations;

- Deficiencies in the operation planning that led to the accident, including the failure of observing the “see and be seen” concept or an evasive maneuver if visual contact is lost between both aircrafts;

- Lack of formal procedures in accordance with the nature of the operations performed;

- The use of aircrafts whose public identification prefix does not imply providing logistics and aerial support for filming of a completely private nature;

- Ambiguity in the observance of regulations related to air operations of public aircrafts; and

4. SAFETY RECOMMENDATIONS

u. To the Aviation Provincial Administrations

Note.- These recommendations are addressed to all aviation provincial administrations of the Argentine Republic and exclusively to the ones involved in the accident..

- To develop an Operations Manual (OM) including the necessary guidelines for all the flight activities in an aviation provincial administration to be planned and performed, depending on its nature, observing polices formally established by the provincial administration, and safety requirements and personnel training, which are standards in the aviation industry.

- To include in the OM the *Standard Operating Procedures* (SOPs) that provide unambiguous information of the organization expectations about how the air operations must be developed, according to their nature.

- To establish a formal mechanism that ensures that, each time an operation that exceeds the framework of operations considered routine by a aviation provincial administration is planned, a safety risk assessment is carried out to establish the guidelines and mitigation actions under which the operations are performed.

v. To the Civil Aviation National Administration (ANAC)

- To develop a regulatory framework imposing the aviation provincial administrations the obligation that whenever their aircrafts operations are within article 132 of the Aeronautical Code and its regulatory Decree 2836/71 as Aerial Work, the aircrafts are operated under the regulatory framework established by RAAC 135, doing without its record, and in agreement with article 37 of Act N° 17.285 (Aeronautical Code of the Argentine Republic),

- To adopt the necessary measures for the supervision and control of the compliance of the new regulations, once implemented.

5. ADDITIONAL REQUIREMENTS

Individuals and legal entities whom the recommendations issued by the Civil Aviation Accident Investigation Board are addressed to shall report to the AVIATION AUTHORITY in a period no longer than sixty (60) working days, from the time of the receipt of the Final Report and the Resolution that approves it, the compliance of the actions that have been entrusted to them (Provision Nº 51/02 -19 JUL 02- published in the Official Bulletin of 23 July 2002).

The above information shall be addressed to:

Administración Nacional de Aviación Civil, ANAC (Civil Aviation National Administration)
Av. Azopardo 1405, esquina Av. Juan de Garay
(C 1107 ADY) Ciudad Autónoma de Buenos Aires
Or to the email address: “info@anac.gov.ar”

BUENOS AIRES,

Florencia Cerutti
Traductora Pública Nacional de Inglés
Mat. 907
Colegio de Traductores Públicos de la Provincia de Córdoba